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Strategic Agility in Turbulent Times: A Framework for SME Resilience in an Era of Global Instability

ABSTRACT
In an era defined by geopolitical conflict, economic volatility, and persistent supply chain disruptions, small and medium-sized enterprises (SMEs) face an existential challenge. Unlike large corporations, SMEs lack the financial buffers, dedicated risk management teams, and supplier diversity necessary to absorb repeated shocks, making traditional, defensive resilience insufficient. This paper argues that SMEs must shift from merely "bouncing back" to "bouncing forward" by embedding strategic agility as a core competency. Drawing on strategic management and crisis response literature, we first analyze the multidimensional nature of contemporary global instability, including supply chain fragility, financial market volatility, shifting consumer behavior, and the digital divide, and demonstrate how these factors disproportionately impact SME survival and growth. We then propose a practical, four-stage maturity framework: (1) Reactive Crisis Stabilization, focused on immediate survival through cash flow protection and essential functions; (2) Robust and Flexible Operations, building operational buffers, supplier diversification, and cross-trained employees; (3) Strategic Adaptability, enabling business model pivoting through digital channels, modular offerings, and environmental scanning; and (4) Strategic Agility as a Core Competency, characterized by decentralized decision-making, continuous learning, foresight capabilities, and a culture of experimentation. The framework guides SMEs from reactive survival to proactively capturing opportunities arising from disruption. The paper further elaborates on the critical philosophical shift from "bouncing back" to "bouncing forward," drawing on empirical evidence from the COVID-19 pandemic. We conclude with actionable recommendations for SME owners, policymakers, and technology providers. Ultimately, this paper posits that true resilience, reconceptualized as strategic agility, transforms disruption from a threat into a competitive advantage. In a turbulent world where the only certainty is continued instability, strategic agility is not merely a survival tactic but the new foundation for lasting competitive advantage for SMEs worldwide.
Keywords: Global Instability, SME Resilience, Strategic Agility, Business Environment, Adaptive Strategy

1. INTRODUCTION
The early decades of the 21st century have witnessed a unique and dangerous convergence of global challenges. Beginning with the financial crisis of 2008, continuing through the unprecedented global effects of the COVID-19 pandemic, and accelerating due to intensifying trade disputes, rising geopolitical tensions (e.g., the Russian invasion of Ukraine, US-China decoupling), and the growing frequency of climate-related disruptions, the very notion of a stable and predictable business environment has become obsolete. For large multinational corporations, this turbulence is costly but manageable; they can draw on deep financial reserves, geographically diversified markets, and dedicated risk management teams. However, for Small and Medium-sized Enterprises (SMEs), typically defined as firms employing

fewer than 250 people with an annual turnover not exceeding €50 million, this new reality presents a fundamental threat to their survival.

Despite their vulnerability, SMEs are the backbone of most economies. They account for over 90% of all businesses worldwide and contribute approximately 70% of employment and 50% of GDP in developed countries (World Bank, 2021). Their importance extends beyond pure economics; SMEs are primary drivers of local innovation, community well-being, and social cohesion. When SMEs fail, it is not merely a market correction but a hollowing out of the middle class and a loss of the adaptive, human-scale enterprises that communities depend on during crises. Therefore, understanding how SMEs can not only survive but thrive amid constant instability is a pressing academic and practical concern.

This paper begins from a central critique of traditional resilience thinking. For decades, business resilience has been defined as the ability to "bounce back" to a pre-crisis state, thereby restoring operations, recovering lost revenue, and returning to "business as usual" (Mihotić, Raynard, & Sinčić Ćorić, 2023). In a world where disruptions are no longer rare events but overlapping and continuous pressures, this definition is no longer sufficient. Returning to a prior state that was itself fragile is a recipe for eventual failure. Instead, this paper advocates for a paradigm shift toward strategic agility: the ongoing, organization-wide capability to sense environmental changes early, seize emerging opportunities rapidly, and fundamentally adapt the business model when necessary (North & Varvakis, 2016). Strategic agility transforms resilience from a defensive cost center into a dynamic competitive strength.

The aim of this paper is two-fold. First, it analyzes how the multidimensional nature of contemporary global instability, specifically supply chain fragility, financial market volatility, and shifting consumer behavior, disproportionately impacts SMEs. Second, it introduces a practical, staged framework that guides SMEs from reactive crisis management toward embedded strategic agility. The paper's structure is as follows: Section 2 details the specific impacts of global instability on SME operations. Section 3 presents the four-stage resilience framework. Section 4 elaborates on the critical shift from "bouncing back" to "bouncing forward." Section 5 offers targeted recommendations for SME managers, policymakers, and technology providers. Section 6 concludes by summarizing the paper's core argument and emphasizing the long-term strategic value of agility.

2. The Nature of Global Instability and Its Impact on SMEs

The world feels less stable than it used to. Economies are more connected than ever, but that connectivity cuts both ways; a regional conflict or trade dispute can ripple through global supply chains and currency markets within days (Caldara & Iacoviello, 2022). Unlike large multinationals, SMEs typically lack the cash reserves, legal teams, or supplier diversity to cushion sudden shocks. When tariffs rise, a key logistics partner is hit by a cyberattack, or currencies swing, an SME's slim margins can vanish before a single shipment clears customs (Bartzsch et al., 2021). Furthermore, as countries increasingly adopt "friend-shoring"—trading within trusted political blocs—SMEs are left to navigate a complex patchwork of new compliance rules that they lack the resources to manage (Antràs, 2020). The result is that many SMEs are quietly scaling back or closing, which erodes the most adaptable and local part of the economy.

This instability is not merely episodic but structural. The post-2008 era has been characterized by what some scholars term "polycrisis"—the simultaneous occurrence of multiple, interacting shocks across economic, geopolitical, and environmental domains (Lawrence et al., 2022). For SMEs, this means that disruptions no longer arrive in predictable cycles but cascade unpredictably. For example, the COVID-19 pandemic exposed the fragility of just-in-time inventory models, which disproportionately harmed SMEs that could not afford to hold safety stock or switch suppliers quickly (Juergensen et al., 2020). Similarly, the Russian invasion of Ukraine triggered spikes in energy and commodity prices that forced many European SMEs into insolvency within weeks rather than months (Organization for Economic Co-operation and Development [OECD], 2022).

Moreover, the digital transformation that enables global reach also introduces new vectors of vulnerability. Cyberattacks on SMEs have risen sharply, with nearly half of all small businesses reporting at least one breach in the past year, and many lacking dedicated IT security personnel (European Union Agency for Cybersecurity [ENISA], 2021). Unlike large firms that can absorb forensic costs and reputational damage, an SME that loses customer data or operational access for a week may never recover. Financial volatility compounds these risks: currency fluctuations can erase export profits overnight, while rising interest rates, often deployed by central banks to counter inflationary shocks, disproportionately raise borrowing costs for SMEs, which typically rely on variable-rate loans (Beck & Demirgüç-Kunt, 2006).

In addition, regulatory fragmentation has intensified. As major economies diverge on standards for data privacy (e.g., GDPR in Europe vs. varying state laws in the U.S.), environmental reporting, and supply chain due diligence, SMEs face a compliance burden that scales almost linearly with each new market they enter (World Trade Organization [WTO], 2021). Larger firms can centralize compliance through specialized teams or automated software; SMEs cannot. Consequently, many SMEs are forced to abandon cross-border ambitions altogether, choosing to stay in shrinking local markets rather than navigate an increasingly hostile international environment. The cumulative effect is a slow hollowing-out of the small-business sector, reducing economic diversity and resilience at precisely the moment when agility and local responsiveness are most needed (Eggers, 2020).

The Multidimensional Crisis Landscape

Today's global instability is not just a single crisis; it's a complex situation made up of several interconnected issues. From high-stakes geopolitical tensions—like the trade war between the US and China or the Russian invasion of Ukraine—to the fallout from the COVID-19 pandemic, the landscape is anything but stable. These events have disrupted energy markets, disrupted commodity prices, and changed trade routes. The pandemic also highlighted the fragility of just-in-time supply chains and significantly accelerated the shift towards digital transformation. At the same time, climate-related events are becoming more frequent, and inflation is impacting people's purchasing power in major markets. For SMEs, navigating this landscape is especially challenging (Choudhury *et al.*, 2025). Industry experts and prominent researchers have also noted that small and medium-sized enterprises (SMEs) experienced the shock more severely than their larger counterparts during the crises as discussed by (Khalil, Abdelli and Mogaji, 2022). The closure or temporary shutdown of many SMEs was driven by a combination of factors, including lockdowns, supply chain disruptions, decreased consumer spending, and ongoing financial uncertainty (Alkhodair & Alkhudhayr, 2025). They typically work with shorter planning timelines, have less access to capital, and often serve a narrower customer base. While larger companies can absorb financial hits through various strategies, a small or medium-sized business can face serious consequences, even bankruptcy, after just one major disruption or a significant drop in demand (Eggers, 2020).

Supply Chain Fragility

Global supply chains optimized for just-in-time efficiency have left SMEs feeling especially vulnerable. They often operate on razor-thin margins with minimal stock, making them prone to even minor disruptions (Ghosh et al., 2026). For instance, a small electronics assembler depending on a single supplier in a politically unstable region for a critical microchip could face production stops due to port closures or tariffs. The COVID-19 pandemic brought this fragility into sharp focus: while large automakers secured their supplies, smaller suppliers were often left without essential components (Gao, 2025). Additionally, SMEs usually lack the negotiating power to get better terms. During the post-COVID shipping crisis, big firms locked in shipping space with long-term contracts, while SMEs had to pay skyrocketing spot prices. Studies on Hungarian SMEs during crises show that such disruptions create a domino effect—missed deadlines, reputational damage, and even the risk of bankruptcy (Oravecz, Pólya, & Máté, 2025). To build resilience, it is important to rethink dependencies, maintain strategic inventories, and cultivate relationships with diverse suppliers.

Financial Market Volatility

Access to capital has always been a challenge for small and medium-sized enterprises, but global instability makes this even harder. Banks become more cautious during uncertain times, tightening their lending criteria and demanding more collateral (Finnegan & Kapoor, 2023). For an SME seeking a modest loan to update production lines, a bank might see the sector as "high risk" and either refuse credit or offer loans at very high rates. Unpredictable currency exchange rates also hit SMEs involved in international trade particularly hard; a sudden 10% shift can wipe out profit margins on exports, while larger firms hedge their risks using financial tools that SMEs often cannot access. As Rideg, Szerb, and Varga (2023) point out, the role of intellectual capital in innovation, as evidenced by Hungarian SMEs, shows that external relationships with buyers, suppliers, and support organizations often help SMEs overcome resource constraints by providing valuable information and knowledge that foster innovation. SMEs are inherently more fragile than large multinationals, a reality that makes them the first to suffer when global shocks occur. Their fundamental structural barriers—such as minimal cash reserves, a persistent and multi-trillion dollar global credit gap, and limited capacity for strategic planning—turn temporary disruptions into existential threats (Baker Tilly International, 2025; ICSB, 2025). When a geopolitical event triggers a currency swing or a sudden tariff hike, an SME lacks the financial buffer to absorb the loss, unlike a larger competitor (Grant Thornton Singapore, 2026). Furthermore, the "polycrisis" of interconnected supply chain disruptions, from semiconductor shortages to port delays, hits smaller firms hardest as they often rely on single suppliers and lack the leverage to demand priority or favorable terms (Forbes Business Council, 2025). This perfect storm of financial fragility and operational rigidity means that global instability does not just reduce profits for SMEs; it actively forces them to scale back, freeze hiring, or shutter entirely, thereby eroding the very foundation of local economic resilience (ICSB, 2025).

The Innovation Gap and the Digital Divide

Compounding their financial and trade challenges, SMEs are increasingly being left behind in the digital transformation that is critical for surviving modern disruptions, creating a widening performance gap (Grant Thornton Singapore, 2026). While large enterprises rapidly adopt artificial intelligence and data analytics to build resilient, adaptive supply chains, the majority of SMEs lack the capital and technical skills to implement even basic digital tools (Forbes Business Council, 2025). For example, sophisticated AI-powered risk sensing can predict geopolitical shocks and automate supplier diversification, but such technology remains out of reach for most small businesses, leaving them reliant on slow, manual processes (Small Business Connections, 2025). This digital divide is a critical vulnerability, as digitally mature SMEs are demonstrably more agile, able to pivot to new markets or secure alternative financing, while their non-digital peers remain paralyzed by uncertainty and invisible risks (Grant Thornton Singapore, 2026). Consequently, as the global economy becomes more technologically complex and volatile, SMEs that cannot bridge this digital gap will inevitably be weeded out, concentrating economic power in the hands of the few who can afford to innovate (ICSB, 2025).

Shifting Consumer Behavior Economic

Economic instability shifts what people buy, how they pay, and which brands they trust. SMEs, which often rely on loyal local customers, are especially vulnerable. During COVID-19, restaurants and boutique hotels saw demand drop overnight while grocery delivery surged. With rising inflation, consumers have become more price-sensitive, gravitating toward cheaper alternatives and comparing prices aggressively online. Furthermore, the shift toward digital platforms and cashless payments has left many small retailers without user-friendly websites losing relevance. Changing consumer values—preference for sustainable, local, or ethically sourced products—also demand adaptation (Deutsch, Drávavölgyi, & Rideg, 2013). This requires not only agility in strategy but also a deeper understanding of evolving customer needs.

3. A Phased Framework for Strategic Resilience

This framework aims to help SMEs navigate disruptions by blending insights from strategic management, organizational resilience, and crisis management (Foli, Durst, & Temel, 2024). Since SMEs vary greatly, this framework is a flexible maturity model, not a strict checklist.

Stage 1: Reactive Crisis Stabilization

Objective: Ensure survival during immediate disruption.

- Key actions: Secure cash flow (cut costs, renegotiate payments, seek emergency credit); protect essential functions and employees; maintain open communication with key customers/suppliers; implement basic remote work or digital alternatives (Brown et al., 2018).
- Indicators of success: Positive cash flow, meeting critical obligations, retaining key customers.
- Limitations: Not a long-term solution; firm remains vulnerable to future shocks (Duchek, 2020).

Stage 2: Robust and Flexible Operations

Objective: Build operational buffers and redundancy.

- Key actions: Diversify suppliers (even at higher cost); stock strategic inventories; cross-train employees; design quickly adjustable production processes.
- Indicators of success: Ability to handle 15-20% demand/supply shift without emergency measures; decreased lead time variability.
- Example: A small food manufacturer shifting from one national distributor to three regional suppliers reduces supply disruption risk.

Stage 3: Strategic Adaptability

Objective: Enable business model pivoting.

- Key actions: Develop digital channels to complement physical operations; create modular products/services; form strategic partnerships for resource sharing; establish market environment scanning (e.g., weekly indicator reviews) (Gölgeci et al., 2026).
- Indicators of success: Launch of new product/service variant within 4-6 weeks of recognizing a market shift; diversified revenue streams.
- Example: A small tour operator pivoting to virtual cultural experiences during travel restrictions, then to hybrid offerings post-pandemic (Hadjielias, Christofi, & Tarba, 2022).

Stage 4: Strategic Agility as Core Competency

Objective: Embed agility into organizational culture and strategy.

- Key characteristics: Decentralized decision-making empowering front-line managers; continuous learning (after-action reviews, scenario planning); foresight capabilities tracking early warning signs; a culture embracing calculated risk and experimentation.
- Indicators of success: Regularly seizing opportunities from disruptions (e.g., gaining market share when competitors falter); low employee turnover; strategic planning as an ongoing process (Foli, Durst, & Temel, 2024).
- Example: A medium-sized software firm that routinely adjusts priorities based on real-time customer feedback and geopolitical risk signals.

4. Shifting from "Bouncing Back" to "Bouncing Forward"

In today's turbulent and often unpredictable business environment, the conventional understanding of resilience has become insufficient. Traditionally, crisis management aimed for a return to the pre-crisis status quo—a concept often described as "bouncing back." However, with the rise of overlapping and continuous disruptions (e.g., pandemics, supply chain volatility, geopolitical shifts), the notion of a stable, pre-crisis equilibrium has largely vanished. Organizations that simply try to rebuild what existed before risk being perpetually behind the curve.

To address this new reality, Mihotić, Raynard, and Sinčić Ćorić (2023) offer a vital distinction in the context of family-run businesses, which applies equally to small and medium-sized enterprises (SMEs). They contrast two uses of family social capital: a *retrospective* approach, which is conservative and aims to restore "business as usual," versus

a *prospective* approach, which is strategic, flexible, and oriented toward adapting to an entirely "new" future. This paper explicitly embraces the latter, known as **"bouncing forward."**

But what does bouncing forward mean in practice for an SME? Unlike bouncing back, which focuses on recovery, bouncing forward focuses on *opportunity within disruption*. For example, when facing a supply chain breakdown, a bouncing-back mindset seeks a like-for-like replacement supplier as quickly as possible. In contrast, a bouncing-forward mindset rethinks the entire procurement strategy—perhaps diversifying suppliers regionally, investing in nearshoring, or redesigning products to use alternative materials. Similarly, if customer demand drops sharply, bouncing back would emphasize aggressive cost-cutting and layoffs. Bouncing forward, however, asks: *What new offerings, services, or digital channels can we develop right now?* In this way, resilience transforms from a defensive tactic—merely absorbing shocks—into a strategic asset that actively enhances long-term competitiveness.

Real-world evidence strongly supports this shift. A study of UK SMEs during the COVID-19 crisis found that businesses possessing pre-existing adaptive capabilities—such as flexible work arrangements, digital readiness, and decentralized decision-making—not only survived but actually captured additional market share from less agile competitors (Hadjielias, Christofi, & Tarba, 2022). Conversely, firms that relied solely on reactive, bounce-back strategies struggled with recurring crises and lost ground. In a similar vein, research on Germany's renowned Mittelstand firms revealed that strategic agility—the ability to reconfigure operations and offerings rapidly—was the single most important differentiator between industry leaders and laggards during economic downturns. Therefore, adopting a "bouncing forward" posture reframes resilience not as a cost of survival but as a driver of competitive advantage, innovation, and sustained growth in an age of permanent uncertainty.

5. Practical Recommendations

For SME Owners and Managers

1. Conduct a Resilience Audit: Assess where you stand on the four-stage scale. Are you still just reacting?
2. Invest in Environmental Scanning: Weekly review of news, supplier communications, and customer feedback to spot problems early (Gölgeci et al., 2026).
3. Build Financial Buffers: Keep access to credit lines open; maintain conservative debt ratios.
4. Foster a Learning Culture: After every disruption, hold a quick "after-action review" (what went well, what didn't, how to improve) (Ghosh et al., 2026).
5. Embrace Imperfection: Build agility through small experiments (new payment method, backup supplier, cross-training).

For Policymakers

1. Create Rapid-Response Financing: Government-backed loans or grants triggered by specific crisis indicators (e.g., significant revenue drop) (Global Snapshot of Sendai Framework Monitoring Countries, 2025).
2. Support Digital Upgrades and Skills: Subsidies for cybersecurity, e-commerce platforms, and employee training (Khalil, Abdelli, & Mogaji, 2022).
3. Reduce Administrative Burden: Temporarily ease reporting requirements during crises to allow SMEs to focus on survival (Eggers, 2020).
4. Facilitate Collaborative Resilience: Develop regional programs identifying supply chain interdependencies and shared contingency plans (Stojanovic, 2024).

For Technology and Service Providers

1. Develop Accessible Resilience Tools: Affordable, modular, cloud-based solutions for supply chain risk management, as many SMEs cannot afford high-end software (Scholz et al., 2010).
2. Offer Structured Frameworks: Provide easy-to-follow guides aligned with the SME's current resilience stage (European Commission, 2025).
3. Encourage Peer Learning: Create platforms for SMEs to anonymously share resilience strategies and experiences (Trunk & Birkel, 2022).

6. Conclusion

The era of predictable, stable business environments has definitively ended. For small and medium-sized enterprises—which form the economic backbone of most nations yet remain the most vulnerable to disruption—the central challenge is no longer simply weathering the next crisis. It is learning to thrive amid continuous, overlapping, and often unpredictable shocks. This paper has argued that the traditional notion of resilience as "bouncing back" to a pre-crisis state is not only outdated but dangerous. It lulls SMEs into a defensive posture that leaves them perpetually reacting, always one disruption away from failure.

In its place, this paper has proposed a paradigm of strategic agility: the ability to sense changes early, seize opportunities decisively, and adapt the business model as needed. To make this concept actionable, we presented a four-

stage maturity framework. The framework acknowledges that most SMEs begin in a Reactive Crisis Stabilization mode, focused on immediate survival. From there, it provides a clear pathway: first, build Robust and Flexible Operations (buffers, redundancies, cross-training). Second, develop Strategic Adaptability (digital channels, modular offerings, environmental scanning). Finally, and most critically, embed Strategic Agility as a Core Competency—decentralizing decisions, fostering continuous learning, and making foresight a daily habit rather than a quarterly exercise.

The shift from "bouncing back" to "bouncing forward" is the philosophical heart of this framework. As Mihotić, Raynard, and Sinčić Ćorić (2023) demonstrated, firms that prospectively use their resources to adapt to a new future outperform those that merely try to restore the past. Evidence from the COVID-19 pandemic confirms that SMEs with existing adaptive capabilities not only survived but gained market share (Hadjielias, Christofi, & Tarba, 2022). Therefore, resilience, reconceptualized as strategic agility, becomes a competitive weapon rather than a cost burden.

No framework can eliminate uncertainty, and this paper does not claim to offer a magic solution. The journey to strategic agility requires committed leadership, investment of scarce resources (especially time and attention), and a genuine cultural shift away from rigid planning toward iterative learning (Rideg, Szerb, & Varga, 2023). However, for those SME owners and managers willing to embark on this journey—supported by smart policymaking and accessible technology—the reward is substantial. It is the ability to navigate whatever future disruptions arise, not with fear, but with confidence; not as victims of change, but as shapers of it. In a turbulent world, strategic agility is not merely a survival tactic. It is the new foundation for lasting competitive advantage.

REFERENCES

Alkhodair, M., & Alkhudhayr, H. (2025). Harnessing Industry 4.0 for SMEs: Advancing smart manufacturing and logistics for sustainable supply chains. *Sustainability, 17*(3). https://doi.org/10.3390/su17030813

Antràs, P. (2020). De-globalisation? Global value chains in the post-COVID-19 age* (NBER Working Paper No. 28115). National Bureau of Economic Research.

Baker Tilly International. (2025). *The perfect storm: Macroeconomics, markets and money*. https://www.bakertilly.com/insights/perfect-storm-macroeconomics-markets-money

Bartzsch, N., Krolage, C., & Obst, T. (2021). The impact of exchange rate shocks on SME exports. *Economic Modelling, 102*, 105568. https://doi.org/10.1016/j.econmod.2021.105568

Beck, T., & Demirgüç-Kunt, A. (2006). Small and medium-size enterprises: Access to finance as a growth constraint. *Journal of Banking & Finance, 30*(11), 2931–2943. https://doi.org/10.1016/j.jbankfin.2006.05.009

Borderlex. (2024). *'Friendshoring' now a reality, cushioned by deep FTAs*. https://borderlex.net/2024/06/10/friendshoring-reality-cushioned-deep-ftas/

Brown, N. A., et al. (2018). An integrative framework for investigating disaster resilience within the hotel sector. *Journal of Hospitality and Tourism Management, 36*, 67–75. https://doi.org/10.1016/j.jhtm.2018.07.004

Caldara, D., & Iacoviello, M. (2022). Measuring geopolitical risk. *American Economic Review, 112*(4), 1194–1225. https://doi.org/10.1257/aer.20191823

Deutsch, N., Drávavölgyi, T., & Rideg, A. (2013). Note on the development of sustainable supply chain strategy. *Chemical Engineering Transactions, 35*, 655–660. https://doi.org/10.3303/CET1335109

Duchek, S. (2020). Organizational resilience: A capability-based conceptualization. *Business Research, 13*(1), 215–246. https://doi.org/10.1007/s40685-019-0085-7

Eggers, F. (2020). Masters of disasters? Challenges and opportunities for SMEs in times of crisis. *Journal of Business Research, 116*, 199–208. https://doi.org/10.1016/j.jbusres.2020.05.025

European Commission. (2025). *Omnibus IV legislative proposal: Directive amending MiFID II and the Critical Entities Resilience Directive (COM/2025/xxx final)*.

European Union Agency for Cybersecurity. (2021). *Cybersecurity for SMEs: Challenges and recommendations*. Publications Office of the European Union.

Finnegan, M., & Kapoor, S. (2023). ECB unconventional monetary policy and SME access to finance. *Small Business Economics, 61*(3), 1253–1288. https://doi.org/10.1007/s11187-023-00730-0

Foli, S., Durst, S., & Temel, S. (2024). The link between supply chain risk management and innovation performance in SMEs in turbulent times. *Journal of Entrepreneurship in Emerging Economies, 16*(3), 626–648. https://doi.org/10.1108/JEEE-03-2022-0084

Forbes Business Council. (2025). *Building adaptive supply chains beyond friend-shoring*. https://www.forbes.com/sites/forbesbusinesscouncil/2025/adaptive-supply-chains

Gao, Y. (2025). Exploring the impact of COVID-19 on the international logistics and supply chain challenges faced by small and medium-sized enterprises (SMEs): A case study of two companies. *BILT Student Research Journal*, (6). https://doi.org/10.70969/20250201

Ghosh, S., et al. (2026). Reinforcing small- and medium-sized enterprises' resilience to future disruptions: A novel decision-making framework for supply chain risk quantification. *Risk Sciences, 2*, 100052. https://doi.org/10.1016/j.risk.2026.100052
Global snapshot of Sendai Framework monitoring countries. (2025).
Gölgeci, I., et al. (2026). A policymaking perspective on international business and the natural environment. *Journal of International Business Policy*. https://doi.org/10.1057/s42214-026-00239-9
Grant Thornton Singapore. (2026). *The new norm: How SMEs can navigate and reposition amid global disruption*. https://www.grantthornton.sg/insights/sme-navigate-global-disruption-2026
Hadjielias, E., Christofi, M., & Tarba, S. (2022). Contextualizing small business resilience during the COVID-19 pandemic: Evidence from small business owner-managers. *Small Business Economics, 59*(4), 1351–1380. https://doi.org/10.1007/s11187-021-00588-0
International Council for Small Business. (2025). *Small businesses in crisis: Policy responses for a fragmented world*. https://icsb.org/small-business-crisis-report-2025
Juergensen, J., Guimón, J., & Narula, R. (2020). European SMEs amidst the COVID-19 crisis: Assessing impact and policy responses. *Journal of Industrial and Business Economics, 47*(3), 499–510. https://doi.org/10.1007/s40812-020-00169-4
Khalil, A., Abdelli, M. E. A., & Mogaji, E. (2022). Do digital technologies influence the relationship between the COVID-19 crisis and SMEs' resilience in developing countries? *Journal of Open Innovation: Technology, Market, and Complexity, 8*(2). https://doi.org/10.3390/joitmc8020100
Lawrence, M., Janzwood, S., & Homer-Dixon, T. (2022). *What is a global polycrisis?* (Cascade Institute Technical Paper No. 2022-4). Cascade Institute.
Mihotić, L., Raynard, M., & Sinčić Ćorić, D. (2023). Bouncing forward or bouncing back? How family firms enact resilience in times of crisis. *Journal of Family Business Management, 13*(1), 68–86. https://doi.org/10.1108/JFBM-03-2022-0047
North, K., & Varvakis, G. (Eds.). (2016). *Competitive strategies for small and medium enterprises: Increasing crisis resilience, agility and innovation in turbulent times*. Springer.
Oravecz, T., Pólya, É., & Máté, Z. (2025). Decision-making in crisis: Insights from Hungarian SMEs and households during the Covid-19 pandemic. *Decision Making: Applications in Management and Engineering, 8*(2), 395–413. https://doi.org/10.31181/dmame8220251538
Organisation for Economic Co-operation and Development. (2022). *SMEs and the war in Ukraine: Policy responses and resilience strategies*. OECD Publishing.
Rideg, A., Szerb, L., & Varga, A. R. (2023). The role of intellectual capital on innovation: Evidence from Hungarian SMEs. *Tec Empresarial, 17*(2), 1–19. https://doi.org/10.18845/te.v17i2.6695
Scholz, P., et al. (2010). Benefits and challenges of business intelligence adoption in small and medium-sized enterprises. *Proceedings of the European Conference on Information Systems (ECIS)*. http://aisel.aisnet.org/ecis2010/32
Sebuwufu, J. A., & Timilsina, B. (2024). SME operational bid through adversity and turbulent economic environment: Resilience through dynamic capabilities. *International Journal of Innovation and Learning, 36*(1), 53–71. https://doi.org/10.1504/IJIL.2024.139690
Small Business Connections. (2025). *Why Australian businesses are rethinking global supply chains*. https://www.smallbusinessconnections.com.au/supply-chain-rethink
Stojanovic, R. (2024). *Trends and future perspectives in business intelligence*.
Trunk, A., & Birkel, H. (2022). No resilience without partners: A case study on German small and medium-sized enterprises in the context of COVID-19. *Schmalenbach Journal of Business Research, 74*(4), 537–574. https://doi.org/10.1007/s41471-022-00149-5
World Bank. (2021). *Small and medium enterprises (SMEs) finance*. World Bank Group. https://www.worldbank.org/en/topic/smefinance
World Trade Organization. (2021). *World Trade Report 2021: Economic resilience and trade*. WTO Secretariat.

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AUTONOMOUS AI SYSTEMS AS A FOUNDATION OF SUSTAINABLE COMPETITIVE ADVANTAGE IN ENTERPRISE MANAGEMENT

Abstract: Artificial intelligence is rapidly transforming enterprise management, evolving from a decision-support tool into an autonomous actor capable of independently executing complex managerial and operational tasks. This paper advances the thesis that the development, deployment, and strategic orchestration of autonomous AI systems constitute a fundamental condition for achieving sustainable competitive advantage in modern enterprises. Unlike traditional IT systems, autonomous AI systems demonstrate capabilities for continuous learning, adaptation, and independent execution within defined operational boundaries. Viewed through the lens of the resource-based and dynamic capabilities theories, these systems enable enterprises to significantly enhance operational efficiency, reduce decision latency, and dynamically respond to environmental shifts. Consequently, autonomous AI systems transition from merely supporting managers to becoming strategic assets deeply embedded within core business processes. To bridge conceptual considerations with practical applicability, the paper incorporates an exploratory analysis of the open-source AI ecosystem, utilizing data from the Hugging Face platform. By examining the proliferation and accessibility of pre-trained models, the study demonstrates how the barriers to building enterprise-specific autonomous systems have been radically lowered. This democratization allows organizations to shift their strategic focus from building models from scratch to the orchestration and fine-tuning of open-source agents using proprietary data. Ultimately, the paper argues that enterprises capable of continuously integrating external open-source AI innovations with internal, unique organizational data will establish durable, hard-to-imitate competitive advantages. The transition toward autonomous AI represents a fundamental shift in organizational governance and a key determinant of long-term strategic resilience.

Keywords: autonomous AI systems, agentic AI, dynamic capabilities, sustainable competitive advantage, strategic orchestration, open-source AI ecosystems.

1. INTRODUCTION

The contemporary business environment is undergoing a profound digital transformation that is reshaping how organizations create value, coordinate operations, and sustain competitiveness in increasingly volatile markets. At the center of this transformation is the rapid advancement of artificial intelligence (AI). While earlier generations of AI were primarily applied to narrow, rule-based decision-support systems, recent developments have introduced a new paradigm often described as agentic or autonomous AI. These systems exhibit increasing levels of autonomy and self-governance, enabling them to perceive complex environments, reason across multiple information sources, and execute managerial or operational tasks with limited human supervision (Biswas & Talukdar, 2025). As such technologies become embedded

within core enterprise processes, AI increasingly functions not merely as an operational tool but as a strategic organizational capability.

Understanding the strategic implications of this technological shift requires an appropriate theoretical perspective. This paper therefore examines autonomous AI systems through the lenses of the resource-based view (Barney, 1991) and dynamic capabilities (Teece, 2007) theory. Within highly dynamic digital markets, sustainable competitive advantage depends on an organization's ability to develop and deploy valuable, rare, and difficult-to-imitate resources while continuously adapting these resources to changing environmental conditions (Scavilla , 2025). Although the foundational algorithms underlying AI technologies are becoming widely accessible, the effective orchestration of autonomous AI agents – combined with proprietary organizational data and domain knowledge – can create capabilities that are difficult for competitors to replicate. Through such integration, enterprises may dynamically reconfigure resources, accelerate decision-making processes, and improve responsiveness to market changes.

Importantly, the development of advanced AI capabilities is no longer restricted to large technology corporations with extensive computational resources. The rapid expansion of the open-source AI ecosystem has significantly democratized access to state-of-the-art machine learning models and development tools. Platforms such as Hugging Face have emerged as central infrastructures within this ecosystem, hosting extensive repositories of pre-trained models across domains including natural language processing, computer vision, and multimodal learning (Lee, 2026). As a result, the strategic challenge for many organizations has shifted from building foundational AI models to effectively adapting and integrating existing open-source models into enterprise-specific workflows. By fine-tuning these models using proprietary organizational data, companies can develop highly specialized AI capabilities tailored to their operational contexts.

Against this background, the present study advances the argument that the development and strategic orchestration of autonomous AI systems represents a critical mechanism for achieving sustainable competitive advantage in contemporary enterprises. To connect theoretical insights with practical application, the study incorporates an exploratory empirical examination of the Hugging Face platform. By analyzing the availability and characteristics of models within this ecosystem, the paper illustrates how organizations can utilize open-source resources to construct enterprise-oriented autonomous AI systems capable of supporting strategic and operational decision-making.

2. THEORETICAL FOUNDATIONS OF AUTONOMOUS AI SYSTEMS IN ENTERPRISE MANAGEMENT

The integration of autonomous artificial intelligence systems represents a significant shift in how technology contributes to enterprise competitiveness (Davenport & Kirby, 2016). Rather than serving solely as operational support tools, AI systems increasingly function as strategic organizational capabilities that shape how firms create and sustain value. Competitive advantage emerges when organizations generate greater economic value than their rivals; however, maintaining this advantage in a rapidly evolving digital environment requires that technological investments be grounded in established strategic management frameworks (Kaur, 2019).

One of the most influential perspectives explaining sustainable competitive advantage is the resource-based view (RBV). According to RBV, firms achieve long-term advantage by possessing and effectively utilizing resources that are valuable, rare, imperfectly imitable, and non-substitutable (VRIN). In the context of the contemporary digital economy, the core technologies underlying artificial intelligence – such as algorithms, frameworks, and pretrained models – are increasingly accessible through open-source ecosystems. Consequently, these technological components alone rarely satisfy the VRIN criteria necessary for sustainable competitive advantage. Instead, competitive differentiation emerges from the ways organizations combine AI technologies with proprietary resources, including internal data assets, domain expertise, and organizational processes. Through the strategic orchestration of autonomous AI agents integrated with firm-specific knowledge and workflows, enterprises can develop capabilities that are significantly more difficult for competitors to imitate (Abrantes & Madsen, 2023). When intelligent automation is embedded across organizational functions rather than applied as isolated technological solutions, AI becomes part of an integrated system architecture capable of generating distinctive and defensible market value (Hardy, 2025).

However, competitive advantage based solely on existing resources may erode quickly in environments characterized by volatility, uncertainty, complexity, and ambiguity (Bennett, 2021). Under such conditions, the dynamic capabilities view provides an important complementary framework for understanding how organizations maintain long-term competitiveness (Teece, 2007). Dynamic capabilities refer to a firm's capacity to integrate, build, and reconfigure internal and external competencies in response to rapidly changing market conditions. Autonomous AI systems can operationalize this framework by supporting the continuous processes of sensing, seizing, and transforming organizational resources. Through advanced data analytics and real-time monitoring, AI systems enable organizations to sense emerging trends and shifts in their environments. Autonomous or semi-autonomous decision mechanisms allow firms to seize opportunities by recommending or executing strategic actions. Finally, adaptive AI-driven processes can contribute to the transformation of organizational structures and workflows, allowing firms to reconfigure resources more rapidly than traditional managerial approaches (Scavilla , 2025).

The growing role of AI in enterprise management is also closely associated with the emergence of hyperautomation. It refers to the systematic integration of multiple advanced technologies – including machine learning, agentic AI systems, and composable digital architectures – to automate increasingly complex organizational activities. Rather than focusing

exclusively on individual processes, hyperautomation creates cumulative efficiency gains by enabling organizations to automate interconnected tasks across entire value chains. As routine processes become automated, firms can redirect human and financial resources toward higher-value strategic activities, thereby reinforcing a continuous cycle of technological reinvestment and capability development. Over time, this iterative expansion of automated capabilities may lead to substantial improvements in operational efficiency, innovation capacity, and strategic responsiveness, strengthening the firm's competitive position relative to slower-moving rivals (Wilson & Tyson, 2025).

Realizing the strategic benefits of autonomous AI systems also requires alignment between technological capabilities and organizational business models. Simply integrating AI into existing legacy processes is unlikely to produce transformative outcomes. Instead, organizations must adapt their strategic structures and value creation mechanisms to fully leverage AI-enabled capabilities. Emerging research suggests several strategic approaches for organizations pursuing AI-driven transformation, including focusing on specific segments of the value chain, integrating AI capabilities comprehensively across existing operations, or expanding beyond current operational boundaries to develop entirely new data-driven business models (Zarifis, 2025, p. 111). By embedding autonomous AI systems within these evolving strategic architectures, firms can fundamentally reshape how value is created, delivered, and captured. In doing so, traditional enterprises may gradually evolve into highly adaptive, digitally native organizations capable of sustaining competitive advantage in increasingly data-driven markets (Hardy, 2025).

3. THE OPEN-SOURCE AI ECOSYSTEM AS INFRASTRUCTURE FOR AUTONOMOUS SYSTEMS

The open-source movement has become a key driver of innovation in artificial intelligence by lowering entry barriers and enabling organizations of varying sizes to experiment with and deploy sophisticated AI capabilities. Through publicly available frameworks, datasets, and pretrained models, firms can build advanced AI applications without developing complex systems entirely from scratch. Widely adopted machine learning frameworks such as TensorFlow and PyTorch have become foundational tools for AI development, allowing organizations to focus on application-specific innovation rather than fundamental algorithmic design (Frankl, 2025).

At the center of this ecosystem is Hugging Face, a platform that has emerged as a widely adopted infrastructure for the development and distribution of deep learning models. Originally established as a community-oriented open-source initiative, Hugging Face has evolved into a collaborative hub where researchers, developers, and organizations share and deploy machine learning models across domains including natural language processing, computer vision, and audio processing. By facilitating collaboration and knowledge exchange, the platform supports the rapid diffusion of new AI techniques and significantly accelerates the pace of technological development.

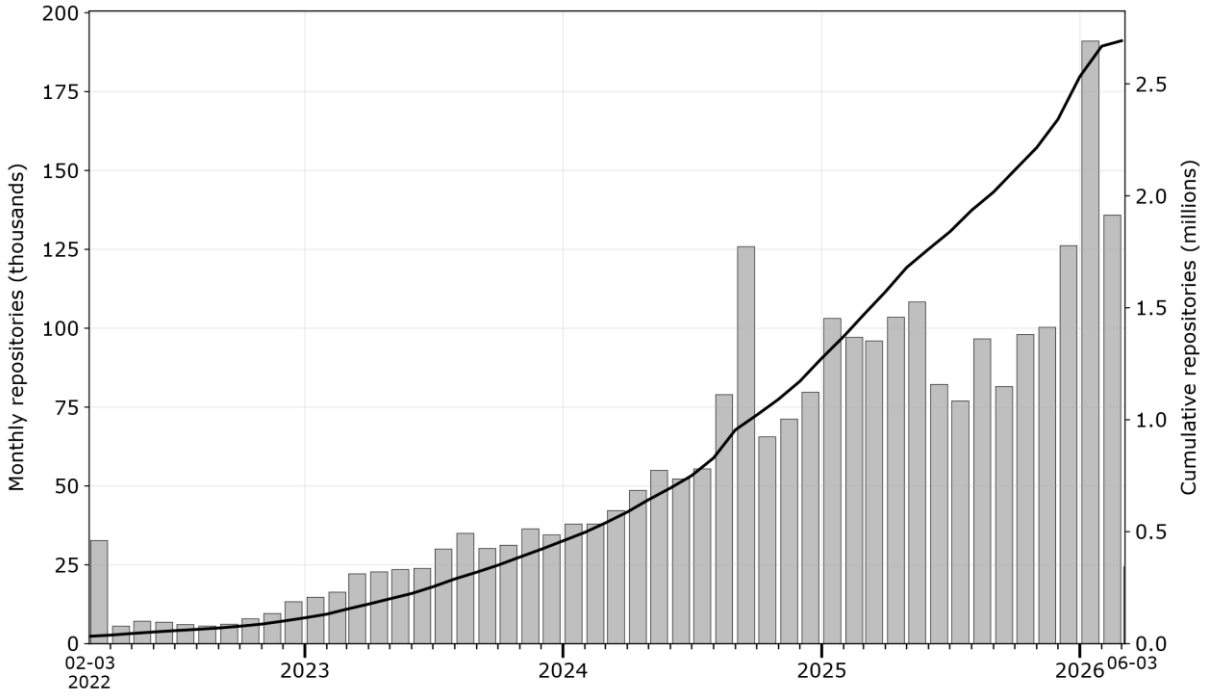


Figure 1: Monthly number of Hugging Face model repositories created (bars) and cumulative total of repositories (line)

Source: the authors based on data retrieved from huggingface.co

Figure 1 illustrates the rapid expansion of the Hugging Face ecosystem, showing the monthly number of model repositories created alongside the cumulative total of repositories hosted on the platform. In recent years, the number of available repositories has grown substantially, with the cumulative total surpassing two million. This growth reflects the increasing global interest in AI development and the growing role of open-source collaboration in advancing machine learning technologies. At the same time, the apparent scale of the repository landscape should be interpreted with caution, as many repositories represent experimental projects, model variations, or incremental modifications rather than entirely new and production-ready models.

The platform hosts extensive collections of pretrained models and datasets while providing tools that simplify model integration and application development. Libraries such as Transformers enable standardized access to large language models and other deep learning architectures, while tools such as Gradio facilitate the rapid creation of interactive interfaces for AI applications (Lee, 2026). Together, these resources form a technological infrastructure that allows organizations to efficiently build, adapt, and deploy intelligent systems.

For enterprises seeking to implement autonomous AI capabilities, such platforms significantly reduce the technological and financial barriers traditionally associated with advanced AI development. Instead of constructing large-scale models independently, organizations can leverage existing open-source resources and adapt them to specific operational contexts through fine-tuning and integration with proprietary data. In this way, the open-source AI ecosystem provides the foundational infrastructure upon which enterprise-level autonomous systems can be developed and scaled.

4. EMPIRICAL ANALYSIS OF HUGGING FACE MODEL REPOSITORIES

The empirical analysis was conducted using data downloaded from the Hugging Face platform (*Hugging Face*, 2026) on March 6, 2026. The snapshot contained 2,692,498 model repositories representing the entire publicly accessible catalog available at that time. However, the raw dataset includes a large number of repositories that are not directly useful for practical deployment, such as empty repositories, intermediate training artifacts, mirrored repositories, or technical conversions of existing models. Consequently, the objective of the analysis was not to describe the complete Hugging Face ecosystem but rather to approximate the subset of repositories that correspond to usable AI models from the perspective of potential enterprise users.

To achieve this objective, the dataset was filtered in several stages. First, repositories without files and repositories lacking model weight files (e.g., PyTorch, Safetensors, TensorFlow, ONNX, or Flax weights) were removed. A further filter excluded repositories with fewer than ten downloads in order to eliminate inactive or purely experimental projects. In the second stage, several technical categories were excluded because they do not represent distinct base models. These included adapter repositories (such as PEFT or LoRA adapters), intermediate training checkpoints, repositories containing quantized or converted formats (e.g., GGUF, GPTQ, or AWQ), and large mirror repositories that replicate existing models.

In the final stage, a stricter usage threshold was applied by retaining only repositories with more than 100 downloads. This filtering process resulted in a dataset of 307,482 repositories, representing approximately 11% of the original catalog of more than 2.6 million repositories. The structure of the filtered dataset across major task categories is presented in Table 1.

Table 1: Distribution of Hugging Face model repositories by task category

Model category	All repositories		Selected repositories	
	Count	Share (%)	Count	Share (%)
Natural Language Processing	550 289	20.44	163 968	53.33
Computer Vision	138 775	5.15	48 477	15.77
Audio	33 942	1.26	7 543	2.45
Multimodal	40 853	1.52	18 294	5.95
Reinforcement Learning	1 383	0.05	135	0.04
Tabular	84 367	3.13	6 435	2.09
Other	335	0.01	62	0.02
Unknown	1 842 554	68.43	62 568	20.35
Total	2 692 498	100.00	307 482	100.00

Source: data retrieved from Hugging Face, 2026

The filtered dataset reveals a strong dominance of Natural Language Processing (NLP) models, which account for 163,968 repositories, or 53.33% of all selected repositories. Within this category, text generation models represent the largest subgroup (77,562 repositories; 25.22% of the filtered dataset), followed by text classification (39,235; 12.76%) and token classification (13,742; 4.47%). These tasks correspond to the core applications of large language models, which have become a central driver of recent developments in artificial intelligence. Other NLP tasks – including question answering,

translation, summarization, and sentence similarity – appear in smaller numbers, suggesting that the ecosystem is increasingly oriented toward generative and general-purpose language models.

Computer Vision represents the second largest category, with 48,477 repositories (15.77% of the filtered dataset). Within this category, text-to-image generation models form the largest subgroup (26,495 repositories; 8.62%), reflecting the rapid expansion of diffusion-based image generation technologies. More traditional computer vision tasks such as image classification (11,959; 3.89%) and object detection (3,065; 1.00%) remain present but constitute a smaller share of repositories compared with generative models. This pattern indicates a broader technological shift within the ecosystem toward generative AI systems rather than purely analytical visual recognition tasks.

Other categories are considerably smaller but still relevant. Multimodal models account for 18,294 repositories (5.95%), while audio models represent 7,543 repositories (2.45%). Reinforcement learning repositories remain relatively rare (135; 0.04%), reflecting their more specialized nature. Tabular data models account for 6,435 repositories (2.09%). A further notable observation is the substantial number of repositories without clearly defined task metadata (62,568 repositories; 20.35%), indicating that the classification structure of the platform remains partially inconsistent despite the overall maturity of the ecosystem.

To better understand which models attract the greatest attention and practical adoption within the ecosystem, the analysis next examines the most popular repositories according to two indicators available on the Hugging Face platform: the number of downloads and the number of community likes.

Table 2. Top five models by downloads and community likes within major task categories

Model	Downloads	Model	Likes
Natural Language Processing			
bert-base-uncased	2 745 582 187	DeepSeek-R1	13116
all-MiniLM-L6-v2	2 236 270 093	Meta-Llama-3-8B	6476
all-mpnet-base-v2	1 133 834 539	Llama-3.1-8B-Instruct	5524
gpt2	826 644 506	bloom	4987
xlm-roberta-large	674 932 218	Llama-2-7b-chat-hf	4716
Computer Vision			
nsfw_image_detection	1 288 177 163	FLUX.1-dev	12403
clip-vit-large-patch14	1 078 290 178	stable-diffusion-xl-base-1.0	7503
mobilenetv3_small_100.lamb_in1k	1 037 767 447	stable-diffusion-v1-4	6983
fairface_age_image_detection	763 996 830	stable-diffusion-3-medium	4910
resnet-50	569 628 399	FLUX.1-schnell	4660
Audio			
ast-finetuned-audioset-10-10-0.4593	2 181 445 589	Kokoro-82M	5800
wav2vec2-large-xlsr-53-english	1 104 932 767	whisper-large-v3	5447
segmentation-3.0	344 336 954	XTTS-v2	3417
segmentation	177 560 198	whisper-large-v3-turbo	2851
wav2vec2-large-xlsr-53-portuguese	148 429 547	Dia-1.6B	2830
Multimodal			
Qwen2.5-VL-3B-Instruct	66 470 270	Janus-Pro-7B	3565
Qwen2.5-VL-7B-Instruct	47 939 916	DeepSeek-OCR	3175
Qwen2-VL-2B-Instruct	28 439 743	Kimi-K2.5	2227
Qwen2-VL-7B-Instruct	24 583 925	gemma-3-27b-it	1906
llava-1.5-7b-hf	21 416 461	Qwen2.5-Omni-7B	1868
Reinforcement Learning			
openvla-7b	10 574 542	Magma-8B	415
ppo-seals-CartPole-v0	1 314 565	Alpamayo-R1-10B	376
ppo-Pendulum-v1	401 063	GR00T-N1-2B	348
Tifa-Deepsex-14b-CoT-Q8	308 540	smolvla_base	343
smolvla_base	231 683	pi0_old	307
Tabular			
chronos-t5-small	323 476 742	granite-timeseries-ttm-r1	321
chronos-t5-tiny	112 325 579	timesfm-2.0-500m-pytorch	238
chronos-bolt-small	86 387 643	chronos-2	195
chronos-bolt-base	67 157 276	tabpfn_2_5	177
chronos-2	35 899 346	chronos-t5-large	171

Source: the authors based on data retrieved from Hugging Face, 2026

Table 2 compares the most prominent repositories within each major task category according to these two indicators. Downloads primarily reflect practical use and integration into real-world applications, whereas likes capture community recognition and perceived importance within the developer ecosystem. The comparison between these indicators reveals a notable distinction between widely used infrastructure models and highly visible frontier models. For instance, several of the most downloaded NLP repositories – such as bert-base-uncased or all-MiniLM-L6-v2 – serve as foundational components within numerous machine learning pipelines. In contrast, repositories receiving the largest numbers of likes are often large frontier models, such as DeepSeek-R1 or Meta-Llama-3, which attract significant attention due to their capabilities and visibility within the research and developer community.

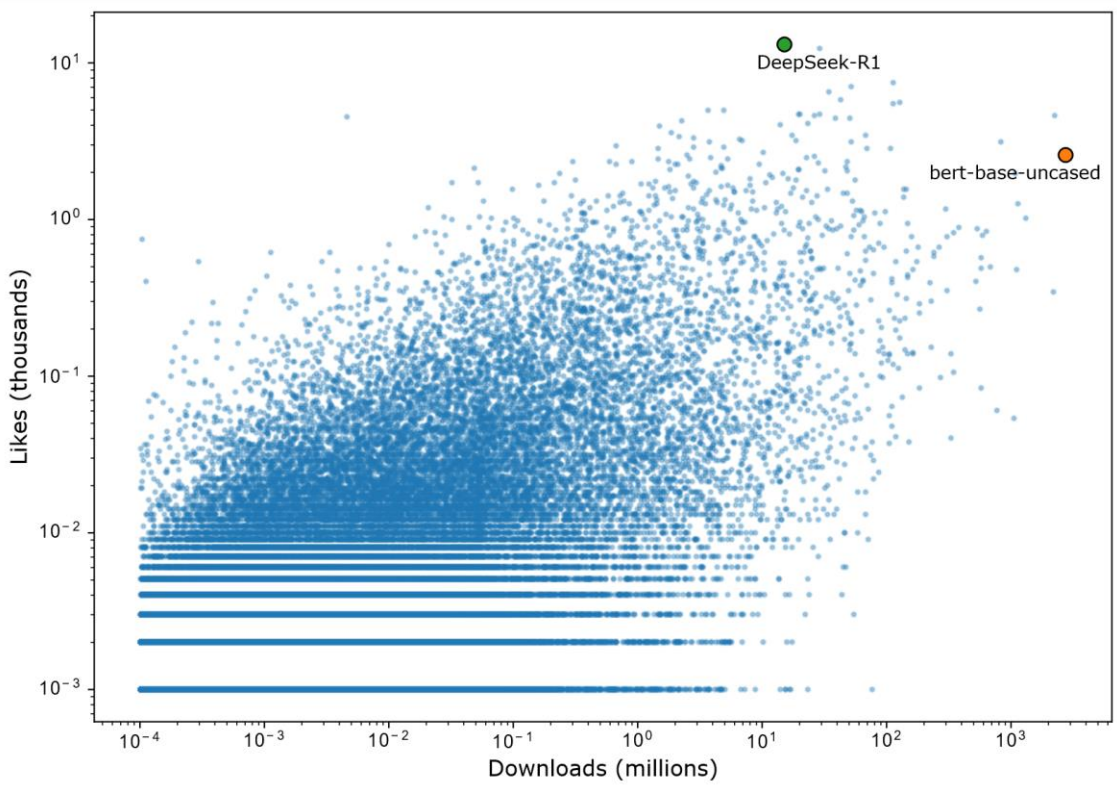


Figure 2: Downloads versus community likes for Hugging Face model repositories (log–log scale)
Source: the authors based on data retrieved from Hugging Face, 2026

As shown in Figure 2, each point in the figure represents a single repository. The distribution is highly uneven, with the majority of repositories clustered in the lower-left region of the chart, indicating relatively modest levels of both downloads and community engagement. Only a small number of repositories reach extremely high levels of popularity. Because both downloads and likes span several orders of magnitude, a logarithmic scale is applied to both axes. This representation makes it possible to visualize both the large number of smaller repositories and the relatively small group of extreme outliers within a single plot. The repository bert-base-uncased has the highest number of downloads, reflecting its widespread use as a foundational NLP model in numerous machine learning pipelines. In contrast, DeepSeek-R1 records the largest number of likes, indicating strong community attention rather than necessarily the highest level of real-world deployment.

The dominance of generative NLP and vision models observed in the Hugging Face ecosystem suggests that open-source innovation is currently concentrated around foundation models capable of supporting autonomous AI agents. This reinforces the argument that organizations can build enterprise-specific autonomous systems by orchestrating existing open-source models rather than developing proprietary models from scratch.

5. IMPLICATIONS FOR BUILDING AUTONOMOUS ENTERPRISE AI SYSTEMS

The empirical analysis of the Hugging Face ecosystem suggests that the current open-source AI landscape already provides a broad range of mature and widely used models across multiple functional domains. Language models, computer vision architectures, audio processing systems, and multimodal models collectively cover many of the core capabilities required for intelligent information processing. From the perspective of enterprise management, this implies that the fundamental technological components necessary for constructing autonomous AI systems are already available within the open-source ecosystem.

Based on the filtered repository catalog analyzed in this study, it appears technically feasible to assemble the key functional modules of an autonomous enterprise AI system by combining existing models. Such systems could integrate natural language understanding, information retrieval, document analysis, predictive modeling, and multimodal perception into a unified decision-support environment. Although additional integration, orchestration, and domain-specific adaptation remain necessary, the empirical results indicate that the foundational building blocks of enterprise-oriented autonomous AI systems are already present within the Hugging Face ecosystem.

Figure 3 illustrates a conceptual architecture of an autonomous enterprise AI system organized as a layered, cyclic structure that connects data resources, AI capabilities, and organizational performance. At the core of the system lies enterprise data, including knowledge bases, operational logs, and sensor or IoT data, which feed into the AI architecture together with resources from the open-source ecosystem such as pretrained models, agent frameworks, and model checkpoints. The system processes information through several functional layers. The Perception and External Inputs layer interprets incoming information streams using technologies such as computer vision, speech recognition, and document OCR. The extracted information is transformed in the Knowledge Structuring layer, where techniques such as embeddings, vector databases, and knowledge graphs convert raw enterprise data into machine-readable knowledge. This knowledge is then interpreted within the Cognitive Processing layer, which employs large language models, multimodal models, and reasoning models to enable understanding and interaction. Based on this reasoning, the Decision and Planning layer applies reinforcement learning, predictive analytics, and optimization models to generate strategic or operational decisions. These decisions are implemented through the Execution layer, which integrates with enterprise systems via APIs, automation tools, and workflow management. Surrounding the architecture are mechanisms for enterprise AI governance and a continuous learning loop involving evaluation, retraining, and model updates, ensuring that the system evolves over time and supports improved organizational performance and competitive advantage.

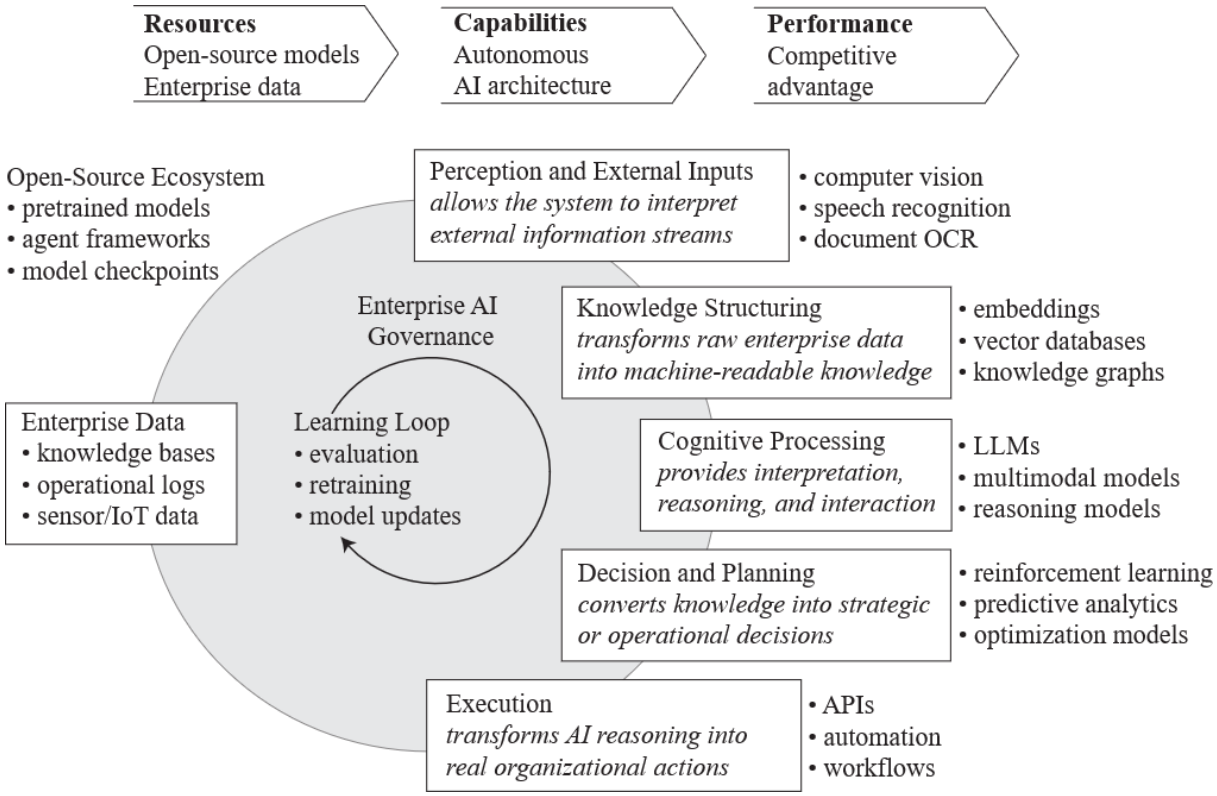


Figure 3: Conceptual architecture of an autonomous enterprise AI system
Source: the authors

From a strategic perspective, the existence of such open-source technological infrastructures carries significant implications for competitive advantage. Although the base algorithms and models available through open-source platforms are widely accessible and therefore not inherently rare, their strategic value emerges when they are integrated with proprietary organizational data, domain knowledge, and internal workflows. The orchestration of these components into a coherent autonomous system creates a complex socio-technical capability that is significantly more difficult for competitors to replicate (Abrantes & Madsen, 2023; Wilson & Tyson, 2025).

The growing importance of open-source ecosystems reflects a broader transformation in the nature of competitive dynamics. In contemporary digital markets, firms rarely innovate in isolation; instead, they operate within interconnected technological ecosystems that collectively shape the pace and direction of innovation (Charan & Willigan, 2021). Platforms such as Hugging Face function as collaborative infrastructures through which new models, techniques, and

tools are continuously developed and disseminated. By actively participating in these ecosystems, enterprises can leverage external innovation while avoiding the substantial costs associated with building large foundation models independently. This dynamic creates cumulative advantages: early investments in AI-driven automation often free organizational resources that can subsequently be reinvested into more advanced applications of AI, leading to progressive improvements in efficiency, decision-making, and innovation capacity (Wilson & Tyson, 2025). Over time, this iterative process may reinforce competitive advantages for organizations that are able to integrate new AI capabilities more rapidly than their competitors.

At the organizational level, realizing the potential benefits of autonomous AI systems requires appropriate leadership structures and governance mechanisms. Many organizations are therefore establishing dedicated leadership roles, such as Chief AI Officers, responsible for aligning AI initiatives with broader business strategies and ensuring that technological investments generate measurable organizational value (Anderson, 2025). Effective implementation of AI-driven transformation also depends on leadership approaches capable of balancing technological innovation with organizational stability. In practice, this often requires a combination of leadership styles that support experimentation and innovation while maintaining trust and engagement among employees during periods of significant technological change (Zarifis, 2025).

Importantly, the adoption of autonomous AI systems does not eliminate the role of human decision-makers. Instead, many emerging enterprise architectures emphasize a collaborative relationship between humans and intelligent systems. Within such frameworks, AI systems perform large-scale data analysis, pattern recognition, and repetitive cognitive tasks, while human managers retain responsibility for strategic judgment, ethical oversight, and contextual interpretation (Smith & Riley, 2025). Mechanisms such as human-in-the-loop supervision and human-controlled outcomes allow organizations to maintain appropriate oversight while benefiting from the analytical capabilities of autonomous systems (Wilson & Tyson, 2025). This human–AI collaboration enables organizations to combine computational efficiency with human judgment and ethical reasoning.

At the same time, the growing autonomy of AI systems introduces significant governance challenges. When generative models are embedded within agent-based architectures capable of executing real-world actions, the risks associated with data privacy violations, algorithmic bias, and unreliable outputs become more consequential. Without appropriate safeguards, such vulnerabilities may lead to financial losses, regulatory violations, or reputational damage that undermines organizational trust and long-term competitiveness. Consequently, enterprises implementing autonomous AI systems must establish robust governance structures that include data management policies, transparency mechanisms, and continuous monitoring of system performance. Technical safeguards such as system-level guardrails – designed to control and filter model inputs and outputs – can further reduce the likelihood of unintended or harmful actions.

6. CONCLUSIONS

The emergence of autonomous artificial intelligence systems represents an important development in enterprise management, transforming AI from a primarily analytical tool into an increasingly active component of organizational decision-making processes. As AI agents gain the capability to interpret information, propose actions, and execute operational tasks, enterprises must reconsider how these technologies are governed and integrated within existing organizational structures. Unlike traditional decision-support systems, agentic AI architectures may directly influence or initiate real-world actions. This increased autonomy amplifies potential risks related to algorithmic bias, data privacy violations, and unreliable model outputs. Consequently, organizations adopting autonomous AI systems must establish robust governance mechanisms that include system-level safeguards, continuous monitoring, and clear ethical and regulatory frameworks in order to maintain alignment between automated decision processes and organizational objectives.

The findings of this study indicate that the technological foundations required for building enterprise-level autonomous AI systems are already widely available within the contemporary open-source ecosystem. The empirical analysis of the Hugging Face repositories demonstrates the presence of a large and diverse set of machine learning models capable of supporting core functionalities such as language understanding, computer vision, multimodal processing, and predictive analytics. When appropriately integrated and orchestrated, these models provide the technical building blocks necessary for constructing layered AI architectures capable of supporting complex enterprise decision processes.

From a strategic management perspective, the results reinforce key insights from the resource-based view and dynamic capabilities theory. The widespread availability of open-source AI models implies that the technology itself rarely constitutes a unique strategic resource. Instead, sustainable competitive advantage emerges from the ways in which organizations integrate these models with proprietary data resources, internal knowledge, and organizational workflows. Through such integration, firms can develop complex socio-technical capabilities that are difficult for competitors to replicate. At the same time, autonomous AI systems enhance an organization's ability to sense environmental changes, seize emerging opportunities, and reconfigure internal processes – capabilities that are central to maintaining competitiveness in rapidly evolving digital markets.

Another important implication of this research concerns the role of the open-source AI ecosystem as a strategic infrastructure for enterprise innovation. Platforms such as Hugging Face have significantly lowered the barriers associated with advanced AI development by providing access to extensive repositories of pretrained models and development tools (Lee, 2026). Rather than investing heavily in the development of proprietary foundation models, many organizations may

achieve greater strategic value by focusing on the orchestration, adaptation, and integration of existing open-source technologies with their internal data assets and operational processes. This approach allows enterprises to leverage rapid external innovation while concentrating internal resources on domain-specific applications that generate business value.

REFERENCES

Abrantes, B., & Madsen, J. (2023). *Essentials on Dynamic Capabilities for a Contemporary World* (B. F. Abrantes & J. L. Madsen, Eds.). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-34814-3

Anderson, J. (2025). *The Chief AI Officer's Handbook. Master AI leadership with strategies to innovate, overcome challenges, and drive business growth*. Packt Publishing.

Barney, J. (1991). Firm Resources and Sustained Competitive Advantage. *Journal of Management*, *17*(1), 99–120. https://doi.org/10.1177/014920639101700108

Bennett, B. (2021). The impact of teaching culture online during COVID-19. *International Social Work*, *64*(5), 739–741. https://doi.org/10.1177/00208728211017963

Biswas, A., & Talukdar, W. (2025). *Building Agentic AI Systems. Create intelligent, autonomous AI agents that can reason, plan, and adapt*. Packt Publishing.

Charan, R., & Willigan, G. (2021). *Rethinking Competitive Advantage: New Rules for the Digital Age*. Penguin Random House.

Davenport, T. H., & Kirby, J. (2016). *Only humans need apply: Winners and losers in the age of smart machines*. Harper Business.

Frankl, M. (2025). *Unleashing AI: Harnessing Artificial Intelligence for Business Success*. Business Expert Press. https://doi.org/10.4128/9781637428016

Hardy, J. (2025). *Intelligent Automation in Digital Transformation Strategy*. Apress. https://doi.org/10.1007/979-8-8688-1425-9

Hugging Face. (2026). https://huggingface.co/

Kaur, V. (2019). *Knowledge-Based Dynamic Capabilities*. Springer International Publishing. https://doi.org/10.1007/978-3-030-21649-8

Lee, W. (2026). *Hugging Face in action*. Manning Publications.

Scavilla, R. (2025). Digital transformation through AI, machine learning, and analytics. In: J. Liebowitz (ed.). *Achieving Digital Transformation through Analytics and AI* (Vol. 08). WORLD SCIENTIFIC. https://doi.org/10.1142/13939

Smith, D. V., & Riley, A. (2025). *The Art of Collaborating with AI*. Routledge. https://doi.org/10.4324/9781003514879

Teece, D. J. (2007). Explicating dynamic capabilities: the nature and microfoundations of (sustainable) enterprise performance. *Strategic Management Journal*, *28*(13), 1319–1350. https://doi.org/10.1002/smj.640

Wilson, R., & Tyson, J. (2025). *Age of Invisible Machines. A guide to orchestrating AI agents and making organizations more self-driving*. John Wiley & Sons, Inc.

Zarifis, A. (2025). *Leadership With AI and Trust*. De Gruyter. https://doi.org/10.1515/9783111630137

DOI: 10.46541/978-86-7233-439-5_541



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MAPPING INNOVATION DOMAINS USING TOPIC MODELING

Abstract: Innovation plays a crucial role in driving economic growth and development, improving competitiveness, and creating new opportunities for individuals and businesses. It can lead to higher living standards and improved quality of life by addressing some of the world's most pressing challenges, such as climate change, health crises, and poverty. In recent years, artificial intelligence (AI) has emerged as one of the most influential forces shaping everyday life. It is also revolutionizing the innovation process by supporting R&D activities, automating complex tasks and enabling data analysis at speeds far exceeding human capabilities. The adoption of AI technologies accelerates the development of new products and business models while fundamentally transforming decision-making processes. Consequently, companies are required to restructure their innovation processes in response to rapid technological advancement and evolving workforce roles. AI is widely perceived as a source of unlimited possibilities, and its increasing adoption is strongly reflected in the expanding body of scholarly work. The number of papers addressing innovation and AI has grown significantly in recent years. To illustrate, assess and map research at the intersection of AI and innovation, this study analyzes published work indexed in the Elsevier Scopus databases. The research examines thousands of publications related to innovation by analyzing titles, abstracts, and keywords, employing BERTopic modeling and bipartite graph analysis to identify emerging patterns. The findings reveal five distinct innovation technology domains and systematically map their relationships with various AI methods. The results indicate that AI-related innovations are not isolated phenomena but are widely integrated across multiple domains, highlighting the importance of cross-departmental collaboration to maximize system-wide benefits.
Keywords: Artificial Intelligence (AI), innovation, innovation management, BERTopic, bipartite graph models, SCOPUS.

1. INTRODUCTION

Technological innovation developments in organizations have attracted increasing scholarly attention over the last few decades, as firms have rapidly learned to use technology to enhance their innovativeness and performance (Beilin et al., 2019; Bai and Li, 20020; Hoffman et al., 1988; Musiolik et al., 2020). More specifically, organizations have soon learned that they can blend innovative technologies with their capabilities to enhance their competitive advantage (Porter, 1985). Among digital technologies that are constantly allowing firms to innovate in the digital age, there is artificial intelligence (AI), which is increasingly affecting how firms innovate (Kakatkar et al., 2020; Mariani and Fosso Wamba, 2020; Wamba and Mishra, 2017) and how consumers respond to AI-informed innovations (Mustak et al., 2021).

Economists have recently sought to understand the impact of AI on innovation (Cockburn et al., 2019) and have called for more research at both the industry and organizational levels. So far, management scholars dealing with technology-driven innovation have focused mainly on themes such as the barriers in the implementation of AI systems in organizations (Desouza et al., 2020; Haefner et al. 2021), and ways through which AI can support organizational processes (Frank et al., 2019), decision making (Kakatkar et al., 2020; Verganti et al., 2020), operations (Belhadi et al., 2021), business models (Di Vaio et al., 2020) and the achievement of organizational objectives (Hutchinson, 2021). While this body of research is very recent, it apparently displays several features: (1) there are indicators on research fragmentation (2) its nature is mostly exploratory; (3) innovation scholars do not have a clear, holistic, and comprehensive picture of what has been researched and where are the most relevant new research gaps that might provide fruitful avenues for further enquiry in the focal domain.

More specifically, despite AI being increasingly critical in innovation studies, so far, no systematic effort has been made to synthesize and assess comprehensively and quantitatively through a systematic literature review (SLR) the knowledge produced on the role of AI in innovation management. Furthermore, innovation management scholars miss a structured framework that clearly maps extant literature in relation to the drivers and outcomes of AI adoption in the innovation field. To bridge these research gaps, and in line with the tenets of literature review research (Donthu et al., 2021), we conduct an SLR to answer the following research question: What is the emerging intellectual structure of the innovation literature on AI?

To answer this research question, we conduct an SLR to identify the evolution of research on AI and innovation, to investigate the scientific knowledge produced to date, and to portray the advancement of innovation research pertaining to AI. Having identified the relevant sample for the review (N = 16950 articles), an SLR approach is used to identify the drivers and outcomes of AI adoption for innovation purposes. Adopting an SLR allows researchers to embrace a systematic, transparent, and reproducible approach that can reduce bias (Snyder, 2019).

This paper makes several contributions to the intersection of innovation and AI by adopting a multidisciplinary perspective. First, we provide an updated overview of the volume and trends in research outputs at the intersection of AI and innovation, thereby contributing to the field of innovation management. Second, we single out economic, technological, and social factors as drivers of AI adoption in firms willing to innovate. Third, we identify firms' economic, innovation, competitive, and organizational factors as key outcomes of AI adoption in firms aiming to innovate. Fourth, we leverage a bibliometric analysis to uncover seminal work in the field of AI in innovation research and to map the research field over time. Fifth, we contribute to the innovation literature by developing an interpretive framework that elucidates the drivers and outcomes of AI adoption for innovation, thereby offering a theoretical contribution to the field of innovation management. Sixth, we identify the most frequently used theories to provide clear directions for further inquiry. Seventh, we develop a rich research agenda that contributes to expanding the field's perimeter while revealing new research gaps that can lead to fruitful avenues for further enquiry in the focal field.

The article is structured as follows. In section 2, we review the recent debate on AI in the innovation domain. Section 3 describes the methodology adopted in this study. Section 4 portrays the findings in relation to the descriptive statistics of extant publications, major themes and topics that emerged from the bibliographic coupling analysis, theoretical lenses deployed in the literature, and a comprehensive framework to identify drivers and outcomes of AI adoption. Section 5 elucidates the major contributions and illustrates the limitations while developing a rich research agenda.

2. RECENT DEBATE ON AI IN INNOVATION STUDIES

As the aim of this study is to map the intellectual structure of innovation literature dealing with AI, we first introduce several key concepts and definitions to better inform this systematic literature review.

Several scholars in business and management have recognized that AI has multiple ramifications. These ramifications have been theorized recently by Davenport and Ronanki (2018) and Huang and Rust (2018). For instance, Davenport and Ronanki (2018) distinguish three types of AI: process automation, cognitive insight and cognitive engagement. More recently, AI has been defined as "the use of computational machinery to emulate capabilities inherent in humans, such as doing physical or mechanical tasks, thinking, and feeling" (Huang and Rust,2018, p.31). In innovation contexts, AI has been defined as systems developed with the "objective of creating human-like behaviour in machines for perception, reasoning, and action" (Prem, 2019, p.2). AI has gained power due to rapid advances in computational capabilities and a huge variety of new technologies (e.g., computer vision, machine learning, and natural language processing) (Mariani et al. 2022), as well as a blast of available data to train algorithms (Bornet et al., 2021).

The increasing relevance of AI in innovation is witnessed by the production of several studies on topics such as AI supporting innovation analytics (Kakatkar et al., 2020), AI enabling digital experimentation and digital innovation (Mariani and Nambisan, 2021), AI and sustainable business models (Di Vaio et al., 2020), AI in supply chain management (Toorajipour et al., 2021), strategic uses of AI (Borges et al., 2021), AI and big data integration within business processes

(Wamba and Mishra, 2017), and AI capabilities in industrial markets (Akter et al., 2021). However, to the best of our knowledge, there is only one literature review focusing on AI within innovation: Haefner et al. (2021) review the literature on AI and innovation management using the behavioural theory of the company to identify the application of AI systems in the innovation process, and illustrate the challenges that firms may face during the innovation process.

Our study is unique and distinct from the mentioned literature review on AI and innovation management, for several reasons. First, our study embraces a bibliometric and quantitative approach to examine the relevant literature, whereas Haefner et al. (2021) adopted a narrative approach. Second, the work of Haefner et al. (2021) is confined to "innovation management", while our study captures holistically the way AI has been researched in innovation studies. Third, bibliometric techniques allowed us to dig in depth about several key topics, and to portray the scholarly debate on the drivers and outcomes of AI adoption by firms trying to pursue product, process, and business model innovation.

As such, this work makes the following contributions. First, to the best of our knowledge, our study is the first (or among the first) to conduct a SLR on AI in the wider innovation research context (without a mere focus on innovation management) and to provide an integrated and holistic view of this emerging research area. Second, we leverage several bibliometric techniques (e.g., citation analysis, co-citation analysis, bibliographic coupling, and co-word analysis) as well as network analysis to scrutinize the intellectual structure emerging from the literature, and subsequently, provide a comprehensive framework that sheds light on the drivers and outcomes of AI adoption for innovation. Third, we single out and examine the wide range of theoretical lenses adopted in this research area to enable a better theoretical and conceptual interpretation of AI in innovation research.

3. RESEARCH METHODOLOGY

It is assumed that the input data consists of text files containing abstracts of scientific publications related to the fields of innovation and artificial intelligence.

The purpose of the research methodology developed was:

1. Identification of concepts related to artificial intelligence area,
2. Identification of main issues related to innovation area,
3. Analysis of relationships between AI and innovation topics.

3.1. The identification of AI concepts

Computer Science Ontology (available at: https://cso.kmi.open.ac.uk/home) was used to identify concepts related to AI . In this ontology, the concept "artificial ontology" is a direct descendant of the root node "computer science" and has 1,826 descendants, 36 of which are direct descendants, while the rest are indirect descendants. Each concept has a label containing its name (e.g., "machine learning"). After collecting all concepts related to the field of AI , an embedding was assigned to each of them using a model all-MiniLM-L6-v2, which produces 384-dimensional embedding vectors. Word's embedding can be treated as its coordinates in semantic space (it means that in this space words with similar meaning are places close together). The all-MiniLM-L6-v2 model is one of the most popular tools for calculating embeddings for English words. Determining the distance between word embeddings allows us to assess their semantic similarity. This property has been used in research to identify the alignment between each analyzed sentence and concepts characteristic of a selected field of knowledge. To use this feature, the same model was used for calculating embeddings for every sentence taken from descriptions of publications (titles, keywords, abstracts). To assign concepts to specific sentences, the distance between the concept's location in the semantic space and the location of every sentence was calculated. If the calculated distance was less than the specified threshold value, the concept was assigned to the given sentence. In the study, the Euclidean formula was used to calculate the distance, and the threshold value was set at 0.9 The threshold value was determined experimentally, based on an assessment of the accuracy of concept assignment to the analyzed set of example sentences. In the last step, for every AI concept that was found in documents, the upper-level concepts being the direct descendants of the "artificial intelligence" concept were identified. These concepts (called "main AI sub-concepts) were used for further analysis.

3.2. The identification of main areas in the field of innovations

Due to the lack of a generally accepted ontology describing the field of innovation, the concept of identification process was conducted using an unsupervised learning procedure. The procedure consisted of two steps. In the first step, the main topics discussed in the publication descriptions were identified. The analysis identified 40 topics. It was assumed that the number of topics identified would exceed the number of innovation-related issues planned for identification, as it was expected that some of the topics appearing in the texts would not refer to the analyzed area.. For topic identification BERTopic algorithm was used (Grootendorst, M., (2022)).

In the next step of the analysis, the identified topics were grouped into categories corresponding to the issues most frequently discussed in the literature regarding the field of innovation. Finally, it was decided that the following five issues would be included in the subsequent analysis:

1. Digital and Intelligent Technological Enablers
2. Sectoral and Industrial Application Environments
3. Sustainability and Energy Transformation Drivers
4. Analytical and Modelling Support for Innovation
5. Innovation Systems and Diffusion Context

For each of the innovation-related issues identified in this way, aggregated word frequencies were calculated to indicate the frequency of specific words in the texts assigned to each group. These values served as the basis for creating word cloud charts illustrating the issue under consideration.

3.3. Analysis of relationships between AI concepts and innovation areas

Bipartite graph models (Lula et al., 2019) were used to show relationships between AI main sub-concepts. Bipartite weighted graph shows the number of occurrences of concepts belonging to two separate sets (AI and innovation) and the strength of connections between them (expressed as a number of cases in which two given concepts belonging to different sets occur at the same time). A bipartite graph presenting relationships between innovation and AI issues was presented in the form of a Sankey diagram.

4. RESULTS OF EMPIRICAL RESEARCH

4.1. General description of the publications analyzed

As part of the empirical research, an analysis was conducted of abstracts, keywords, and titles of papers published in 2025, indexed in the Scopus database, and related to the topic of "innovation and management". The total number of publications meeting the criteria defined above was 16,950.

The scope of the analyzed works is presented in Figure 1 in the form of a word cloud.



Figure 1. The scope of the analyzed works
Source: The authors

Word clouds show the importance of words and phrases used in text documents. The importance of a given phrase is proportional to the font size used to display it. The content of the figure indicates that the following concepts should be considered particularly important: artificial intelligence, machine learning, sustainable development, supply chain, innovation, digital transformation and technology.

4.2. Topics identified in the area of AI

The method used to identify the main thematic areas within the field of AI was of a different nature. It was based on a semantic search within publication descriptions for concepts associated with the field of AI in Computer Science Ontology (https://cso.kmi.open.ac.uk/home).

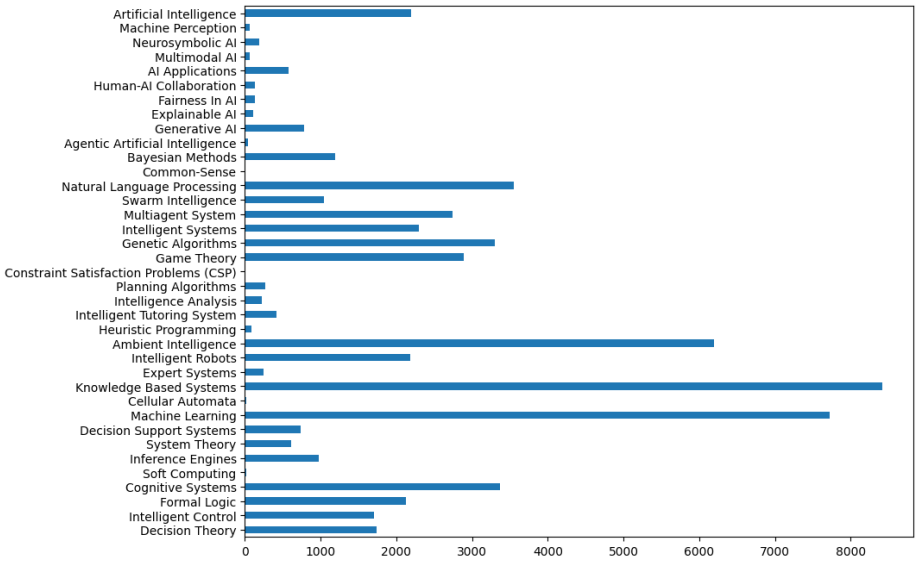


Figure 1: The number of references to AI main subareas.
Source: The authors

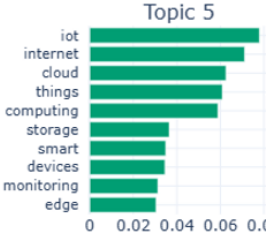
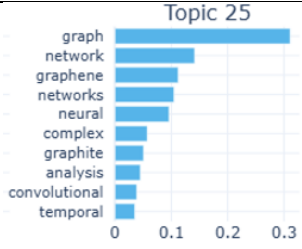
The figure shows that knowledge based systems, machine learning and ambient intelligence belong to the group of the most important concepts in AI area.

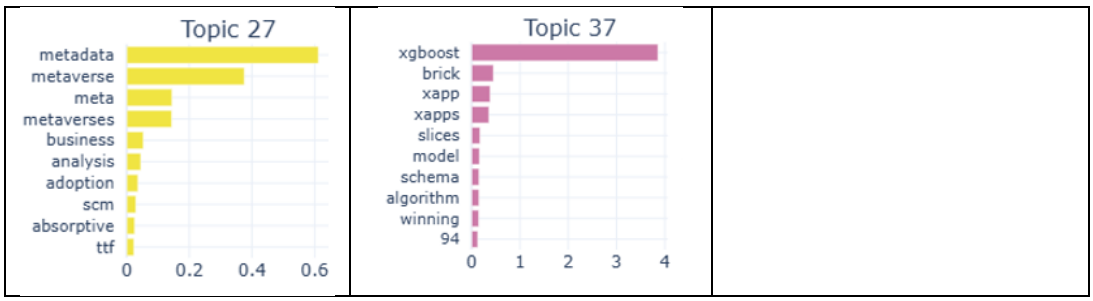
4.3. Topics identified in the area of innovations

The process of identifying the main issues in the field of innovation consisted of two main stages. During the first stage, 40 topics were identified using the BERTopic algorithm. The identified topics were then assigned to five areas.

The first area was identified as “Digital and Intelligent Technological Enablers”. The description of topics assigned to this area is presented in Table 1. This domain encompasses digital and computer technologies that enable the development of innovation. Identified technologies are not innovations by themselves but represent the infrastructure that empowers big data processing, process automation, and the development of new digital functionalities.

Table 1. The characteristics of the “Digital and Intelligent Technological Enablers” area

Digital and Intelligent Technological Enablers		
		



Source: The authors

The word cloud created with the use of texts assigning by BERTopic method to topics belonging to the "Digital and Intelligent Technological Enablers" area is presented in Figure 1.

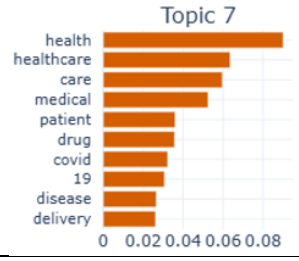
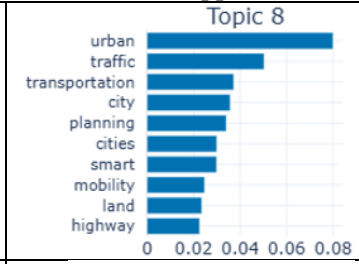
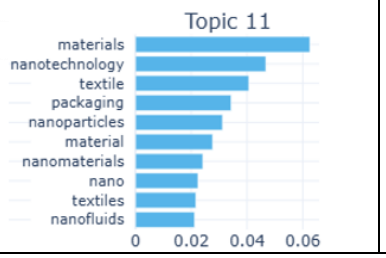
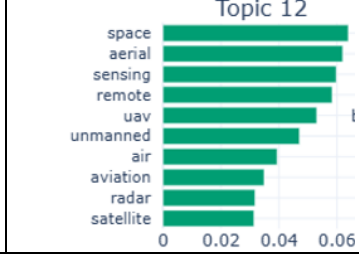
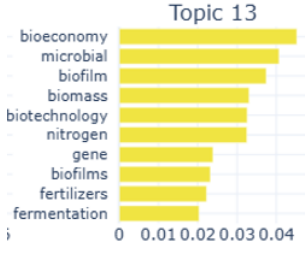


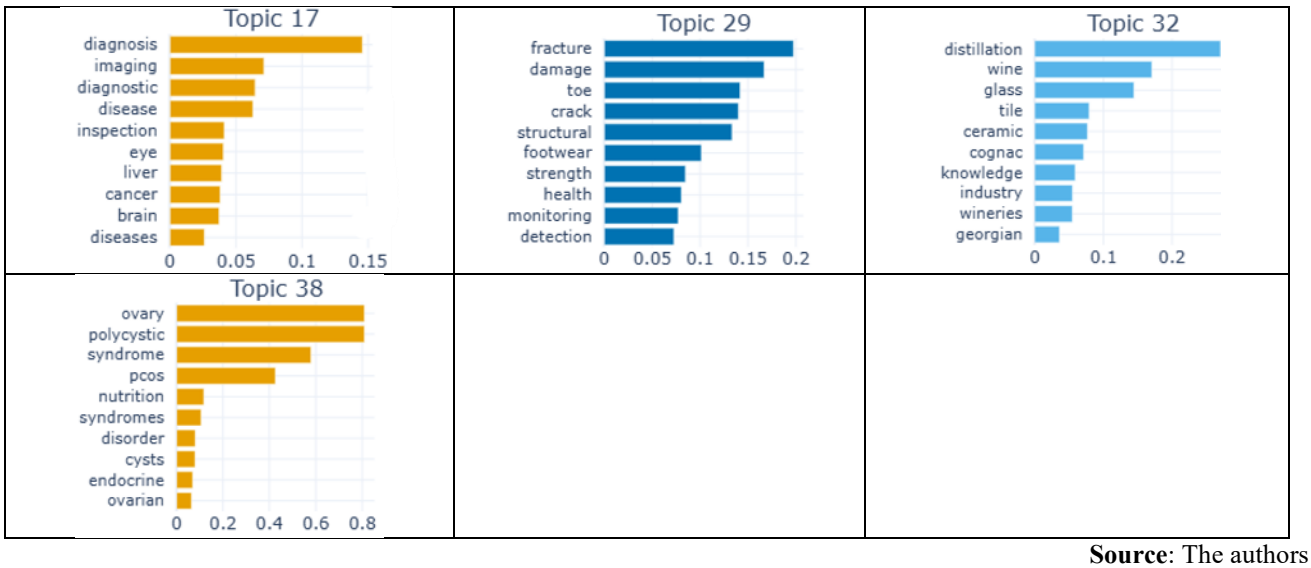
Figure 3. Word cloud for the "Digital and Intelligent Technological Enablers" area
Source: The authors

The content of the figure confirms the importance of issues related to knowledge management, data analysis, and the technological aspects of the implemented solutions.

The characteristics of the "Sectoral and Industrial Application Environments" area are presented in Table 2. These domains represent the sector and industry contexts in which innovations are developed and applied. It can be interpreted as a concrete technology application or development of new products, services, or technological solutions adjusted to customer requirements in the specific industry.

Table 2: The characteristics of the "Sectoral and Industrial Application Environments" area

Sectoral and Industrial Application Environments		
		
		



Source: The authors

The word cloud for the "Sectoral and Industrial Application Environments" is presented in Figure 3.

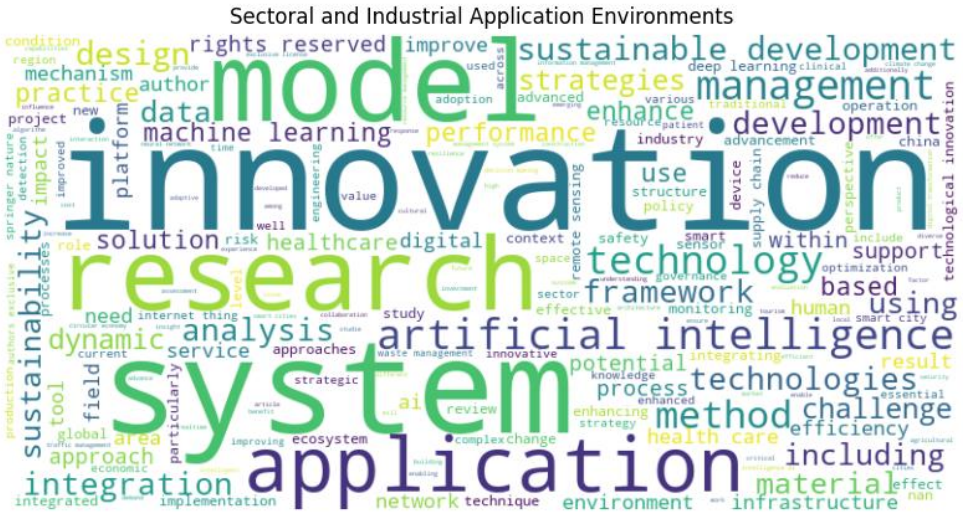
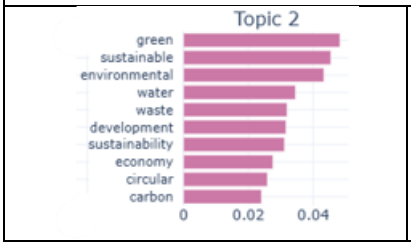
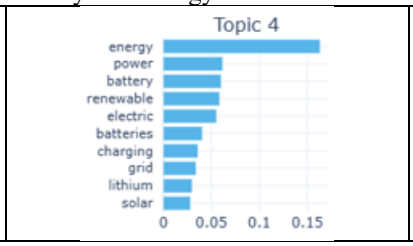
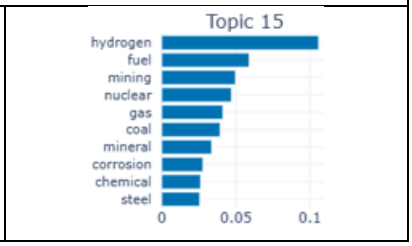


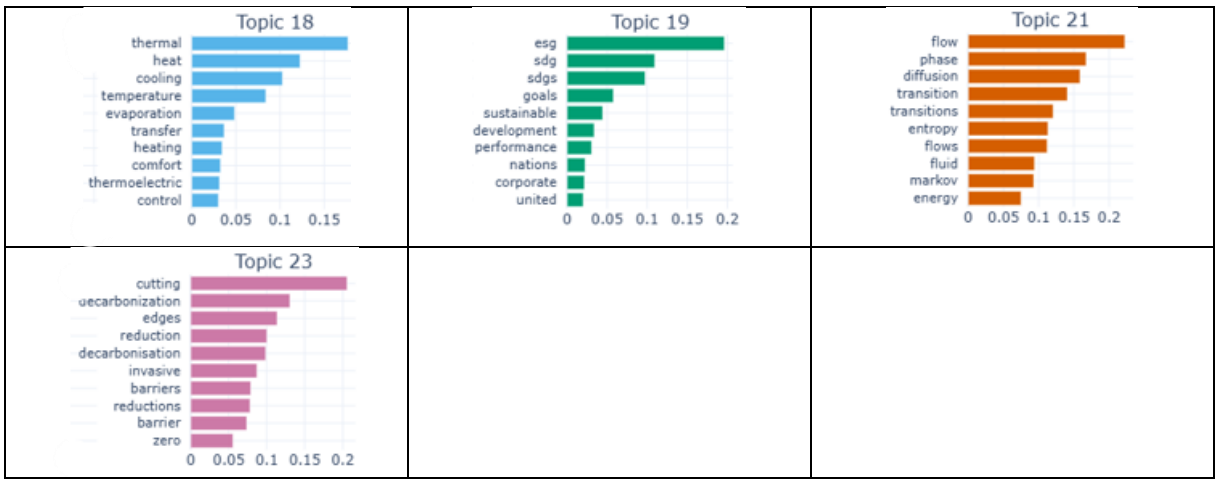
Figure 4: Word cloud for the "Sectoral and Industrial Application Environments" area
Source: The authors

The resulting plot confirms that the most important issue in the area "Sectoral and Industrial Application Environments" is the implementation of the innovative solutions that have been developed.

Next, an analysis of the "Sustainability and Energy Transformation Drivers" area was conducted. The description of topics that were assigned to this area is presented in Table 3. Dominant concepts include renewable energy, hydrogen, energy efficiency, ESG principles, etc. These topics reflect global efforts to reduce emissions and the development of sustainable technological solutions. This area is especially significant in current innovation policies that emphasize the transition towards sustainable energy solutions.

Table 3: The characteristics of the "Sustainability and Energy Transformation Drivers" area

Sustainability and Energy Transformation Drivers		
		



Source: The authors

Main issues discussed in the area "Sustainability and Energy Transformation Drivers" are presented in Figure 4.

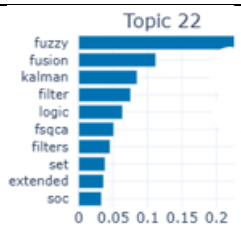
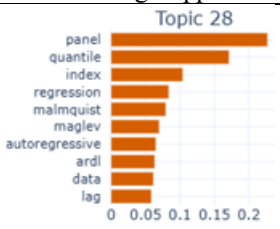
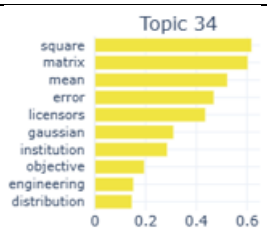
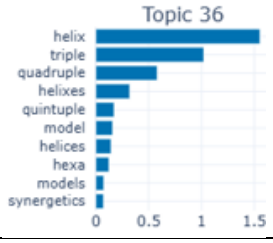


Figure 4: Word cloud for the „Sustainability and Energy Transformation Drivers" area
Source: The authors

The most important concepts related to the "Sustainability and Energy Transformation Drivers" area include: sustainable development, green innovation, waste management, circular economy and climate change issues.

"Analytical and Modelling Support for Innovation" was another area identified during the research process. It was presented in Table 4. This domain encompasses mathematical, statistical and analytical methods used for modelling and evaluation of innovation processes. Models enable innovation feasibility, resource optimization and informed decision making during new product or service development.

Table 4: The characteristics of the "Analytical and Modelling Support for Innovation" area

Analytical and Modelling Support for Innovation		
		
		

Source: The authors

The word cloud for the "Analytical and Modelling Support for Innovation" is presented in Figure 5.

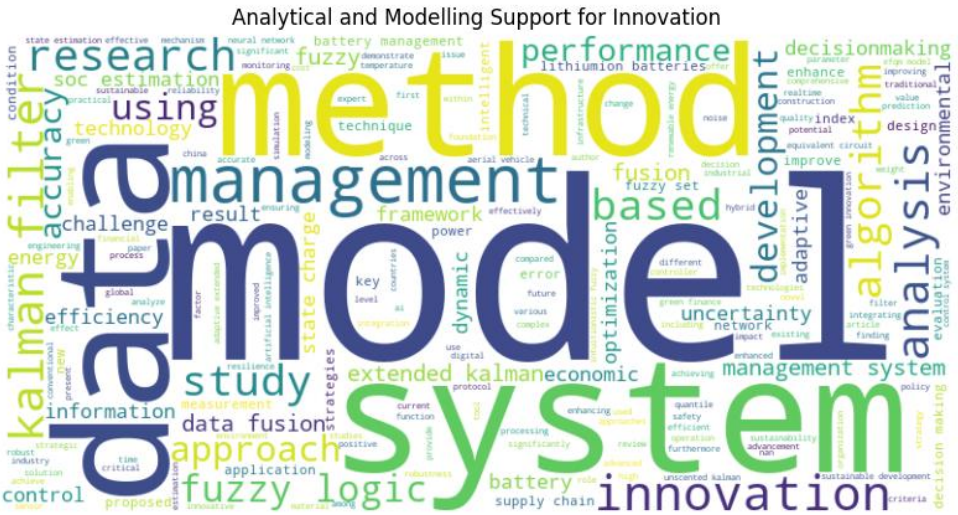
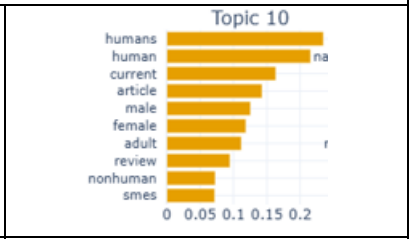
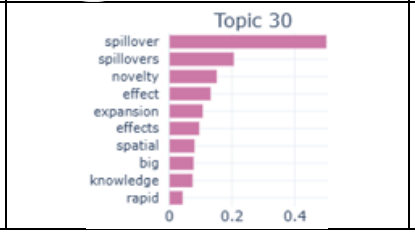
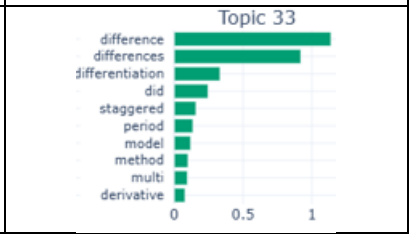


Figure 5: Word cloud for the „Analytical and Modelling Support for Innovation" area
Source: The authors

Data, models, methods, analysis and performance belong to the most important issues connected with "Analytical and Modelling Support for Innovation" area.

The area "Innovation Systems and Diffusion Context" is presented in Table 5. The domain includes organizational, social and institutional factors that shape development and diffusion of innovation. It is very important for understanding the process of how innovation passes through development phase to phase of commercialization and adoption.

Table 5. The characteristics of the "Innovation Systems and Diffusion Context" area

Innovation Systems and Diffusion Context		
		
		

Source: The authors

Main issues belonging to the area "Innovation Systems and Diffusion Context" are presented in Figure 6.



Figure 6: Word cloud for the „Innovation Systems and Diffusion Context" area
Source: The authors

Phrases presented in Figure 6 indicate issues related to the application of innovation solutions.

The significance of areas identified within the innovation field is presented in Figure 7. Values presented in this figure show the number of references to topics belonging to five main innovation areas.

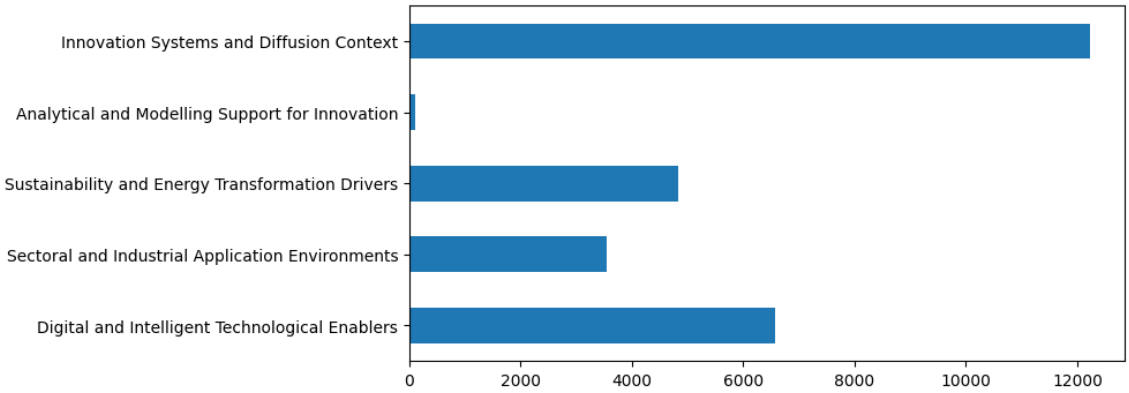


Figure 7: The number of references to main areas defined within innovation field
Source: The authors

4.4. Analysis of relationships between main AI sub-areas and main areas belonging in innovation field

The relationships between AI subareas and main areas within the innovation field are presented in Figure 8 in the form of a Sankey diagram.

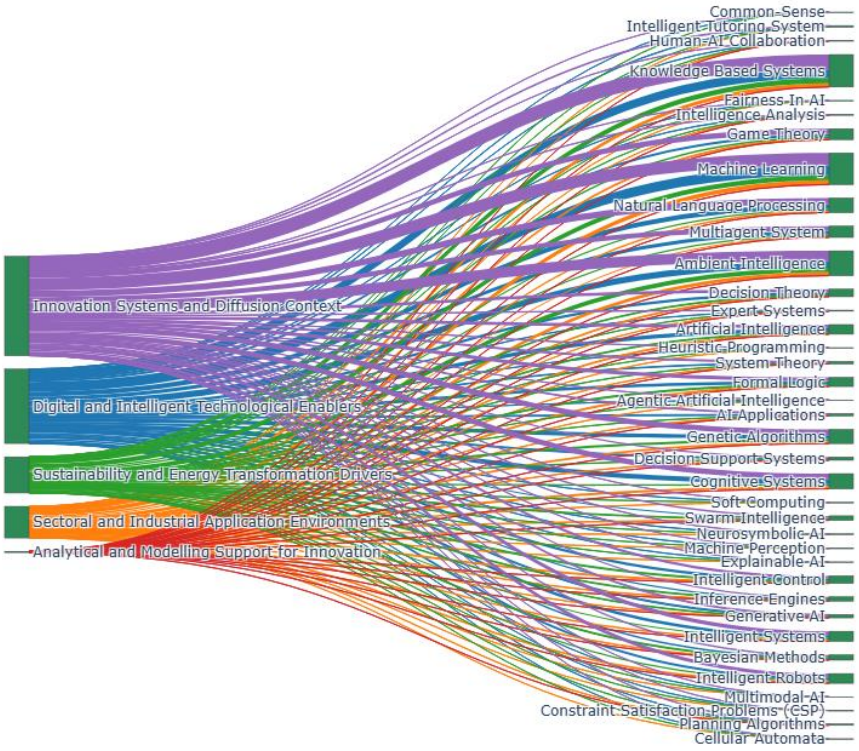


Figure 2: Relationships between main AI subareas and areas within innovation field
Source: The authors

In the document corpus under study, from the perspective of innovation-related topics, the following areas were of the greatest significance:

- Innovation Systems and Diffusion Context
- Digital and Intelligent Technological Enablers
- Sustainability and Energy Transformation Drivers

The following areas were significantly underrepresented:

- Sectoral and Industrial Application Environments
- Analytical and Modelling Support for Innovation

Knowledge-based systems, machine learning and ambient intelligence should be considered one of the most important concepts in the field of AI. Particularly strong connections emerge between the aforementioned fields of artificial intelligence and the “Innovation Systems and Diffusion Context”.
Analysis of the graph confirms the high specificity of the concepts under examination—which indicates a high degree of variation in the strength of connections between the concept under consideration (belonging to the first set) and the concepts belonging to the second set.

5. CONCLUSIONS

The analysis confirms the existence of a strong link between AI and innovation. In the context of innovation, the following areas of AI should be considered particularly important: knowledge-based systems, machine learning, ambient intelligence, cognitive systems, natural language processing and genetic algorithms.
It should be noted that the importance of AI concepts in various areas of innovation is not evenly distributed.

From the theoretical aspect, the identified clusters and their subsequent classification into broader areas contribute to a better understanding of the complex and multidimensional nature of innovation. The resulting clusters provide an insight into the latent thematic structures within the literature, whereby innovations are not viewed as a single phenomenon, but as a result of the interaction of various technological, sectoral, analytical and systemic factors.

The research results provide a practical tool for researchers, decision-makers, and organizations developing innovative solutions. Identification of these areas and their relationships allows easier recognition of the key factors that influence the success of innovation activities, as well as identification of areas with the greatest potential for the development of new technologies. The primary problem identified during the research was the lack of a widely accepted ontology describing the field of innovation. In their future work, the authors of this paper aim to address this issue by proposing an ontology that includes a set of concepts related to innovation and their interrelationships.

REFERENCES

Akter, S., Wamba, S. F., Mariani, M., & Hani, U. (2021). How to build an AI climate-driven service analytics capability for innovation and performance in industrial markets. *Industrial Marketing Management, 97*, 258–273.

Bai, X., & Li, J. (2020). The best configuration of collaborative knowledge innovation management from the perspective of artificial intelligence. *Knowledge Management Research & Practice.*

Beilin, I. L., Homenko, V. V., & Aleeva, D. D. (2019). Digital modeling of economic processes and supply chain management in the formation of cooperative relations in the petrochemical cluster of the region. *International Journal of Supply Chain Management, 8*, 532–537.

Belhadi, A., Mani, V., Kamble, S. S., Khan, S. A. R., & Verma, S. (2021). Artificial intelligence-driven innovation for enhancing supply chain resilience and performance under the effect of supply chain dynamism: An empirical investigation. *Annals of Operations Research.*

Borges, A. F., Laurindo, F. J., Spínola, M. M., Gonçalves, R. F., & Mattos, C. A. (2021). The strategic use of artificial intelligence in the digital era: Systematic literature review and future research directions. *International Journal of Information Management, 57*, Article 102225.

Bornet, P., Barkin, I., & Wirtz, J. (2021). *Intelligent automation: Welcome to the world of hyperautomation*. World Scientific.

Cockburn, I. M., Henderson, R., & Stern, S. (2019). The impact of artificial intelligence on innovation. In *The economics of artificial intelligence: An agenda* (pp. 5–152).

Davenport, T., & Ronanki, R. (2018). Artificial intelligence for the real world. *Harvard Business Review.*

Desouza, K. C., Dawson, G. S., & Chenok, D. (2020). Designing, developing, and deploying artificial intelligence systems: Lessons from and for the public sector. *Business Horizons, 63*, 205–213.

Di Vaio, A., Palladino, R., Hassan, R., & Escobar, O. (2020). Artificial intelligence and business models in the sustainable development goals perspective: A systematic literature review. *Journal of Business Research, 121*, 283–314.

Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. *Journal of Business Research, 133*, 285–296.

Frank, A. G., Mendes, G. H. S., Ayala, N. F., & Ghezzi, A. (2019). Servitization and Industry 4.0 convergence in the digital transformation of product firms: A business model innovation perspective. *Technological Forecasting and Social Change, 141*, 341–351.

Gartner. (2019). *Gartner top 10 strategic technology trends for 2019*. https://www.gartner.com/smarterwithgartner/gartner-top-10-strategic-technology-trends-for-2019/

Grootendorst, M. (2022). BERTopic: Neural topic modeling with a class-based TF-IDF procedure. *arXiv*. https://arxiv.org/abs/2203.05794

Haefner, N., Wincent, J., Parida, V., & Gassmann, O. (2021). Artificial intelligence and innovation management: A review, framework, and research agenda. *Technological Forecasting and Social Change, 162.*

Haenlein, M., & Kaplan, A. (2019). A brief history of artificial intelligence: On the past, present, and future of artificial intelligence. *California Management Review, 61*(4), 5–14.

Hoffman, K., Parejo, M., Bessant, J., & Perren, L. (1988). Small firms, R&D, technology and innovation in the UK: A literature review. *Technovation, 18*, 39–55.

Huang, M.-H., & Rust, R. T. (2018). Artificial intelligence in service. *Journal of Service Research, 21*, 155–172.

Hutchinson, P. (2021). Reinventing innovation management: The impact of self-innovating artificial intelligence. *IEEE Transactions on Engineering Management, 68*, 628–639.

Kakatkar, C., Bilgram, V., & Füller, J. (2020). Innovation analytics: Leveraging artificial intelligence in the innovation process. *Business Horizons, 63*, 171–181.

Lula, P., Kovaleva, A., Oczkowska, R., Tyrańska, M., & Wiśniewska, S. (2019). Bipartite competency schemas on Polish labour market. *Central European Business Review, 8*(4), 1–25.

Mariani, M. M., & Wamba, S. F. (2020). Exploring how consumer goods companies innovate in the digital age: The role of big data analytics companies. *Journal of Business Research, 121*, 338–352.

Mariani, M. M., & Nambisan, S. (2021). Innovation analytics and digital innovation experimentation: The rise of research-driven online review platforms. *Technological Forecasting and Social Change, 172*, Article 121009.

Mariani, M., Perez-Vega, R., & Wirtz, J. (2022). AI in marketing, consumer research & psychology: A systematic literature review and research agenda. *Psychology & Marketing, 39*(4), 755–776.

Musiolik, J., Markard, J., Hekkert, M., & Furrer, B. (2020). Creating innovation systems: How resource constellations affect the strategies of system builders. *Technological Forecasting and Social Change, 153.*

Mustak, M., Salminen, J., Plé, L., & Wirtz, J. (2021). Artificial intelligence in marketing: Topic modeling, scientometric analysis, and research agenda. *Journal of Business Research, 124*, 389–404.

Porter, M. E. (1985). Technology and competitive advantage. *Journal of Business Strategy.*

Prem, E. (2019). Artificial intelligence for innovation in Austria. *Technology Innovation Management Review, 9*, 5–15.

Snyder, H. (2019). Literature review as a research methodology: An overview and guidelines. *Journal of Business Research, 104*, 333–339.

Toorajipour, R., Sohrabpour, V., Nazarpour, A., Oghazi, P., & Fischl, M. (2021). Artificial intelligence in supply chain management: A systematic literature review. *Journal of Business Research, 122*, 502–517.

Verganti, R., Vendraminelli, L., & Iansiti, M. (2020). Innovation and design in the age of artificial intelligence. *Journal of Product Innovation Management, 37*, 212–227.

Wamba, S. F., & Mishra, D. (2017). Big data integration with business processes: A literature review. *Business Process Management Journal, 23*, 477–492.

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JEL: C38, Z30

HOSPITALITY AND TOURISM RESEARCH DURING GLOBAL INSTABILITY: A BERTOPIC ANALYSIS

Abstract: Hospitality and tourism represent the sector most affected by global disruptions caused by pandemics, energy crises, or political disturbances. In this paper authors examine how instability shapes research priorities and responses in hospitality and tourism research between 2019 and 2023, a period characterized by global pandemics. Topic modelling is utilized as the main method applied on abstracts of 1,100 scientific publications from this domain. These publications are collected from Web of Science and Scopus citation databases. Topic modelling, a natural language processing technique, uncovers hidden thematic structures in large text collections and corpora. This study utilized BERTopic to uncover research topics studied within an observed time interval. BERTopic uncovered 23 dominant topics in hospitality and tourism research, which emerged during the pre-crisis, crisis, and the adaptation period. Most prominent topics discovered include customer experience and review, energy systems modelling, consumption, brand loyalty and satisfaction and destination image and behavior.

Keywords: topic modeling, BERTopic, NLP, hospitality, tourism

INTRODUCTION

Global disruptions can take various forms and influence numerous sectors and multiple aspects of social and economic life. The hospitality and tourism sector is highly vulnerable to different types of crises, including pandemics, terrorism, political instability, natural disasters, and economic recessions (Kocak, Okumus & Altin, 2023; Leta & Chan, 2021; Liu, Pahrudin, Tsai & Hao, 2024; Sampaio, Farinha, Sebastião & Fernandes, 2023). Any factor that restricts human mobility has an impact on this sector and its overall performance and stability. The growth and development of many national economies depend directly on tourism and hospitality, and in some cases, it even represents the primary economic activity that generates value (Wijesekara et al., 2022). For example, COVID-19 outbreak led to 2.86 trillion USD losses, which represents more than 50% of total income in this area (Abbas, Mubeen, Iorember, Raza & Mamirkulova, 2021). Therefore, tourism represents an important research area that attracts considerable attention from the scientific community, and any change in its functioning represents a research challenge that becomes a relevant topic in academic studies (Leta & Chan, 2021; Liu et al., 2024).

Since the early 2000s, researchers have actively examined the vulnerability of the tourism and hospitality sector to various destabilizing events. During this period, attention was devoted to events such as terrorist attacks, bombings, tsunamis, and the SARS outbreak. Around the 2010s, research focus was shifted toward the impact of global financial crises on tourism demand and stability (Liu et al., 2024). More recently, the COVID-19 pandemic has significantly increased academic interest in crisis-related disruptions and highlighted the sensitivity of tourism and hospitality to global shocks (Liu et al., 2024; Wong, Kim, Liu & Grace Baah, 2025; Zhong, Sun, Law & Li, 2021). To better understand the shifting of research focus during the crisis period, this study focuses on topics which were examined in the tourism and hospitality literature during the COVID-19 pandemic. One possible approach to answering this question is the application of topic modeling (TM), a natural language processing (NLP) technique on published studies. Topic modeling is a statistical, NLP tool for extracting hidden semantic structures in large collections of documents (Blei, Ng & Jordan, 2003). It can also be described as a generative model in which documents are represented as mixtures of topics, while each topic is represented as a probability distribution over words (Alghamdi & Alfalqi, 2015). This modeling approach has been applied across various fields such as medical sciences, software engineering, geography, political science, marketing, sociology and digital humanities (Dieng, Ruiz & Blei, 2020; Jelodar et al., 2019). The most used topic modeling methods include Latent Dirichlet Allocation (LDA), Non-negative Matrix Factorization (NMF), Latent Semantic Analysis (LSA), Probabilistic Latent Semantic Analysis (pLSA), BERTopic, Correlated Topic Models (CTM), Top2Vec, LDA2Vec (Hankar, Kasri & Beni-Hssane, 2025).

Compared with other models such as LDA, BERTopic shows better performance in terms of semantic relevance and contextual coherence (Sy, Maceda, Flores & Abisado, 2024). This method generates topics by converting documents into embedding representations, then reducing their dimensionality to optimize the clustering process, and finally extracting topics using a class-based variation of TF-IDF (Grootendorst, 2022). For this reason, the BERTopic is chosen as a topic modelling method in this study. Consequently, the aim of this paper is to apply BERTopic to identify topics that reflect the research focus and priorities in the field of hospitality and tourism during the period of global instability caused by the COVID-19 pandemic. The extracted topics are used to answer two research questions. These research questions are:

RQ1: Which topics dominate research in the field of hospitality and tourism between 2019 and 2023?
RQ2: Does the research focus shift on resilience and risk management after 2020?

The dataset used for answering these RQs consists of 1,212 research papers retrieved from the Scopus and Web of Science citation databases, published between 2019 and 2023, while after pre-processing of publications 1,100 remained for analysis.

The remainder of this paper is organized as follows. The first section presents the theoretical foundations of topic modeling, with a particular focus on the BERTopic method. *Materials and Methods* section presents data used in the study and the methodology that was applied. Third section presents the results of the modelling, followed by discussion section where focus is to present obtained findings from topics through time transition of COVID pandemic. Finally, the conclusion is presented.

1. TOPIC MODELING

Topic modelling, a natural langugage processing technique, reveals thematic structures from collection of texts that may not have been anticipated. It relies on unsupervised learning algorithms that detect patterns within textual data (Abdelrazek, Eid, Gawish, Medhat, & Hassan, 2023; Alghamdi & Alfalqi, 2015). By grouping texts according to semantic similarity and context, topic modelling forms clusters or topics (Kherwa & Bansal, 2020). BERTopic represents one of the emerging topic modeling methods in applied research in hospitality domain (Egger & Yu, 2022). Due to its advantages, such as it represents multilingual model for 50 different languages (Egger & Yu, 2022) or that it enables researchers to examine and observe trends and changes addressed in the texts (Rejeb, Rejeb, Simske, & Süle, 2025), it is selected for the case study presented in this paper.

The BERTopic framework implies three key steps (Rejeb et al., 2025; Grootendorst, 2022). After collecting the documents, the first step refers to vector representation of documents. For this purpose, BERTopic utilizes BERT embeddings and most often a pre-trained Sentence Transformer (SBERT) that embeds sentences in a high-dimensional vector space. The second step is the reduction of the dimensionality of the vector for more effective clustering. It is recommended to use the UMAP (*Uniform Manifold Approximation and Projection*) technique in order to preserve the revealed information and word meanings. The last step involves grouping the reduced embeddings using clustering algorithms, such as HDBSCAN (*Hierarchical Density-Based Spatial Clustering of Applications with Noise*), and generating topics per cluster using the c-TF-IDF technique (Grootendorst, 2022). The HDBSCAN technique in the model enables the storage of identified outliers in a separate cluster, avoiding forced assignment to dominant and meaningful clusters, which would damage the quality of the output (Angelov, 2020). Thus, compared to traditional

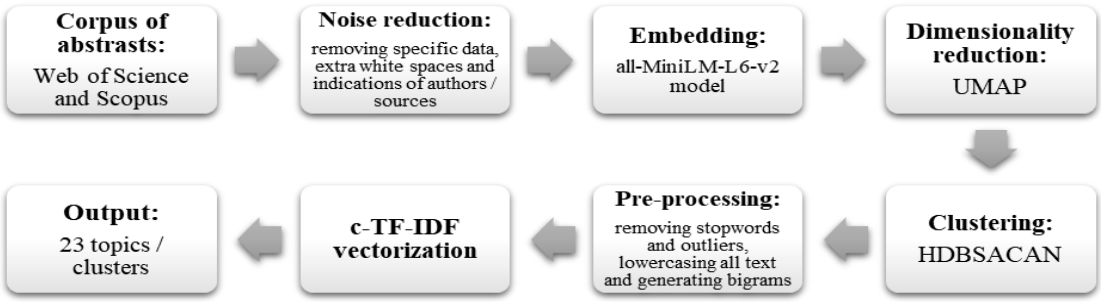
techniques, clustering is not performed on a centroid-based but on a class-based approach of calculated frequencies, the c-TF-IDF.

Although the mentioned steps are crucial for the application of the BERTopic model, the framework is extendable with additional steps, such as data pre-processing (Grootendorst, 2022; Rejebet al., 2025), topics representation (Ma et al., 2025), or visualization and inspection of individual topics (Egger & Yu, 2022). Also, BERTopic model is not strictly restricted to the application of HDBSCAN and UMAP techniques. Other techniques and models can be used, depending on the need, goal, or application area of topic modelling. The flexibility and modularity of the model represents advantage over other models (Alammar & Grootendorst, 2024).

2. MATERIALS AND METHODS

Data is collected by querying Web of Science and Scopus, two citation databases complying with the highest publishing standards and cross-linking publications in numerous other citation databases. The study focuses on pandemics response of hospitality researchers examining customer/traveler experience, preferences, and perceptions by utilizing topic modeling as a technique. The search is set accordingly, using the combination of the following keywords and their alternative spellings with Boolean operators: “topic modeling” OR “topic modelling”, “tourism” OR “destination marketing” OR “tourist perceptions” OR “hospitality” OR “attractions” OR “tourists’ preferences" OR “customer satisfaction” OR “destination management”. The timeframe is restricted to period from 2019 to 2023, covering pre-pandemics, pandemics, and post-pandemics period, and only peer-reviewed journal articles written in the English language were included in the analysis.

The search resulted with 1,212 records. For the modelling purposes, we recorded paper title, author names, publication year, source title, and abstract in an Excel file. Two records were eliminated due to the lack of abstract and 110 records were duplicate records and removed, leaving a total of 1,100 records for further analysis. Prior embedding, as presented in Picture 1, the noise is eliminated by removing data specific to structured abstracts, such as “*Purpose:*”, “*Design/Methodology/Approach*:”, “*Research limitations/implications*”, etc. Using regular expressions in Python, extra white spaces in the abstracts are removed, and all indications of authors or publications source. Such pre-processing was conducted to ensure the plain abstract text will be used as an input for topic modelling.



Picture 1: Topic modelling flow
Source: Authors

To numerically represent abstracts and capture their meaning, we utilized sentence transformers model *all-MiniLM-L6-v2*, which is optimized for semantic similarity tasks and clustering, an important criteria for selection of embedding model for topic modelling (Alammar & Grootendorst, 2024). Resulting embedding model is used for BERTopic modelling along with class based variant of TF-IDF for vectorization (Grootendorst, 2022), UMAP for dimensionality reduction (McInnes, Healy, Saul, & Großberger, 2018), and HDBSCAN for clustering (McInnes, Healy, & Astels, 2017). Following (Grootendorst, 2022) suggestion, a creator of BERTopic, light pre-processing is done after embeddings and prior processing topic representations: removal of stopwords, lowercasing all text, generating bigrams, and removing extremely rare words (that appear in fewer than 3 documents). Extracted semantic topics spanning five-year research in hospitality and tourism are used to examine the research response on global instability caused by pandemics.

3. RESULTS

3.1. Corpus statistics

The corpus comprises 1,100 abstracts collected from 594 different journals. Table 1 illustrates distribution of abstracts per year. Data indicates gradual shift in the number of papers, indicating the rise in relevance of topic modeling as analytical tool in hospitality and tourism sector.

Table 1: Distribution of abstracts per year

Year	Papers	Percentage	Cumulative %
2019	158	14.36	14.36
2020	185	16.82	31.18
2021	229	20.82	52.00
2022	286	26.00	78.00
2023	242	22.00	100.00

Source: Authors

Kern, et al. (2016) found that documents shorter than 500 tokens represent short text and, as illustrated in Table 2, corpus predominantly comprises short abstracts. On average abstract length is 206.83 tokens, i.e. words, while median is 195. This indicates right-skewed distribution and presence of atypically long abstracts. Percentile distribution confirms this – 75% of documents contain 237 tokens or less.

Table 2: Abstract characteristics

Abstract length statistics	Value
Mean	206.83
Std	95.43
Min	16
25%	151
50%	195.00
75%	237
Max	1,474

Source: Authors

Total number of tokens in the corpus is 229,522, while 11,625 are unique. Type-token ratio, calculated as the share of unique words in the total number of tokens, is 0.0506, which indicates very low lexical diversity, i.e. highly repetitive texts and vocabulary restriction. Only ~5% of total tokens used are unique.

3.2. BERTopic model

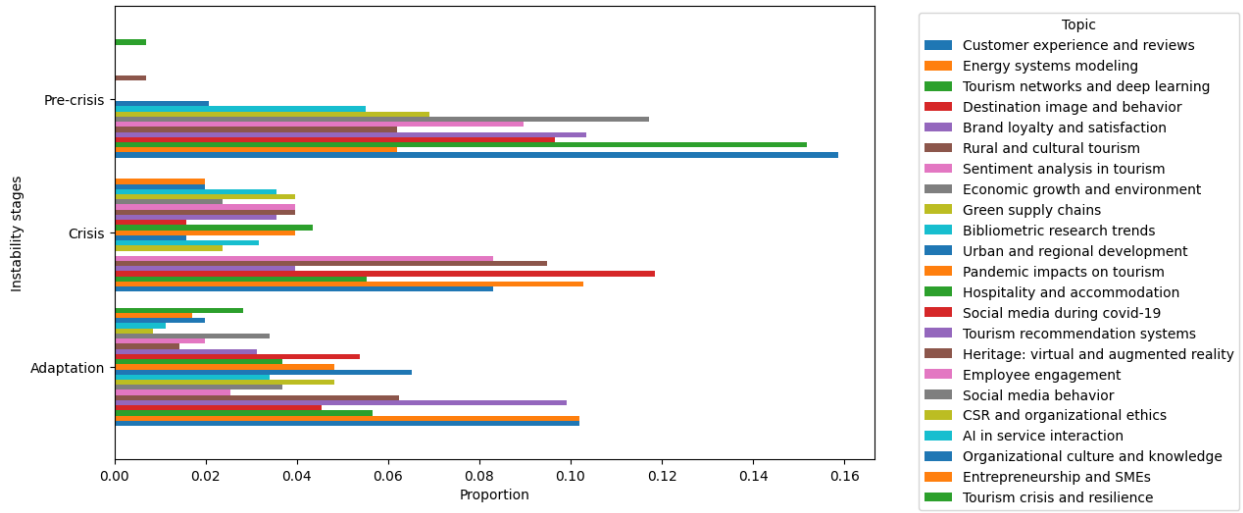
BERTopic modelling resulted in 23 topics presented in Picture 2 with top 10 keywords extracted during modelling based on their distribution over each topic (Grootendorst, 2022). Topic names are defined based on keyword analysis.



Picture 2: Top keywords per topic
Source: Authors

3.3 Topics analysis and interpretation

The instability period can be subdivided into stages. In this study, the year of publication was used to subdivide the publications into three stages and these stages are: pre-crisis, crisis, and adaptation. Pre-crisis refers to 2019, crisis period refers to 2020 and 2021, while adaptation period refers to 2022 and 2023. Picture 2 illustrates topic distribution by these three periods. The values are normalized to indicate the proportion of topic in each instability stage. Normalization allows comparison of the relative importance of topics within each period, independent of the number of papers.



Picture 3: Topic distribution by instability stages
Source: Authors

The distribution of topics indicates differences in research topics within the observed periods. In the period before the crisis caused by Covid-19, the research focus was on development topics. Researchers explored user experience based on the analysis of user online reviews (topic: Customer experience and reviews), ways to optimize tourism systems using deep learning (topic: Tourism networks and deep learning), as well as economic and ecological aspects of sector development (topic: Economic growth and environment).

In the period marked by the peak of crisis, topics characterized by the crisis emerged. These topics were not addressed in the previous period. The researchers are engaged in examining the public's perception of the risks associated with the pandemic and the impact on tourism (topic: Pandemic impacts on tourism), which is closely linked with studying social media communication during Covid-19 (topic: Social media during Covid-19) and sentiment analysis of these posts (topic: Sentiment analysis in tourism). In this stage of instability, the most pronounced topic that researchers explored relates to the image of tourist destinations and the behavior of tourists (topic: Destination image and behavior). Compared to other periods when employee engagement and dynamics were not studied or were studied on a significantly smaller scale, in the crisis phase this topic represents one of the emerging research trends (topic: Employee engagement), as well as corporate social responsibility and ethics in the organization (topic: CSR and organizational ethics).

In adaptation stage, topic addressing implementation of artificial intelligence (AI) in human-service interactions emerges (topic: AI in service interaction), as well as more pronounced research focus on crisis management and tourism resilience (topic: Tourism crisis and resilience). These topics reflect response of the scientific community to the emergence of the pandemic, during which the application and implementation of AI systems took momentum in addressing the challenges of the pandemic and to reduce interpersonal contacts. Also, a significant amount of research was done into examining directions to strengthen the sector's resistance to future instabilities. Such topics point to a pronounced digital transformation of the tourism and hospitality sector, which was fueled by global instability.

During the adaptation period and the crisis period, a topic dedicated to the study of personalized recommendation systems and their application in the tourism and hospitality sector appeared (topic: Tourism recommendation systems), which is also a response to the changed conditions. These two periods are also characterized by the emergence of studying possibilities for recovery through innovation and entrepreneurship (topic: Entrepreneurship and SMEs).

CONCLUSION

The COVID-19 outbreak acted as a global disruption, destabilizing numerous sectors and activities and particularly affecting the hospitality and tourism industry, which are highly vulnerable to such conditions. This situation has attracted significant attention in the scientific community, resulting in a substantial number of studies published between 2019 and 2023. This study presents an analysis of these documents to answer two research questions: which topics were most prominent in the studies, and how the focus of these topics evolved over the observed period. To address the research questions and identify the key topics discussed in the papers, a topic modeling technique was applied, specifically the BERTopic method.

A total of 1,210 papers from the Web of Science and Scopus databases were collected and pre-processed. After preparing the corpus, BERTopic was applied to generate 23 distinct topics. The results of topic modeling within the three observed periods indicate clear changes in research interests or focuses. In the pre-crisis period, researchers focused on user experience and tourism development, while in the crisis period there is a shift towards topics closely related to the pandemic and risk perception during the crisis, as well as ways to strengthen the sector's resilience. In the adaptation phase, the research focus shifts to the digital transformation of the sector, the application of artificial intelligence and innovations in tourism and hospitality. By analyzing research topics such as customer experience, crisis risk perception, and digital innovation, this study illustrates how topic modelling can assist managers in times of instabilities with concrete and actionable insights, such as directions for services adaptation to tourist preferences, improvement of safety and crisis planning, and implementation of technological innovations that respond to dynamic preferences.

Future research could expand the analysis by including the results sections of the analyzed publications, thus further refine the identified topics. Furthermore, applying alternative topic modeling methods and expanding the corpus to include papers from additional scientific databases could provide a more comprehensive basis for comparison and deeper interpretation of the results.

REFERENCES

Abbas, J., Mubeen, R., Iorember, P. T., Raza, S., & Mamirkulova, G. (2021). Exploring the impact of COVID-19 on tourism: transformational potential and implications for a sustainable recovery of the travel and leisure industry. *Current Research in Behavioral Sciences*, *2*, 100033. https://doi.org/10.1016/j.crbeha.2021.100033

Abdelrazek, A., Eid, Y., Gawish, E., Medhat, W., & Hassan, A. (2023). Topic modeling algorithms and applications: A survey. *Information Systems, 112*, 102131. https://doi.org/10.1016/j.is.2022.102131

Alammar, J., & Grootendorst, M. (2024). *Hands-on large language models - Language understanding and generation.* Sebastopol, California, USA: O'Reilly books.

Alghamdi, R., & Alfalqi, K. (2015). A survey of topic modeling in text mining. *International Journal of Advanced Computer Science and Applications*, *6*(1). https://doi.org/10.14569/IJACSA.2015.060121

Angelov, D. (2020). Top2vec: Distributed representations of topics. *arXiv preprint arXiv:2008.09470*. 7. https://doi.org/10.48550/arXiv.2008.09470

Blei, D. M., Ng, A. Y., & Jordan, M. I. (2003). Latent Dirichlet Allocation. *Journal of Machine Learning Research*, *3*, 993-1022.

Dieng, A. B., Ruiz, F. J. R., & Blei, D. M. (2020). Topic modeling in embedding spaces. *Transactions of the Association for Computational Linguistics*, *8*, 439–453. https://doi.org/10.1162/tacl_a_00325

Egger, R., & Yu, J. (2022). A topic modeling comparison between lda, nmf, top2vec, and BERTopic to demystify twitter posts. *Frontiers in sociology, 7*, 886498. https://doi.org/10.3389/fsoc.2022.886498

Grootendorst, M. (2022). BERTopic: Neural topic modeling with a class-based TF-IDF procedure. *ArXiv*. https://doi.org/10.48550/arXiv.2203.05794

Hankar, M., Kasri, M., & Beni-Hssane, A. (2025). A comprehensive overview of topic modeling: Techniques, applications and challenges. *Neurocomputing*, *628*, 129638. https://doi.org/10.1016/j.neucom.2025.129638

Jelodar, H., Wang, Y., Yuan, C., Feng, X., Jiang, X., Li, Y., et al. (2019). Latent Dirichlet allocation (LDA) and topic modeling: models, applications, a survey. *Multimedia Tools and Applications*, *78*(11), 15169–15211. https://doi.org/10.1007/s11042-018-6894-4

Kern, M., Park, G., Eichstaedt, J., Schwartz, H., Sap, M., Smith, L., et al. (2016). Gaining insights from social media language: Methodologies and challenges. *Psychological Methods, 21*(4), 507–525. https://doi.org/10.1037/met0000091

Kherwa, P., & Bansal, P. (2020). Topic modeling: A comprehensive review. *EAI Endorsed Transactions, 7*(24), e2. doi:10.4108/eai.13-7-2018.159623

Kocak, E., Okumus, F., & Altin, M. (2023). Global pandemic uncertainty, pandemic discussion and visitor behaviour: A comparative tourism demand estimation for the US. *Tourism Economics*, *29*(5), 1225–1250. https://doi.org/10.1177/13548166221100692

Leta, S. D., & Chan, I. C. C. (2021). Learn from the past and prepare for the future: A critical assessment of crisis management research in hospitality. *International Journal of Hospitality Management*, *95*, 102915. https://doi.org/10.1016/j.ijhm.2021.102915

Liu, L.-W., Pahrudin, P., Tsai, C.-Y., & Hao, L. (2024). Disaster, risk and crises in tourism and hospitality field: A pathway toward tourism and hospitality management framework for resilience and recovery process. *Natural Hazards Research*, *4*(4), 653–668. https://doi.org/10.1016/j.nhres.2024.06.001

Ma, L., Chen, R., Ge, W., Rogers, P., Lyn-Cook, B., Hong, et al. (2025). AI-powered topic modeling: comparing LDA and BERTopic in analyzing opioid-related cardiovascular risks in women. *Experimental Biology and Medicine, 250*, 10389. https://doi.org/10.3389/ebm.2025.10389

Manning, C. D., Raghavan, P., & Schütze, H. (2008). *Introduction to Information Retrieval.* New York, NY,USA. Cambridge University Press.

McInnes, L., Healy, J., & Astels, S. (2017). hdbscan: Hierarchical density based clustering. *Journal of Open Source Software, 2*(11), 205. doi:10.21105/joss.00205

McInnes, L., Healy, J., Saul, N., & Großberger, L. (2018). UMAP: Uniform Manifold Approximation and Projection. *Journal of Open Source Software, 3*(29), 861. https://doi.org/10.21105/joss.00861

Rejeb, A., Rejeb, K., Simske, S., & Süle, E. (2025). Industry 5.0 research: an approach using co word analysis. *Discover Sustainability, 6*(1), 402. https://doi.org/10.1007/s43621-025-01252-3

Sampaio, C., Farinha, L., Sebastião, J. R., & Fernandes, A. (2023). Tourism industry at times of crisis: a bibliometric approach and research agenda. *Journal of Hospitality and Tourism Insights*, *6*(4), 1464–1484. https://doi.org/10.1108/JHTI-08-2021-0223

Sy, C. Y., Maceda, L. L., Flores, N. M., & Abisado, M. B. (2024). Unsupervised machine learning approaches in NLP: A comparative study of topic modeling with BERTopic and LDA. *International Journal of Intelligent Systems and Applications in Engineering 12*(21s), 3276–3283.

Wijesekara, C., Tittagalla, C., Jayathilaka, A., Ilukpotha, U., Jayathilaka, R., & Jayasinghe, P. (2022). Tourism and economic growth: A global study on Granger causality and wavelet coherence. *PLOS ONE*, *17*(9), e0274386. https://doi.org/10.1371/journal.pone.0274386

Wong, A. K. F., Kim, S., Liu, Y. Y., & Grace Baah, N. (2025). COVID-19 research in hospitality and tourism: critical analysis, reflection, and lessons learned. *Journal of Hospitality & Tourism Research*, *49*(1), 188–204. https://doi.org/10.1177/10963480231156079

Zhong, L., Sun, S., Law, R., & Li, X. (2021). Tourism crisis management: evidence from COVID-19. *Current Issues in Tourism*, *24*(19), 2671–2682. https://doi.org/10.1080/13683500.2021.1901866

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Bojan Đurić
University of Novi Sad – Faculty of Economics in Subotica
Subotica, Serbia

Participation (direct/virtual): **direct**
JEL: O15, J24, M15, O33

THE IMPACT OF AI ON THE COMPETENCIES OF EMPLOYEES IN COMPANIES ENGAGED IN SOFTWARE DEVELOPMENT IN THE IT SECTOR

Abstract: *The rapid proliferation of artificial intelligence technologies, particularly generative AI and large language models, is fundamentally reshaping the landscape of software development. This paper aims to examine the multifaceted impact of AI on employee competencies within software companies, drawing upon recent empirical research, industry reports, and practitioner insights from a decade of IT management experience. The analysis reveals a critical paradox: while AI accelerates code generation and automates routine programming tasks, it simultaneously elevates the importance of human competencies that machines cannot replicate. The findings suggest that the future software engineer will transition from being primarily a code writer to becoming a systems architect, quality assessor, and ethical guardian. Particularly significant is what this paper terms the "junior paradox" — the observation that entry-level positions face the greatest disruption, while experienced professionals who possess deep domain knowledge, architectural thinking, and the ability to evaluate AI outputs become increasingly valuable. The paper concludes with recommendations for competency development frameworks that balance technical AI literacy with the cultivation of uniquely human capabilities such as critical thinking, ethical reasoning, and cross-functional collaboration.*

Keywords: artificial intelligence, large language models, employee competencies, software engineering, human-AI collaboration, digital transformation, skills gap

1. INTRODUCTION

Artificial intelligence has emerged as one of the most transformative technological phenomena of the current decade, occupying a dominant position among disruptive technologies and acting as a connective force across multiple sectors (Păvăloaia & Necula, 2023, p. 8). In the software engineering domain specifically, AI tools are already reshaping the profession, partially or fully substituting traditional coding tasks and replacing them with higher-level responsibilities centred on reviewing and verifying AI-generated outputs (Betz & Penzenstadler, 2025, p. 136:2). The release of large language model-based platforms from late 2022 onwards marked a significant inflection point in public awareness of generative AI, accompanied by an eightfold increase in AI investment flows across sectors ((*/The-Future-of-Jobs-Report-2025*, 2025, p. 10) Whether this trajectory represents a transient technological cycle or a structural transformation of knowledge work remains a central question for both research and practice. This paper fundamentally addresses this phenomenon through the lens of the impact of large language models (LLMs) on the operations of IT software companies — organizations that will, irrespective of organizational readiness, be among the first to experience the full force of this technology, along with the paradoxes that inevitably accompany it. The central paradoxes are, on one hand, the declining demand for junior positions and, on the other, a growing demand for senior developers with deep domain expertise in specific disciplines (Westby & Modestino, 2025, p. 1).In operational terms, the impact of LLMs is already visible through assisted coding and automated testing across all phases of the software development lifecycle (Qiu et al., 2025, p. 121:2). The fundamental question running through all of these phenomena remains one of operational security and data governance — particularly the need for transparent, traceable, and auditable AI usage aligned with ethical and regulatory principles (Singh et al., 2026, p. 89) — and above all the safeguarding of domain knowledge as intellectual property(Vezeteu & Năstac, 2024, pp. 843, 844) As model capabilities continue to advance, the absence of adequate

security safeguards and competency frameworks represents a critical organizational risk. Accordingly, this paper examines these phenomena both through the lens of academic literature and through practitioner insights drawn from a decade of experience as a manager in an IT software company.
AI and other disruptive innovations lead to job losses, but simultaneously create new and appealing forms of employment; those performing routine tasks are most affected, and educational systems and employers must urgently adapt curricula and training programmes to new technologies (Păvăloaia & Necula, 2023, p. 18). 86% of employers expect AI and information processing to transform their business by 2030, and AI and big data have been identified as the fastest-growing skills over the next five years, ahead of cybersecurity and digital literacy(*/The-Future-of-Jobs-Report-2025*, 2025, p. 10,32).

2. METHODOLOGY

This study employs a systematic review of relevant academic literature. The primary search was conducted using Web of Science (WoS) and Scopus, applying the following keyword combinations — in WoS: "artificial intelligence" AND "software engineering" AND "competencies"; "AI" AND "software development" AND "skills"; "large language models" AND "IT sector"; and in Scopus: "artificial intelligence" AND "software engineering" AND ("competencies" OR "skills"); "generative AI" AND "software development"; "large language models" AND "employee competencies" — yielding a combined total of 76 results. Inclusion criteria required that studies directly addressed the impact of AI or LLMs on employee competencies, roles, or skills within the software development or broader IT sector, and were published in English from 2020 onwards. Studies were excluded upon full-text review if they were unrelated to the research focus, regardless of keyword match. Following this screening process, 62 records were removed, and 13 articles were retained for in-depth analysis. Two additional studies directly relevant to the topic of junior developer displacement was identified through Google Scholar and included in the final corpus, bringing the total to 15 analysed works (see Annex A). The findings are further contextualised through relevant legal frameworks, most notably the EU Artificial Intelligence Act adopted in 2024. Practitioner insights drawn from a decade of IT software development management are incorporated as a complementary perspective and are clearly distinguished from findings derived from the literature review.

3. THE IMPACT OF ARTIFICIAL INTELLIGENCE ON BUSINESS OPERATIONS

Explaining the impact of AI on business operations could easily become a list of examples that exceeds the reasonable scope of this paper. It is safe to say that virtually every instance of human intellectual activity ever documented on the internet has served as an ingredient for machine learning — a resource for training models to understand how humans think about particular topics or tasks. Given this, LLM-based tools enable developers to delegate routine coding tasks and focus on critical business logic, thereby augmenting productivity across everyday operations (Qiu et al., 2025, p. 4)Considering the pace at which LLM applications are evolving, two distinct trends emerge. The first is the use of AI tools as aids in day-to-day work, which manifests primarily in increased individual employee productivity. Empirical evidence indicates that productivity gains in software development can be substantial: a controlled experiment with GitHub Copilot demonstrated that developers using the AI pair programmer completed a standardised coding task 55.8% faster than those without access to the tool (Peng et al., 2023, p. 2), while self-reported estimates from practitioners suggest perceived gains of approximately 35% (Peng et al., 2023, p. 7).This is driven by the automation of certain project management processes, faster response times, easier written communication through LLM-powered translation tools, automatic meeting note sorting, email responses, and similar tasks — all the way to assisted coding, which undeniably saves time, though it also represents the most sensitive area of operations as it demands the highest degree of oversight.
On the other hand, when considering companies as whole entities, the adoption of LLMs still appears to be finding its footing in a truly commercial sense. While company-customised agents are a practical reality, broader corporate-level deployment is not advancing as quickly as individual productivity gains. Examples of current use include automatically generated AI chatbots, the development of proof-of-concept solutions, agent-guided system architecture, and the automation of corporate communications, meeting minutes, parking and conference room reservations, and similar tasks. More substantive deployment is visible in the significantly faster analysis of large data volumes, and in agents closely tied to a company's specific domain — for instance in accounting or legal firms. In IT companies specifically, the most impactful applications are assisted programming, agents used to generate proof-of-concept solutions, market data analysis, and the verification and enrichment of domain knowledge.

4. THE IMPACT OF ARTIFICIAL INTELLIGENCE ON HUMAN RESOURCES ACTIVITIES

The impact of AI on HR activities carries particular weight, as organisations are arriving at a point where functions that are fundamentally human, most notably HR itself, can increasingly be assumed by automated systems. This is primarily reflected in large companies through the automated processing of vast amounts of résumés, specifically the initial screening phase based on set criteria. A widely documented case is that of Amazon, which between 2014 and 2017 developed an AI-powered recruiting tool trained on a decade of résumés submitted to the company. Since the technology sector is predominantly male, the majority of that training data came from men, resulting in a system that systematically favoured male candidates and penalised résumés containing references to women's organisations or all-women colleges. The project was ultimately abandoned when it became clear that bias could not be reliably eliminated(Jeffrey Dastin, 2018). Such bias caused significant upheaval in the understanding of both the ethical and practical usability of AI models in recruitment operations. From a practitioner perspective, drawing on the author's decade of experience in IT software development management, AI proves genuinely valuable in employee evaluation processes, feedback collection, training and onboarding assistance, and particularly in the processing of statistical data obtained through internal HR surveys.

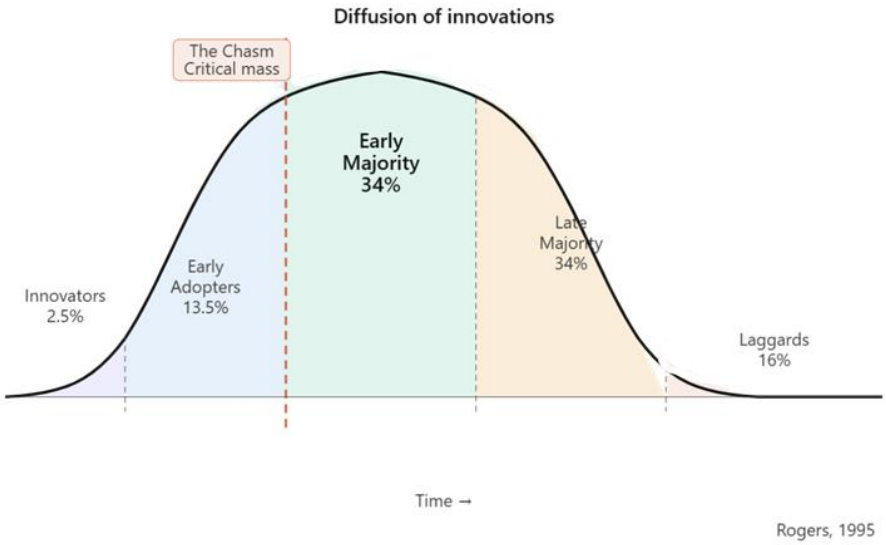
Each of these functions can and already does find practical value through AI tools. However, precisely because mathematical models are here being applied to human beings, it is essential to note the significant constraints the EU has introduced as foundational conditions for the ethical use of AI in HR(Office of the European Union L- & Luxembourg, n.d.). The first condition is transparency — meaning that AI tools may be used, but the configuration of their parameters must be explained in full detail, and those parameters cannot themselves be the product of so-called AI reasoning. Any decision regarding hiring, evaluation, or an employee's overall contribution cannot be validated by an AI model; it must remain the responsibility of a human being. Furthermore, bias of the kind exhibited by Amazon's model must not be embedded in any system, nor must models be permitted to make such decisions automatically. Related to this is the explicit prohibition of social scoring. In essence, the EU AI Act permits AI as an assistive tool in HR processes, while explicitly prohibiting its use as an autonomous decision-maker or parameter-setter.

HR, like all other business functions, must adapt to the new reality. This particularly sensitive and critical driver of every company's performance must be guided by a genuine understanding of the changed landscape on the part of HR professionals themselves. From the author's practitioner perspective, technical literacy among HR professionals — specifically the capacity to understand how parameters are configured in the tools used across all HR processes, as well as the ethical and legal implications and associated risks — is the key competency becoming indispensable for HR staff within IT software companies and beyond..

5. THE GENERAL TRANSFORMATION OF EMPLOYEE COMPETENCIES

As noted in the preceding chapter in relation to the HR department, the general competencies of employees must genuinely keep pace with this trend — not as a matter of employer preference, but as a response to broader market dynamics driven by the absorption of new productivity levels into the economic environment. In this sense, competencies are simultaneously becoming more complex on one hand, while on the other there is a real risk of an operational erosion of domain knowledge if LLM usage proceeds in a manner that bypasses important learning steps within the relevant domain. It is worth noting that this is not an entirely new phenomenon in itself — it is new in the sense of AI entering the business environment, but can we really imagine any position today, including so-called blue-collar roles, held by someone with no basic computer literacy or foundational digital skills? It can therefore be concluded that general competency shifts are a natural progression of events, particularly in the sphere of digitalization, which is genuinely affecting virtually every aspect of human activity.

This means we are currently in a phase of general learning and innovation adoption — a process that can be represented through Rogers' Diffusion of Innovations curve (Rogers, 1995). The model identifies five adopter categories: Innovators (2.5%), Early Adopters (13.5%), Early Majority (34%), Late Majority (34%), and Laggards (16%). Interestingly, just as with individual organizations, this phenomenon can be observed at the level of the general population, where the majority of the working-age population already uses digital technologies — broadening digital access is identified as the single most impactful macro trend affecting businesses globally, with 39% of workers' key skills expected to change by 2030 as a direct consequence(*/The-Future-of-Jobs-Report-2025*, 2025, p. 18). The recommended organizational approach is sequential: first identify the Innovators within the company, then secure senior management support, resources, and authority for them; allow Innovators to attract Early Adopters who see the value; and finally push through the critical "chasm" — the inflection point at which, with a 16% critical mass, the technology moves from niche adoption to mainstream use. This creates a situation in which those who understand the need for transforming employee competencies can, in the medium term, gain a meaningful competitive dvantage.



Picture 1: Rogers Curve
Source: Rogers, 1995

Empirical research confirms the importance of this transition: a statistically significant positive correlation exists between the level of employees' AI competencies and the effectiveness of AI tool implementation within organizations. Employees with higher levels of digital and AI competencies achieve measurably better business outcomes when using AI systems (Popa et al., 2024, p. 42). The top three leadership competencies for this era are: (1) technological literacy — understanding AI systems and their capabilities; (2) emotional intelligence — leading teams through technological transition; and (3) data-driven decision-making — the ability to interpret AI-generated insights for strategic decisions. In total, 15 competencies have been identified as required for effective leadership in organizations adopting AI (Myszak & Filina-Dawidowicz, 2025, p. 12).

From an organizational perspective, it is important to understand which competencies are changing in terms of universality — that is, which competencies all employees should possess in the new reality — and what constitutes the domain-specific element that is critical for the particular field in which the company operates. IT skills are currently rated lowest across all competency categories among workers, specialists, and managers alike. The average rating for general IT skills among workers is 2.7/5, and for professional IT skills 2.5/5, confirming a systemic deficit in IT competencies across organizations (Bîrcă et al., 2025, p. 50) . Despite academic recommendations to focus on soft skills, 57.3% of managers prefer developing technical, job-specific skills; among soft skills, managers most wish to develop teamwork, customer-handling, and problem-solving (Bîrcă et al., 2025, pp. 54–55).

General competencies revolve around foundational concepts of AI and LLMs — such as prompting, the use of agents, and an understanding of the key available models — encompassing both the positive opportunities and the risks that business use entails. This includes the legal and ethical implications of usage: what happens, for instance, if an unauthorised model makes an error — who bears responsibility? It is therefore of critical importance that the AI phenomenon is approached with appropriate seriousness in every company. It is far too easy to arrive at certain solutions with a few keystrokes, and the time savings — combined with a general lack of awareness around particular issues — can over time become a stronger driver of behaviour than outright prohibitions. This leads to the conclusion that investing in competency development and AI literacy is a far more effective path than blanket bans, which are likely to prove unsustainable in the face of prevailing market dynamics. Competency management therefore becomes a core responsibility of leadership, and developing the AI competencies of every employee becomes unavoidable.

The counterargument to these theses is the managerial fear that AI is simply a passing trend that will, like many before it, fade with time — and this is genuinely the greatest risk, as the full operational impact of AI on business has yet to materialise in a fully visible way. However, from the author's perspective as an IT practitioner, given the architecture of LLM models and the continuous refinement of machine learning neural networks through vast quantities of training data, AI models are assessed as a permanent rather than transient phenomenon, one that will continue to develop through its own inherent momentum regardless of any specific commercial application. This leads us to the recognition that developing these new AI-related competencies is becoming the rule rather than the exception, and as such represents one of the key factors in organizational survival.

6. SOFTWARE DEVELOPMENT-SPECIFIC COMPETENCY REQUIREMENTS

The practitioner contribution of this paper is rooted in this specific chapter, drawing upon the author's decade of experience as a manager within an IT software development company. It can be argued that a competency transition is already underway, primarily manifested through what is termed the "junior paradox." Prior to the integration of AI models, the standard onboarding for junior positions focused on understanding architecture and coding rules within specific technologies. The act of manual coding, while slower, provided the necessary cognitive space to gradually adopt best practices, while allowing inexperienced engineers sufficient time to acquire broader skills, such as system architecture, project management within large teams, stakeholder communication, and expectation management.

The paradox emerges as clients, increasingly aware of LLM capabilities, demand higher productivity alongside reduced budgets for new engineering hires. Simultaneously, engineering management is pressured by business objectives to maximize this efficiency. Consequently, as processes become automated, the demand for junior developer roles sharply declines. The industry now prioritizes experienced developers who understand architecture, while the foundational coding tasks — previously the cornerstone of proof-of-concept projects where juniors were employed — are no longer required in the same volume.

This shift leads to the conclusion that competencies in software companies, traditionally bifurcated into technical and soft skills, now incorporate a critical "AI dimension." These include: a technical understanding of AI models; the transition from classical programming toward prompting as a new mode of human-machine communication; an awareness of the implications of coding errors resulting from over-reliance on models; and technical security implications, specifically the fact that prompting involves sharing information used for model refinement. From the perspective of soft skills, this technical foundation must be complemented by an understanding of limitations regarding the ethical code, transparency, data governance, and the legal regulations governing AI usage.

The role of the software engineer is fundamentally changing: with the adoption of LLM tools, software engineers are transitioning from writing code to managing and verifying AI-generated code, while their ethical and social responsibility is growing, as they become accountable for the quality, security, and societal impact of the systems they deliver with AI assistance (Betz & Penzenstadler, 2025, p. 2). Software and application developers remain among the top 10 fastest-growing roles in the global labour market through 2030 (*/The-Future-of-Jobs-Report-2025*, 2025, p. 25). While 92 million jobs may be eliminated by 2030 due to automation, simultaneously 170 million new positions are expected to be created — a net gain of 78 million roles (*/The-Future-of-Jobs-Report-2025*, 2025, p. 18). Furthermore, 85% of employers plan to prioritize employee upskilling, and 50% plan to transition employees from declining into growing roles rather than making redundancies (*/The-Future-of-Jobs-Report-2025*, 2025, p. 52).

In practice, software companies have already devised and initiated comprehensive work on AI-related competencies. The key reason is the fact that, if the impact of AI tools on daily work remains at its current level, the primary resource of these companies will no longer be the number of trained engineers in so-called "traditional" technologies, but rather the actual number of people who will be AI-enabled and understand how to create new digital products using AI.

6.1. Security Challenges in AI-Augmented Development

Among the competencies emerging as critical in relation to AI, security is becoming paramount. Understanding how computer neural networks function, and the algorithms on which AI models are built, leads to important security considerations. From the author's practitioner perspective, communication conducted through publicly available AI platforms may constitute training material for those models. As a result, the sharing of information in a business environment — particularly information relating to technical solutions in a specific business domain — becomes a form of value that can easily be transferred to the model for use without any compensation, if security standards and protocols are not in place. Returning to the junior gap phenomenon — the trend whereby reliance on AI models may in the medium term erode engineers' knowledge depth — we also have justified concerns regarding the reliability and security of the resulting code, and the question of accountability.

The use of publicly available AI platforms (ChatGPT, Copilot, etc.) without adequate security protocols represents one of the greatest risks to the protection of intellectual property and trade secrets. Organizations must develop clear usage policies and equip employees to understand what happens to the data they input into a model (Vezeteu & Năstac, 2024, p. 843). For these reasons, engineering teams working on the creation of digital products must establish clear security standards that themselves constitute a competency — ensuring there is no leakage or disclosure of sensitive information, while simultaneously enabling teams to increase their productivity.

Reflecting further on this phenomenon, it is worth noting that the world's largest technology companies are committing unprecedented resources to data centre investment — Microsoft, Amazon, Alphabet, and Meta alone announced combined capital expenditures of over $300 billion for AI infrastructure in 2025 (Subin, 2025) — and this is certainly no coincidence", since data centres will serve as the repositories for training future models. The data obtained through the use of models themselves — acquired through the appeal of free or low-cost access options — represents the knowledge resource essential for future commercial models. It is easy to conclude that the world's largest technology giants are focused on building the most widely adopted model precisely so that domain knowledge ends up in those data centres.

We conclude that the greatest challenge for knowledge-intensive companies will be precisely how to preserve their intellectual potential for commercial exploitation, and by extension their survival. Consequently, the focus in employee competencies is shifting increasingly towards security awareness, as well as towards the monitoring and enforcement of established rules as a paradigm for market survival.

7. CONCLUSIONS AND RECOMMENDATIONS

As a conclusion to this paper, we can say that we currently find ourselves in a remarkably interesting period of employee competency transition, particularly within IT software development companies. From the perspective of a manager in one such company, we are witnessing a decline in demand for the kinds of profiles that were sought until recently, alongside a growing demand for senior professionals and domain knowledge that, by its very nature, belongs to more experienced engineers and employees. IT software companies are, again by their nature, the first to feel the full impact of the AI phenomenon — but they are equally likely to be the first to chart the path forward, meaning that the competencies of employees in the new reality will most probably take shape first within these very companies.
The recommendation is clear: every company should develop a strategy for the AI transition, which necessarily includes a competency development strategy for its employees. This comes alongside a justified concern for young engineers who are now seeking their place in the market — because entry-level positions continue to exist, but structural demand has contracted significantly: empirical evidence from the U.S. labour market documents a 16.3 percent reduction in the relative proportion of junior- versus senior-level software developer job vacancies in the twelve months following the public release of ChatGPT in November 2022, a decline that has not subsequently reversed (Westby & Modestino, 2025, p. 3), with junior postings falling by 49 percent between September 2022 and January 2025 while senior-level postings proved comparatively resilient (Westby & Modestino, 2025, p. 27). Those who invest in developing the competencies discussed in this paper — both individually and at the organizational level — can expect to compete successfully in the market, and the time to begin that work is now.

REFERENCES

Betz, S., & Penzenstadler, B. (2025). With Great Power Comes Great Responsibility: The Role of Software Engineers. *ACM Transactions on Software Engineering and Methodology*, *34*(5). https://doi.org/10.1145/3715112

Bîrcă, A., Sandu, C. B., Gogu, E., & Matveiciuc, I. (2025). The Assessment of Employees' Competences on the Labour Market in the Context of the Development of Artificial Intelligence Systems. *Montenegrin Journal of Economics*, *21*(3), 45–56. https://doi.org/10.14254/1800-5845/2025.21-3.4

Jeffrey Dastin. (2018). Insight - Amazon scraps secret AI recruiting tool that showed bias against women _ Reuters. *Reuters*.

Myszak, J. M., & Filina-Dawidowicz, L. (2025). Leaders' Competencies and Skills in the Era of Artificial Intelligence: A Scoping Review. In *Applied Sciences (Switzerland)* (Vol. 15, Number 18). Multidisciplinary Digital Publishing Institute (MDPI). https://doi.org/10.3390/app151810271

Office of the European Union L-, P., & Luxembourg, L. (n.d.). *Regulation (EU) 2024/1689 of the European Parliament and of the Council of 13 June 2024 laying down harmonised rules on artificial intelligence and amending Regulations (EC) No 300/2008, (EU) No 167/2013, (EU) No 168/2013, (EU) 2018/858, (EU) 2018/1139 and (EU) 2019/2144 and Directives 2014/90/EU, (EU) 2016/797 and (EU) 2020/1828 (Artificial Intelligence Act)Text with EEA relevance.* Retrieved http://data.europa.eu/eli/reg/2024/1689/oj

Păvăloaia, V. D., & Necula, S. C. (2023). Artificial Intelligence as a Disruptive Technology—A Systematic Literature Review. In *Electronics (Switzerland)* (Vol. 12, Number 5). MDPI. https://doi.org/10.3390/electronics12051102

Peng, S., Kalliamvakou, E., Cihon, P., & Demirer, M. (2023). *The Impact of AI on Developer Productivity: Evidence from GitHub Copilot*. http://arxiv.org/abs/2302.06590

Popa, I., Cioc, M. M., Breazu, A., & Popa, C. F. (2024). Identifying Sufficient and Necessary Competencies in the Effective Use of Artificial Intelligence Technologies. *Amfiteatru Economic*, *26*(65), 33–52. https://doi.org/10.24818/EA/2024/65/33

Qiu, K., Puccinelli, N., Ciniselli, M., & Di Grazia, L. (2025). From Today's Code to Tomorrow's Symphony: The AI Transformation of Developer's Routine by 2030. *ACM Transactions on Software Engineering and Methodology*, *34*(5), 1–17. https://doi.org/10.1145/3709353

Rogers, E. M. . (1995). *Diffusion of innovations*. Free Press.

Singh, P., Ul Haq, A., & Presser, M. (2026). *Towards a Responsible AI Adoption/Adaptation (RAA) Ecosystem: Vision and Model to Keep Socio-Technological Balance* (pp. 71–92). https://doi.org/10.1007/978-3-032-09555-8_5

Subin, S. (2025, February). KEY POINTS. *CNBS*. https://www.cnbc.com/2025/02/08/tech-megacaps-to-spend-more-than-300-billion-in-2025-to-win-in-ai.html

/the-future-of-jobs-report-2025. (2025). www.weforum.org

Vezeteu, P. V., & Năstac, D. I. (2024). Artificial Intelligence Integration in Business: Study of Employee Competences in Relation to the Organisational Needs. *Amfiteatru Economic*, *26*(67), 689–704. https://doi.org/10.24818/EA/2024/67/832

Westby, S., & Modestino, A. S. (2025). *The Impact of Generative AI on Job Opportunities for Junior Software Developers*.

Annex A: Overview of Analysed Works

The following 15 works were retained for in-depth analysis following the systematic search and screening process described in Section 2. Studies are listed in the order in which they appear in the manuscript.

#	Author(s) & Year	Title	Study Type	Rationale for Inclusion	Used in
1	Betz & Penzenstadler (2025)	With Great Power Comes Great Responsibility: The Role of Software Engineers	Conceptual / literature-based	Directly addresses how LLM adoption shifts the SE role from code writing to oversight and ethical guardianship	Sections 1, 6
2	Bîrcă et al. (2025)	The Assessment of Employees' Competences on the Labour Market in the Context of the Development of Artificial Intelligence Systems	Empirical survey	Provides quantitative data on IT skill deficits and managerial preferences for technical vs. soft skill development	Section 5
3	Myszak & Filina-Dawidowicz (2025)	Leaders' Competencies and Skills in the Era of Artificial Intelligence: A Scoping Review	Scoping review	Identifies 15 leadership competencies required in AI-adopting organisations; supports analysis of managerial dimension	Section 5
4	Popa et al. (2024)	Identifying Sufficient and Necessary Competencies in the Effective Use of Artificial Intelligence Technologies	Empirical / quantitative	Establishes statistically significant link between AI competency levels and effectiveness of AI implementation	Section 5
5	Păvăloaia & Necula (2023)	Artificial Intelligence as a Disruptive Technology — A Systematic Literature Review	Systematic literature review	Frames AI as a cross-sector disruptive force; provides baseline on job displacement and the need for curriculum adaptation	Sections 1, 3
6	Qiu et al. (2025)	From Today's Code to Tomorrow's Symphony: The AI Transformation of Developer's Routine by 2030	Comparative analysis / conceptual	Analyses AI impact across all SDLC phases and projects the transition of developers to orchestrators of AI-driven ecosystems	Sections 1, 3
7	Peng et al. (2023)	The Impact of AI on Developer Productivity: Evidence from GitHub Copilot	Controlled experiment	Provides empirical evidence of 55.8% productivity gain with AI coding assistance; key quantitative anchor for productivity claims	Section 3
8	Vezeteu & Năstac (2024)	Artificial Intelligence Integration in Business: Study of Employee Competences in Relation to the Organisational Needs	Empirical study	Addresses IP protection risks arising from use of public AI platforms and the need for security-oriented competencies	Sections 1, 6.1
9	Singh et al. (2026)	Towards a Responsible AI Adoption/Adaptation (RAA) Ecosystem: Vision and Model to Keep Socio-Technological Balance	Conceptual / framework	Provides the RAI framework underpinning arguments on transparent, traceable, and auditable AI usage in organisations	Section 1
10	Westby & Modestino (2025)	The Impact of Generative AI on Job Opportunities for Junior Software Developers	Labour market analysis (Google Scholar)	Delivers empirical evidence of 16.3% decline in junior postings and 49% fall in entry-level vacancies post-ChatGPT release	Sections 1, 7
11	The Future of Jobs Report 2025 — WEF (2025)	The Future of Jobs Report 2025	Industry report	Provides macro-level data on AI-driven skill change projections, job creation/displacement forecasts, and upskilling priorities	Sections 1, 5, 6
12	Rogers (1995)	Diffusion of Innovations	Theoretical model	Provides the Diffusion of Innovations framework applied to explain organisational AI adoption dynamics and the role of innovators	Section 5
13	Office of the European Union (n.d.)	Regulation (EU) 2024/1689 — Artificial Intelligence Act	Legal/regulatory document	Establishes the EU legal framework governing ethical AI use in HR and organisational processes; informs constraints on AI decision-making	Section 4
14	Jeffrey Dastin (2018)	Amazon Scraps Secret AI Recruiting Tool That Showed Bias Against Women	Investigative report (Reuters)	Provides a documented case study of algorithmic bias in HR, illustrating the ethical risks of autonomous AI in recruitment	Section 4
15	Subin (2025)	Tech Megacaps to Spend More Than $300 Billion in 2025 to Win in AI	Industry/media report	Contextualises the scale of Big Tech investment in AI infrastructure and its implications for data sovereignty and IP risks	Section 6.1

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APPLICATION OF THE TOPSIS MULTI-CRITERIA DECISION-MAKING METHOD FOR THE ANALYSIS OF ECONOMIC SECTORS IN SERBIA

Abstract: The TOPSIS method represents an important tool in multi-criteria decision-making, enabling a systematic ranking and evaluation of alternatives based on their distance from the ideal and anti-ideal solutions. Its fundamental principle is the quantitative measurement of each alternative's deviation from the optimal values of the selected criteria, thereby providing a more precise and objective understanding of the observed phenomenon.
In order to ensure a higher level of objectivity in the evaluation process, the weights of the criteria were determined using the entropy method. This approach reduces subjectivity in weight assignment by relying on the informational content and variability of the data. The entropy-based weighting method was integrated into the TOPSIS procedure, thereby enhancing the reliability and robustness of the final ranking results.
The aim of this study was to rank 15 economic sectors in the Republic of Serbia using available economic and business data. The ranking procedure was carried out based on the number of business entities, total turnover, registered employment, average net wages, and gross value added. This approach enabled the identification of sectors with the greatest current development potential, as well as those requiring additional institutional support and investment.
The sectors of trade, manufacturing, and information and communication were identified as the three most promising and stable sectors according to the selected indicators. The conducted analysis provides insight into sectors with relatively lower competitiveness among the selected economic activities in Serbia and may serve as a useful basis for strategic planning and the direction of future investments.

Keywords: TOPSIS method, Serbia, development potential, entropy method

1. INTRODUCTION

Multi-criteria decision-making methods have developed out of the need to systematize scientific approaches in making high-quality decisions. In the modern era, where the flow and volume of available information are continuously increasing, the decision-making process becomes more complex. Given that many economic phenomena represent complex systems, decision-making, ranking alternatives, and the selection of appropriate options become more challenging methodological issues. It is precisely multi-criteria decision-making methods that are designed to provide a comprehensive analytical view of such problems. These methods compare alternatives and evaluate them based on predefined criteria. By integrating different types of information and quantifying them, a more objective picture is achieved, thereby facilitating the decision-making process.

In this paper, a multi-criteria decision-making method is applied in the economic and business analysis of economic sectors. Economic sectors represent an important indicator of the level of development of a country or region. The structure of the economy can provide answers to questions such as which areas of economic activity are dominant, as well as insights into the quality and intensity of business activities. It also encompasses the issue of employment levels as an indicator of interest in a particular sector on the one hand, and as a reflection of job availability on the other. The analysis of economic sectors aims to identify those that contribute the most to economic growth, as well as to detect those that lag behind in development.
The study of economic sectors can enhance the decision-making process related to budget allocation across activities, development planning, and the flow of investment funds. Based on such analysis, it is possible to identify the strengths and weaknesses of individual sectors and their overall contribution to economic activity.
For these reasons, the application of multi-criteria decision-making methods represents an appropriate approach in the analysis and ranking of economic sectors. By using predefined criteria, it is possible to more clearly assess their relative positions and identify differences in economic performance among sectors. In this way, a more comprehensive understanding of the structure and competitiveness of the economy is obtained, as well as the significance of individual sectors for its further development. The results of such analyses can be useful in identifying sectors that make the greatest contribution to economic trends, as well as those where there is room for further improvement and development.

2. THEORETICAL BACKGROUND

The field of multi-criteria decision-making (MCDM) has developed as a methodological framework to support rational decision-making in situations involving multiple, often conflicting criteria. In their seminal work Multiple Attribute Decision Making: Methods and Applications (Hwang & Yoon, 1981), the authors systematize the fundamental theoretical concepts of MCDM and outline its key areas of application. Among the methods presented, the TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution) method stands out as a widely used approach, based on measuring the distance of each alternative from the ideal and negative-ideal solutions, thereby enabling a clear and structured ranking process. Its fundamental principle is the quantitative measurement of each alternative's deviation from the optimal values of the selected criteria, thereby providing a more precise and objective understanding of the observed phenomenon.

Recent studies further confirm the applicability and robustness of the TOPSIS method in empirical research, particularly within emerging economies and the Balkan region. For instance, Skrzyński and Wasiuta (2025) apply a composite TOPSIS index to evaluate the performance of municipalities in Serbia, highlighting the critical role of economic vitality and infrastructure in local development. Similarly, Petrović et al. (2023a) utilized the TOPSIS method to evaluate the annual operational efficiency of road transport in Serbia, demonstrating its utility in tracking performance trends over time. Further applications in the Serbian context include the evaluation of railway system performance (Petrović et al., 2023b), as well as various sectoral and infrastructure analyses based on the TOPSIS method, confirming its applicability in complex decision-making environments.

A critical step in the implementation of the TOPSIS method is the determination of criteria weights, which significantly influences the final ranking results. As highlighted by Žižović et al. (2021), the entropy weight method (EWM) offers an objective approach to weight determination. By relying on the informational content and variability of the data, this method reduces subjectivity and enhances the reliability and consistency of the evaluation process. The integration of entropy weights into the TOPSIS procedure is increasingly recognized as a "hybrid" gold standard for objective evaluation. Ozkaya et al. (2021) and Valaskova et al. (2025) demonstrate that this combination is highly effective for cross-country and cross-sectoral comparisons, such as digitalization levels or innovation policy indicators, where expert subjectivity might otherwise bias the results.

In the empirical part of this research, data from the Statistical Yearbook (Statistical Office of the Republic of Serbia, 2025) were utilized. This source provides comprehensive and up-to-date information on economic, business, and social indicators across different regions and sectors. Due to their accuracy and official nature, these data are considered highly reliable for rigorous scientific analysis, particularly when processed using objective weighting schemes such as the entropy method. To ensure a higher level of objectivity in the evaluation process, the weights of the criteria were determined using the entropy method. This approach reduces subjectivity in weight assignment by relying on the informational content and variability of the data, a rationale supported by recent regional studies that have successfully applied this hybrid approach to Serbian infrastructure and tourism potential (Nedeljković et al., 2025). The entropy-based weighting method was integrated into the TOPSIS procedure, enhancing the reliability and robustness of the final ranking results.

3. METODOLOGY

3.1. TOPSIS method

The TOPSIS method (Technique for Order Preference by Similarity to Ideal Solution) was originally proposed by Hwang and Yoon (1981). It is based on identifying the alternative that is closest, in terms of Euclidean distance, to the ideal solution and farthest from the negative ideal solution.
The ideal solution consists of the best performance values among all alternatives for each observed criterion, while the negative ideal solution represents the worst performance values. Whether a value is considered the best or the worst depends on the nature of the criterion, i.e., whether it is to be maximized or minimized.
Let the set of alternatives be defined as $A=\{A_k, k=1,...,n\}$, the set of criteria as $C=\{C_j, j=1,...,m\}$, the set of performance values of alternatives with respect to each criterion as $X=\{x_{kj}, k=1,...,n; j=1,...,m\}$, and the set of weight coefficients as $w=\{w_j, j=1,...,m\}$. The TOPSIS method employs a decision matrix in which n alternatives are evaluated based on m criteria. The element x_{ij} represents the performance of the i-th alternative with respect to the j-th criterion.
The following steps outline the procedure that precedes the ranking of the alternatives:

1. Normalization of the decision matrix to obtain the normalized matrix $R=[r_{ij}]_{mxn}$

Since the elements x_{ij} in the decision matrix are expressed in different units, the first step is to normalize the matrix $[x_{ij}]_{mxn}$ in order to obtain the normalized matrix $R=[r_{ij}]_{mxn}$, using the following relation:

$$r_{ij} = x_{ij} / \sqrt{\sum_{i=1}^{m} x_{ij}^2}$$

$i=1,2, \dots, m; j=1,2, \dots, n$

The normalized matrix in this case contains only dimensionless values.

2. Multiplication of the normalized matrix by weight coefficients

The weighted normalized values v_{ij} are obtained using the following relation:

$v_{ij} = w_j \cdot r_{ij}$; $i = 1, ..., m, j = 1, ..., n.$

In this expression, w_j denotes the weight of the j-th criterion, which must be normalized so that the following condition is satisfied:

$$\sum_{j=1}^{n} w_j = 1.$$

The weight of a criterion is a positive value that is independent of the measurement unit used for that criterion. A higher weight indicates greater importance assigned to that criterion by the decision-maker.

3. Determination of ideal solutions

The ideal solution and the anti-ideal solution are calculated using the following relations:

$A^+ = \{(\max v_{ij} \mid j \in J^{max}), (\min v_{ij} \mid j \in J^{min})\} = \{v_1^+, v_2^+, ..., v_n^+\}$

$A^- = \{(\min v_{ij} \mid j \in J^{max}), (\max v_{ij} \mid j \in J^{min})\} = \{v_1^-, v_2^-, ..., v_n^-\}$

$i=1,2, \dots, m.$

J^{max} is associated with revenue-related criteria that are maximized, while J^{min} corresponds to cost-related criteria that are minimized.

The best alternatives are those with the highest v_{ij} values for maximization criteria and the lowest v_{ij} values for minimization criteria.

4. Determining the distance of alternatives from ideal solutions

The next step involves calculating the distances of all alternatives from both the ideal and anti-ideal solutions. The distances S_i^+ from the ideal solution and S_i^- from the anti-ideal solution are computed using the following formulas:

$$S_i^+ = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_j^+)^2} \ ;$$

$$S_i^- = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_j^-)^2}$$

$i=1,2, \dots, m.$

5. Determining the relative closeness of alternatives to the ideal solution

For each alternative, the relative closeness to the ideal solution is calculated:

$$RC_1 = \frac{S_i^-}{S_i^+ + S_i^-}, 0 \le RC_1 \le 1, i = 1,2, \dots, m.$$

An alternative is considered closer to the ideal solution RC_1 if its value is closer to 1, or farther if it is S_i^+ closer to 0.

6. Ranking alternatives in descending order (Srđević B., Srđević Z., & Zoranović, 2002).

The five outlined steps represent the methodological structure of the TOPSIS method. One of the key issues in its application is the determination of weight coefficients w_j for each criterion. In this study, a method based on entropy was applied. In general, the determination of weight coefficients is a complex methodological issue that often involves experts from the relevant field in order to define the relationship between the importance of criteria and rational decision-making.

3.2. Entropy-Based Method for Determining Criteria Weights

The determination of criteria weights can significantly influence the ranking process of alternatives. In general, methods for determining weights can be classified into two groups: subjective and objective. Subjective methods are based on the judgments of the author or a team of experts in the observed field, while objective methods rely on predefined mathematical procedures for calculating weight coefficients. Among the latter, the entropy method is one of the most commonly used approaches.

The entropy method is based on the probabilistic nature of entropy and its role as a measure of uncertainty within a finite probability system (Žižović et al., 2021). By utilizing the variability and informational content of the data, this method enables the objective determination of criteria weights.

The following steps illustrate the procedure for determining the weight coefficients using the entropy method.

1. Normalization of the decision matrix

The initial decision matrix $[x_{ij}]_{mxn}$ is transformed into a normalized matrix $P=[p_{ij}]_{mxn}$, where the sum of all elements in each column equals 1:

$$p_{ij} = \frac{x_{ij}}{\sum_{i=1}^{m} x_{ij}} \quad , x_{ij} > 0,$$

$i=1,2, \dots , m; j=1,2, \dots , n.$

2. Calculation of entropy for each criterion

$$e_j = -\frac{1}{log_b m} \sum_{i=1}^{m} p_{ij}\, log_b p_{ij}, \qquad b > 0,\ j = 1, \dots, n.$$

The logarithmic base b is often taken as e, i.e., $log_b m = lnm.$

3. Determination of deviation

$$d_j = 1 - e_j, \qquad j = 1, \dots, n.$$

4. Calculation of criteria weights

$$w_j = \frac{d_j}{\sum_{j=1}^{n} d_j}, \qquad d_j > 0, \quad j = 1, \dots, n.$$

4. RESULTS AND DISCUSSION

The TOPSIS method was applied in order to analyze and rank economic sectors in the Republic of Serbia, in accordance with the official classification of activities used by the Statistical Office of the Republic of Serbia (SORS). The main objective of the analysis was to assess the economic and business position of each sector based on available statistical indicators.

The study included 15 economic sectors, defined according to the official classification of activities, and the ranking was performed based on the following criteria: number of business entities, number of registered employees, total turnover, gross value added (GVA) by sector, and average net wages.

Each alternative represents one economic sector and is denoted by A_i, where i=1,2,…,15.

Table 1: Initial Data on Economic Sectors

Sector (A_i)	Number of Business Entities	Registered Employment	Turnover (RSD)	GVA by Sector (RSD)	Average Net Wages (RSD)
Mining (A_1)	375	30783	248292	285602.3	129 047
Manufacturing (A_2)	30156	497939	5222103	1236744.6	86372
Electricity Supply (A_3)	1047	24554	960473	157332.2	120155
Water Supply (A_4)	910	36001	168601	76726.7	84776
Construction (A_5)	16282	128453	1686846	492727.1	84843
Trade (A_6)	65183	359557	6826757	978907.1	82289
Transport and Storage (A_7)	14934	130316	1051391	373241.1	84059
Accommodation	19339	95937	296477	157751.2	59915

and Food Services (A_8)					
Information and Communication (A_9)	9961	111896	999580	826784.7	228493
Real Estate Activities (A_{10})	3612	9126	81890	679240.2	91038
Professional, Scientific and Technical Activities (A_{11})	24396	142825	662755	540194.7	125372
Administrative Services (A_{12})	6112	105401	333623	229490.4	89929
Education (A_{13})	2970	151376	39468	351174.2	90443
Health (A_{14})	3463	177653	86360	376351.4	97565
Arts and Recreation (A_{15})	2317	44492	136405	147000.3	80876

Source: Statistical Office of the Republic of Serbia, 2025.

The next step involves scaling the initial data and assigning integer values from 1 to 5. The scaling procedure consisted of determining the maximum and minimum values for each of the five criteria and defining the interval step as:

$$h = \frac{x_{max} - x_{min}}{5}$$

The following table presents the intervals based on which values from 1 to 5 are assigned.

Table 2: Intervals for Values on a 1–5 Scalenitial Data on Economic Sectors

Criteria	Value 1	Value 2	Value 3	Value 4	Value 5
C1 – Number of Business Entities	375 – 13336	13337 – 26298	26299 – 39260	39261 – 52222	52223 – 65183
C2 – Number of Employees	9126 – 106888	106889 – 204651	204652 – 302414	302415 – 400177	400178 – 497939
C3 – Turnover	39468 – 1396926	1396927 – 2754385	2754386 – 4111844	4111845 – 5469303	5469304 – 6826757
C4 – Gross Value Added (GVA)	76726 – 308730	308731 – 540734	540735 – 772738	772739 – 1004742	1004743 – 1236744
C5 – Average Net Wages	59915 – 93630	93631 – 127346	127347 – 161062	161063 – 194778	194779 – 228493

Source: Calculated by the author

The next table presents the data scaled on a 1 to 5 scale.

Table 3: Initial Data on Economic Sectors

Sector	C1	C2	C3	C4	C5
A_1	1	1	1	1	3
A_2	3	5	4	5	1
A_3	1	1	1	1	2
A_4	1	1	1	1	1
A_5	2	2	2	2	1
A_6	5	4	5	4	1
A_7	2	2	1	2	1
A_8	2	1	1	1	1
A_9	1	2	1	4	5
A_{10}	1	1	1	3	2
A_{11}	2	2	1	2	2
A_{12}	1	1	1	1	2
A_{13}	1	2	1	2	2
A_{14}	1	2	1	2	2
A_{15}	1	1	1	1	1

Source: Calculated by the author

The first step of the TOPSIS method is the normalization of the decision matrix, which is presented in Table 4.

Table 4: Normalized Decision Matrix

Sector	C1	C2	C3	C4	C5
A_1	0.1302	0.1179	0.1325	0.1043	0.3721
A_2	0.3906	0.5893	0.5298	0.5213	0.1240
A_3	0.1302	0.1179	0.1325	0.1043	0.2481
A_4	0.1302	0.1179	0.1325	0.1043	0.1240
A_5	0.2604	0.2357	0.2649	0.2085	0.1240
A_6	0.6509	0.4714	0.6623	0.4170	0.1240
A_7	0.2604	0.2357	0.1325	0.2085	0.1240
A_8	0.2604	0.1179	0.1325	0.1043	0.1240
A_9	0.1302	0.2357	0.1325	0.4170	0.6202
A_{10}	0.1302	0.1179	0.1325	0.3128	0.2481
A_{11}	0.2604	0.2357	0.1325	0.2085	0.2481
A_{12}	0.1302	0.1179	0.1325	0.1043	0.2481
A_{13}	0.1302	0.2357	0.1325	0.2085	0.2481
A_{14}	0.1302	0.2357	0.1325	0.2085	0.2481
A_{15}	0.1302	0.1179	0.1325	0.1043	0.1240

Source: Calculated by the author

The next step involves determining the weight coefficients, which in this study were calculated using the entropy method. In the expression $e_j = -\frac{1}{log_b m}\sum_{i=1}^{m} p_{ij}\, log_b p_{ij}$, the logarithmic base is taken as $b=e$, as commonly used in studies of this type, such as Skrzyński & Wasiuta (2025). Accordingly, the entropy values in this study are calculated as $e_j = -\frac{1}{ln(15)}\sum_{i=1}^{5} p_{ij}\, ln(p_{ij})$. The weight coefficients are presented in Table 5.

Table 5: Weight coefficients

Criteria	w_j
C1	0.1944
C2	0.1869
C3	0.2642
C4	0.1888
C5	0.1657

Source: Calculated by the author

The next step of the TOPSIS method is to calculate the values v_{ij} as the product of the weight coefficients w_j and the elements of the normalized decision matrix $r_{ij.}$

Table 6: Weighted Normalized Decision Matrix

Sector	C1	C2	C3	C4	C5
A_1	0.0253	0.0220	0.0350	0.0197	0.0617
A_2	0.0759	0.1101	0.1400	0.0984	0.0206
A_3	0.0253	0.0220	0.0350	0.0197	0.0411
A_4	0.0253	0.0220	0.0350	0.0197	0.0206
A_5	0.0506	0.0441	0.0700	0.0394	0.0206
A_6	0.1265	0.0881	0.1749	0.0787	0.0206
A_7	0.0506	0.0441	0.0350	0.0394	0.0206
A_8	0.0506	0.0220	0.0350	0.0197	0.0206
A_9	0.0253	0.0441	0.0350	0.0787	0.1028
A_{10}	0.0253	0.0220	0.0350	0.0591	0.0411
A_{11}	0.0506	0.0441	0.0350	0.0394	0.0411
A_{12}	0.0253	0.0220	0.0350	0.0197	0.0411
A_{13}	0.0253	0.0441	0.0350	0.0394	0.0411
A_{14}	0.0253	0.0441	0.0350	0.0394	0.0411
A_{15}	0.0253	0.0220	0.0350	0.0197	0.0206

Source: Calculated by the author

Once the values v_{ij} are calculated, it is possible to determine the ideal and negative ideal solutions for each criterion.

Table 7: Ideal and Negative Ideal Solutioneight coefficients

Criteria	A^+ (max)	A^- (min)
C1	0.1265	0.0253
C2	0.1101	0.0220
C3	0.1749	0.0350
C4	0.0984	0.0197
C5	0.1028	0.0206

Source: Calculated by the author

After determining the ideal and negative ideal solutions, the distances for each alternative were calculated.

Table 8: Distance from the Ideal and Negative Ideal Solutioneal and Negative Ideal Solutioneight coefficients

Sector	S^+	S^-
A_1	0.2133	0.0411
A_2	0.1027	0.1660
A_3	0.2182	0.0206
A_4	0.2249	0.0000
A_5	0.1772	0.0523
A_6	0.0874	0.1941
A_7	0.1999	0.0389
A_8	0.2147	0.0253
A_9	0.1860	0.1036
A_{10}	0.2072	0.0444
A_{11}	0.1924	0.0440
A_{12}	0.2182	0.0206
A_{13}	0.2037	0.0360
A_{14}	0.2037	0.0360
A_{15}	0.2249	0.0000

Source: Calculated by the author

Finally, Table 9 presents the ranked alternatives.

Table 9: Ranking of Alternatives

Sector	RC	Rank
A_1	0.1616	8
A_2	0.6178	2
A_3	0.0861	12/13
A_4	0.0000	14/15
A_5	0.2280	4
A_6	0.6897	1
A_7	0.1629	7
A_8	0.1055	11
A_9	0.3577	3
A_{10}	0.1765	6
A_{11}	0.1861	5
A_{12}	0.0861	12/13
A_{13}	0.1501	9/10
A_{14}	0.1501	9/10
A_{15}	0.0000	14/15

Source: Calculated by the author

The most developed economic sectors, according to the obtained results, are trade, manufacturing, and the information and communication sector. These sectors represent a key pillar of economic development, as they provide favorable conditions for business operations, the growth of entrepreneurship, and further industrial advancement in the country. Their high ranking indicates a significant contribution to overall economic activity and competitiveness.

On the other hand, the lowest-ranked sectors include electricity supply, water supply, as well as arts and recreation. Such a position may indicate a lower level of development in these sectors, as well as the need for greater investment and stronger systemic support—both financial and institutional—in order to enhance their capacities and enable further growth.

Particular attention is drawn to the position of the education and health sectors, which rank ninth and tenth, respectively. Considering their importance for society as a whole, these results may point to insufficient support and stimulation of these sectors.

5. CONCLUSION

The issue of selecting and ranking economic sectors in the Republic of Serbia is a complex and multidimensional problem that requires consideration of various aspects of each sector. The economic-business aspect represents only one possible perspective in the comparison, providing an evaluation based on quantitatively expressed performance indicators.

Based on the obtained results related to business efficiency indicators, a relatively unfavorable position of the education and health sectors can be observed in the ranking. Considering their importance for overall social and economic development, such results may indicate the need to improve relevant development policies aimed at enhancing service quality, ensuring more adequate valuation of employees, and increasing the attractiveness of these professions in the labor market.

On the other hand, the sectors of trade, manufacturing, and information and communication stand out as areas with more pronounced business potential. Their relatively high ranking suggests a more developed business environment, a higher level of economic activity, and favorable conditions for entrepreneurship and the development of new business initiatives.

The results obtained through the application of multi-criteria decision-making methods provide insight into the relative position of the analyzed sectors with respect to the selected criteria. Future research directions may include expanding the analysis by incorporating social, environmental, and regional development criteria, and comparing the results obtained from such multidimensional approaches. A comprehensive analysis would enable sectors to be observed from multiple perspectives, allowing for a clearer understanding of their overall position.

Beyond simple comparison, such an approach would provide a broader picture of how each sector is positioned. By integrating different dimensions, it would not only describe current conditions but also create a foundation for planning future business and investment strategies, as well as for improving the overall efficiency of the economy.

REFERENCES

Hwang, C. L., & Yoon, K. (1981). *Multiple attribute decision making: Methods and applications*. Springer-Verlag.

Nedeljković, M., Puška, A., Štilić, A., & Maksimović, A. (2025). Examining the sustainable rural tourist potential of Semberija using multi-criteria analysis methods. *Environment, Development and Sustainability, 27*, 12517–12535. Retrieved from https://doi.org/10.1007/s10668-023-04395-3

Ozkaya, G., Timor, M., & Erdin, C. (2021). Science, Technology and Innovation Policy Indicators and Comparisons of Countries through a Hybrid Model of Data Mining and MCDM Methods. *Sustainability, 13*(2), 694. Retrieved from https://doi.org/10.3390/su13020694

Petrović, N., et al. (2023b). Evaluating Annual Operation Performance of Serbian Railway System by using Multiple Criteria Decision-Making Technique. *Acta Polytechnica Hungarica, 20*(1), 157-168. Retrieved from https://doi.org/10.12700/APH.20.1.2023.20.11

Petrović, N., Živojinović, T., & Mihajlović, J. (2023a). Evaluating the Annual Operational Efficiency of Passenger and Freight Road Transport in Serbia Through Entropy and TOPSIS Methods. *JEMSE, 2*(4), 204-211. Retrieved from https://doi.org/10.56578/jemse020402

Statistical Office of the Republic of Serbia. (2025). *Statistical Yearbook of the Republic of Serbia*. Retrieved from https://publikacije.stat.gov.rs/G2025/Pdf/G20252058.pdf

Skrzyński, T., & Wasiuta, A. (2025). Assessing municipal performance in Serbia: A TOPSIS-based analysis of economic vitality and public safety dynamics. *Sustainability, 17*(13), 5838. Retrieved from https://doi.org/10.3390/su17135838

Srđević, B., Srđević, Z., & Zoranović, T. (2002). Promethee, Topsis and Cp in Multicriteria Decision Making in Agriculture. *Letopis naučnih radova, 26*(1), 5-23. Retrieved from https://scindeks-clanci.ceon.rs/data/pdf/0546-8264/2002/0546-82640201005S.pdf

Valaskova, K., Nagy, M., Figura, M., & Rouse, P. (2025). Res publica digitalis: The uneven digital transformation of the European public sector and the impact of policy disparities on governance, service efficiency, and socioeconomic inclusion. *Oeconomia Copernicana, 16*(3), 1177-1260. Retrieved from https://doi.org/10.24136/oc.3866

Žižović, M., Pamučar, D., Stanković, M., Đurčić, D., & Žižović, M. M. (2021). Concept for Determining Weight Coefficients of Criteria Based on the Entropy Method. *SYMOPIS 2021*, University of Kragujevac, Faculty of Technical Sciences, Čačak. Retrieved from https://scidar.kg.ac.rs/handle/123456789/13779

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DIGITALIZING CIRCULAR ECONOMY SYSTEMS: A MULTI-CRITERIA DECISION-MAKING APPROACH TO SUSTAINABLE ECONOMIC DEVELOPMENT

Abstract: The transition from linear to circular economic systems represents one of the key challenges for achieving sustainable economic development. At the same time, digitalization is increasingly recognized as a strategic enabler that can support the implementation, monitoring, and optimization of circular economy practices. This paper explores how digital technologies and multi-criteria decision-making (MCDM) methods can support the transition toward more sustainable and resource-efficient economic systems.

The research is conceptually grounded in a project focused on strengthening institutional and research capacities for the digitalization of circular economy practices. The study develops a methodological framework that integrates sustainability indicators with multi-criteria decision-making tools in order to support decision-making processes related to circular economy implementation. The proposed approach enables the evaluation and prioritization of circular economy strategies by considering multiple economic, environmental, and social criteria simultaneously.

The analysis highlights the importance of stakeholder cooperation among academia, policy makers, and small and medium-sized enterprises in creating enabling conditions for circular economy adoption. Digital platforms and data-driven tools are identified as key instruments for improving resource efficiency, facilitating information exchange, and supporting evidence-based policy making.

The results of the study contribute to the growing body of research on sustainability and circular economy by demonstrating how MCDM approaches can support the design of more efficient and transparent decision-making processes. Furthermore, the research provides practical recommendations for strengthening circular business models, supporting green digital transformation, and enhancing sustainable economic development.

Keywords: circular economy, digitalization, sustainability, multi-criteria decision-making, sustainable economic development

1. INTRODUCTION

The transition from linear to circular economic systems represents a fundamental shift in contemporary economic development paradigms. Circular economy (CE) principles aim to reduce resource consumption, minimize waste, and promote the reuse and recycling of materials, thereby contributing to long-term sustainability.

At the same time, digitalization has emerged as a key enabler of this transition. Digital technologies—such as data platforms, geographic information systems (GIS), and optimization tools—allow for improved monitoring, coordination, and efficiency of resource flows. In this context, the integration of digital tools with decision-support methodologies becomes essential.

Building on recent research in regional infrastructure planning and waste management systems, this paper develops a comprehensive framework that combines digitalization and multi-criteria decision-making (MCDM) approaches to support circular economy implementation.

The research is further grounded in broader capacity-building initiatives in green and digital transitions, where strengthening institutional and research capabilities is identified as a key prerequisite for sustainable development.

The main objective of this paper is to develop an integrated methodological framework that supports decision-making in circular economy systems by combining sustainability indicators, digital tools, and multi-criteria evaluation methods.

2. LITERATURE REVIEW

2.1. Circular Economy and Sustainable Development

The circular economy (CE) has emerged as a central paradigm for achieving sustainable development by decoupling economic growth from resource consumption and environmental degradation. Unlike the traditional linear model, circular systems aim to maintain the value of products, materials, and resources for as long as possible through reuse, recycling, and recovery processes (Geissdoerfer et al., 2017).

Recent research highlights that CE contributes not only to environmental sustainability but also to economic resilience and competitiveness. By promoting resource efficiency and innovation, circular economy practices support the development of new business models and value chains (Kirchherr et al., 2017; Korhonen et al., 2018). In particular, CE has been strongly linked to the objectives of the European Green Deal and the transition toward climate-neutral economies.

However, the implementation of circular economy systems remains uneven, especially in transition economies where institutional capacity, infrastructure, and technological readiness are still developing. In such contexts, waste management systems represent a critical entry point for CE implementation, as they directly influence resource recovery and material circulation (Di Vaio et al., 2023).

As emphasized in recent infrastructure-focused research, waste management should be understood as a complex system that integrates environmental, economic, and logistical dimensions, while also contributing to regional development and innovation processes.

2.2. Digitalization and Circular Economy Systems

Digitalization is increasingly recognized as a key enabler of circular economy transition. Digital technologies facilitate the collection, processing, and analysis of large datasets related to resource flows, emissions, and infrastructure performance. This enables more efficient planning, monitoring, and optimization of circular systems (Nobre & Tavares, 2017).

In the context of CE, digital tools support several critical functions:

- *real-time monitoring of material flows*
- *optimization of logistics and resource allocation*
- *improved traceability and transparency*
- *data-driven policy and decision-making*

Technologies such as Geographic Information Systems (GIS), Internet of Things (IoT), big data analytics, and digital platforms are particularly relevant for infrastructure-intensive sectors such as waste management and energy systems (Kristoffersen et al., 2020).

Existing research confirms that GIS-based spatial analysis significantly improves infrastructure planning by enabling the identification of optimal facility locations and transport routes (Yadav & Karmakar, 2020; Moumane et al., 2025). Furthermore, the integration of digital tools with optimization models enhances the efficiency and sustainability of waste management systems.

Beyond technical applications, digitalization also facilitates stakeholder cooperation by enabling information exchange between public authorities, firms, and research institutions. This is particularly important in circular economy systems, where coordination across multiple actors is required.

The importance of strengthening digital and research capacities is also emphasized in large-scale research initiatives, where digital transformation is seen as a key driver of sustainable development and institutional modernization.

2.3. Multi-Criteria Decision-Making in Sustainability Analysis

Decision-making in circular economy systems involves multiple, often conflicting objectives, including economic efficiency, environmental protection, and social impact. Traditional single-objective optimization approaches are therefore insufficient for capturing the complexity of sustainability-related decisions.

Multi-criteria decision-making (MCDM) methods provide a structured approach for evaluating alternatives based on multiple criteria. Among these methods, the Analytic Hierarchy Process (AHP) is widely used due to its ability to incorporate expert judgment and determine the relative importance of criteria (Saaty, 1980).

Recent studies demonstrate that MCDM approaches are particularly suitable for sustainability assessment, as they allow for the integration of qualitative and quantitative criteria and enable transparent decision-making processes (Mardani et al., 2015). In the context of circular economy, MCDM methods have been applied to:

- *evaluation of waste management strategies*
- *ranking of circular business models*
- *infrastructure planning and site selection*
- *sustainability performance assessment*

The application of AHP in waste management planning enables decision-makers to balance economic, environmental, and technological considerations, thereby supporting more sustainable outcomes.

2.4. Integration of Digital Tools, MCDM and Optimization Models

Recent advances in sustainability research emphasize the importance of integrating digital technologies, multi-criteria decision-making, and mathematical optimization into unified analytical frameworks.

GIS-based approaches provide spatial data and visualization capabilities, while MCDM methods structure decision preferences. Optimization models, particularly Mixed-Integer Linear Programming (MILP), are then used to identify optimal system configurations under defined constraints.

The integration of these approaches enables:

- *evaluation of multiple scenarios*
- *analysis of trade-offs between cost and sustainability*
- *improved robustness of decision-making*

As demonstrated in recent research on regional waste management systems, the combination of GIS, AHP, and MILP allows for comprehensive infrastructure planning that simultaneously considers economic efficiency, environmental impact, and technological feasibility.

Moreover, optimization models incorporating environmental externalities, such as CO_2 emissions, provide a more realistic representation of sustainability challenges and support alignment with climate policies.

2.5. Stakeholder Cooperation and Institutional Capacity

The successful implementation of circular economy systems depends on effective cooperation among stakeholders, including public authorities, businesses, research institutions, and local communities.

Institutional capacity plays a crucial role in this process, as it determines the ability to design policies, implement strategies, and utilize digital tools. In many transition economies, limited institutional capacity represents a key barrier to circular economy adoption.

Recent research highlights the importance of capacity-building initiatives that strengthen research, administrative, and innovation capabilities. Such initiatives contribute to the development of interdisciplinary knowledge, improve policy design, and support the dissemination of sustainability practices.

In this context, universities and research institutions play a central role by providing expertise, developing analytical tools, and supporting evidence-based decision-making.

2.6. Research Gap and Contribution

Although the literature on circular economy, digitalization, and MCDM has expanded significantly in recent years, several gaps remain.

First, many studies focus on conceptual aspects of circular economy without providing operational decision-support frameworks. Second, digitalization is often treated as an external factor rather than being fully integrated into analytical models. Third, MCDM and optimization approaches are frequently applied separately, limiting their potential to address complex sustainability challenges.

This study addresses these gaps by developing an integrated framework that combines digital tools, multi-criteria decision-making, and optimization modelling for circular economy systems. By building on existing research in digitalized infrastructure planning and aligning with broader sustainability and capacity-building initiatives, the paper contributes to the development of more effective and transparent decision-making processes for sustainable economic development.

3. METHODOLOGY

3.1. Research Design and Conceptual Framework

This study adopts an integrated methodological approach aimed at supporting decision-making processes in circular economy systems through the combination of digital technologies and multi-criteria analytical tools.
The proposed framework is structured as a multi-layer decision-support system consisting of three interconnected components:

1. Digital layer – data collection, processing, and spatial analysis using digital tools
2. Decision layer – evaluation and prioritization of criteria using multi-criteria decision-making methods
3. Optimization layer – system configuration through mathematical optimization

This approach builds upon previous research in digitalized infrastructure planning and waste management systems, while extending it toward a broader sustainability-oriented and policy-relevant framework.
The integration of these components enables the simultaneous consideration of economic, environmental, technological, and social dimensions of circular economy systems.

3.2. Data and Digital Infrastructure

The empirical and analytical foundation of the proposed model is based on the integration of heterogeneous data sources that jointly capture the complexity of circular economy systems. This includes spatial data describing the geographical distribution of waste generation and existing infrastructure, economic data related to cost structures and operational expenditures, environmental data reflecting emissions and resource use, as well as technological indicators that capture the level of digital readiness and infrastructure capacity. The combination of these data dimensions enables a comprehensive representation of the system, allowing both physical flows and sustainability-related impacts to be analyzed within a unified framework.
Digital tools play a central role in structuring and processing these data, transforming them into usable inputs for further analysis. In particular, Geographic Information Systems (GIS) are employed to support spatial modelling of the system by identifying feasible locations for infrastructure development, calculating transport distances between waste generation points and processing facilities, and analyzing spatial constraints and regional heterogeneity. Through these functionalities, GIS enables a more precise understanding of the spatial dimension of circular economy systems, which is essential for realistic infrastructure planning.
By integrating digital tools into the analytical process, raw and often fragmented data are transformed into structured and decision-relevant information that can be directly incorporated into multi-criteria evaluation and optimization models. Such digitalization significantly enhances the quality of decision-making by improving the accuracy of input data, enabling more efficient coordination of resource flows, and supporting the development of data-driven and evidence-based solutions for sustainable infrastructure planning.

3.3. Multi-Criteria Decision-Making Model

Given the multi-dimensional nature of circular economy systems, a multi-criteria decision-making (MCDM) approach is applied to structure and evaluate decision alternatives.

3.3.1. Criteria selection

The evaluation framework is based on four main criteria groups:

- *Economic (C_1) – investment, operational, and transport costs*
- *Environmental (C_2) – emissions, waste reduction, resource recovery*
- *Technological (C_3) – level of digitalization and technological feasibility*
- *Social (C_4) – stakeholder impact and regional development effects*

3.3.2. AHP weighting procedure

The Analytic Hierarchy Process (AHP) is used to determine the relative importance of criteria. Pairwise comparisons are conducted based on expert judgment, resulting in a consistent weight vector:

$$W = (w_1, w_2, w_3, w_4), \sum_{i=1}^{4} w_i = 1$$

The consistency of the comparison matrix is verified using the consistency ratio (CR), ensuring the reliability of the results.

3.3.3. Composite evaluation

Each alternative system configuration is evaluated using a composite score:

$$S_j = \sum_{i=1}^{n} w_i \cdot x_{ij}$$

where:

- S_j– *overall performance score of alternative* j
- w_i– *weight of criterion* i
- x_{ij}– *normalized value of alternative* j*under criterion* i

This step introduces stakeholder preferences into the analytical framework and ensures that optimization results reflect sustainability priorities.

3.4. Optimization Model

The circular economy system is modelled as a network of waste generation nodes, processing facilities, and transport links. The objective is to determine the optimal configuration of the system.

3.4.1. Decision variables

- $y_k \in \{0,1\}$*: binary variable indicating whether facility* k *is established*
- $x_{ik} \geq 0$*: quantity of waste transported from node* i *to facility* k
- $z_k \geq 0$*: quantity of processed waste at facility* k

3.4.2. Objective function

The objective function minimizes total system cost, including environmental externalities:

$$\min Z = \sum_{k} F_k \, y_k + \sum_{i,k} C_{ik} \, x_{ik} + \sum_{k} O_k \, z_k + \lambda \sum_{i,k} E_{ik} \, x_{ik}$$

where:

- F_k – *fixed cost of opening facility* k
- C_{ik} – *transport cost from node* i *to facility* k
- O_k – *operational cost*
- E_{ik} – *emissions coefficient*
- λ – CO_2 *penalization parameter*

This formulation extends classical cost-minimization models by internalizing environmental impacts, in line with sustainability-oriented optimization approaches.

3.4.3. Constraints

The model is subject to the following constraints:

1. Flow balance constraint

$$\sum_{k} x_{ik} = D_i \forall i$$

2. Capacity constraint

$$z_k \leq Cap_k \cdot y_k$$

3. Processing constraint

$$z_k = \sum_{i} x_{ik}$$

4. Logical constraint

$$x_{ik} \leq M \cdot y_k$$

5. Non-negativity and binary conditions

The integration of multi-criteria decision-making and optimization modelling represents a key component of the proposed analytical framework. In this study, the results of the Analytic Hierarchy Process are not treated as a separate evaluative step, but are directly embedded into the optimization context. The weights derived from AHP reflect stakeholder preferences and strategic priorities, and are subsequently incorporated into the evaluation of alternative system

configurations. In addition, these preferences influence the calibration of key optimization parameters, allowing the model to reflect different decision-making orientations, such as cost efficiency or environmental sustainability. Following the optimization process, the obtained solutions are further assessed through composite indicators, which enable the ranking of alternatives based on multiple criteria. In this way, the model combines normative optimization with preference-based evaluation, ensuring that the results are not only technically efficient but also aligned with broader sustainability objectives and stakeholder expectations.

In order to examine the robustness and practical relevance of the proposed framework, a scenario-based approach is applied. Different system configurations are analyzed under varying assumptions that reflect alternative policy and decision-making contexts. These scenarios are constructed by modifying both the relative importance of decision criteria and the level of environmental penalization within the optimization model. As a result, one scenario emphasizes cost minimization, another reflects a balanced consideration of economic and environmental objectives, while a third prioritizes sustainability and emission reduction. By systematically varying these parameters, the model enables the analysis of trade-offs between economic efficiency and environmental performance. This approach provides valuable insights into how different policy choices and strategic priorities influence the optimal configuration of circular economy systems, thereby supporting more informed and flexible decision-making processes.

4. RESULTS AND DISCUSSION

The results of the proposed model provide important insights into the relationship between economic efficiency, environmental performance, and the role of digitalization in circular economy systems. By applying the integrated framework across different decision scenarios, the analysis reveals how variations in policy priorities and decision-maker preferences influence the optimal configuration of infrastructure and resource flows.

The findings indicate that solutions derived under purely cost-oriented assumptions tend to favor centralized infrastructure configurations and longer transport routes, as these minimize immediate financial expenditures. However, such configurations are associated with significantly higher environmental impacts, particularly in terms of emissions and inefficient resource utilization. This confirms that traditional cost-minimization approaches are insufficient when sustainability objectives are taken into account.

When environmental considerations are introduced into the model through emission penalization and adjusted criteria weights, the structure of the optimal solution changes substantially. The results show a shift toward more decentralized infrastructure systems, characterized by shorter transport distances and increased reliance on local processing capacities. This transformation reflects the internalization of environmental externalities and demonstrates how policy instruments, such as carbon pricing, can directly influence infrastructure planning decisions.

The integration of digital tools further enhances the performance of the system by improving the allocation of resources and enabling more precise spatial analysis. The use of GIS-based inputs allows the model to better capture regional heterogeneity and logistical constraints, leading to solutions that are both more realistic and more efficient. In this context, digitalization acts not only as a supporting mechanism, but as a critical factor that increases the overall effectiveness of circular economy systems.

From a multi-criteria perspective, the results highlight the importance of incorporating stakeholder preferences into the decision-making process. The application of AHP-based weighting demonstrates that different prioritizations of economic, environmental, and technological criteria lead to different optimal outcomes. In particular, scenarios that assign greater importance to environmental and technological factors consistently achieve higher overall sustainability performance, even when associated with higher initial costs. This suggests that long-term benefits outweigh short-term financial considerations in the context of sustainable development.

The scenario analysis also provides important insights into the trade-offs inherent in circular economy systems. While economically optimal solutions may minimize costs, they often fail to meet environmental targets. Conversely, sustainability-oriented solutions may require higher investments but result in significantly improved environmental outcomes and system resilience. The balanced scenario demonstrates that it is possible to achieve a compromise between these objectives, although such solutions depend heavily on the specific weighting of criteria and policy priorities.

These findings are consistent with existing literature emphasizing the need for integrated decision-support systems in sustainability analysis. However, the present study extends previous research by demonstrating how digitalization, multi-criteria evaluation, and optimization modelling can be combined into a unified framework. This integration allows for a more comprehensive understanding of system behavior and supports more informed decision-making at both the strategic and operational levels.

From a policy perspective, the results underline the importance of incorporating environmental costs into economic decision-making processes and investing in digital infrastructure that supports data-driven planning. For transition economies in particular, the findings suggest that strengthening digital and institutional capacities is essential for the successful implementation of circular economy strategies.

Overall, the results confirm that the transition toward sustainable and circular systems requires not only technological and economic adjustments, but also a fundamental shift in decision-making frameworks. The proposed model contributes to this shift by providing a tool that integrates multiple dimensions of sustainability into a coherent and operational analytical approach.

5. CONCLUSION

This study develops an integrated analytical framework for supporting decision-making in circular economy systems by combining digital tools, multi-criteria decision-making methods, and optimization modelling. By linking Geographic Information Systems, the Analytic Hierarchy Process, and Mixed-Integer Linear Programming, the proposed approach enables a comprehensive evaluation of alternative system configurations that simultaneously consider economic, environmental, technological, and social dimensions.

The results demonstrate that the integration of digitalization into circular economy systems significantly enhances the quality and effectiveness of decision-making processes. Digital tools improve the accuracy and usability of data, enable better spatial analysis, and support more efficient allocation of resources. At the same time, the incorporation of multi-criteria decision-making methods ensures that stakeholder preferences and sustainability priorities are explicitly reflected in the analytical process. The optimization component further strengthens the framework by identifying technically feasible and efficient system configurations.

A key finding of the study is that the inclusion of environmental externalities, particularly through CO_2 penalization, leads to substantial changes in optimal system design. Solutions that account for environmental impacts tend to favour more decentralized and resource-efficient configurations, highlighting the importance of integrating sustainability criteria into infrastructure planning. The results also confirm that decision outcomes are highly sensitive to the relative importance assigned to different criteria, emphasizing the need for transparent and structured decision-making approaches.

From a theoretical perspective, the paper contributes to the literature by integrating digitalization, circular economy principles, and multi-criteria decision-making into a unified framework. While previous studies have addressed these elements separately, this research demonstrates the added value of their combined application in addressing complex sustainability challenges.

From a practical and policy-oriented perspective, the findings underline the importance of developing digital and institutional capacities to support the transition toward circular economy systems. Policymakers are encouraged to adopt data-driven and multi-criteria approaches in infrastructure planning and to incorporate environmental costs into economic decision-making. For transition economies in particular, strengthening cooperation between academia, public institutions, and the private sector is essential for the successful implementation of circular strategies.

Despite its contributions, the study has certain limitations. The model relies on the availability and quality of input data, and the results may vary depending on the assumptions used in criteria weighting and parameter calibration. In addition, the current framework focuses primarily on static system configurations, without fully capturing dynamic changes over time.

Future research should therefore focus on the development of dynamic and stochastic models that incorporate uncertainty and temporal evolution of circular economy systems. The integration of real-time data, artificial intelligence, and advanced simulation techniques represents a promising direction for further improving decision-support systems. Moreover, expanding the framework to include additional sustainability dimensions, such as social acceptance and governance factors, could provide a more holistic assessment of circular economy strategies.

In conclusion, the study confirms that the transition toward sustainable economic development requires not only technological innovation but also advanced analytical frameworks that support informed and balanced decision-making. The proposed model provides a foundation for such frameworks and contributes to the development of more efficient, transparent, and sustainable circular economy systems.

REFERENCES

Di Vaio, A., Hasan, S., Palladino, R., Hassan, R., Escobar, O., & Vrontis, D. (2023). Circular economy and waste: A systematic review. *Environmental Development and Sustainability, 25*, 734–810.

Geissdoerfer, M., Savaget, P., Bocken, N. M., & Hultink, E. J. (2017). The circular economy—A new sustainability paradigm? *Journal of Cleaner Production, 143*(6), 757–768.

Kirchherr, J., Reike, D., & Hekkert, M. (2017). Conceptualizing the circular economy: An analysis of 114 definitions. *Resources, Conservation and Recycling, 127*, 221–232.

Krinen, J., Honkasalo, A., & Seppälä, J. (2018). Circular economy: The concept and its limitations. *Ecological Economics, 143*, 37–46.

Kristoffersen, E., Blomsma, F., Mikalef, P., & Li, J. (2020). The smart circular economy: A digital-enabled circular strategies framework. *Journal of Business Research, 120*, 241–261.

Mardani, A., Jusoh, A., Nor, K. M., Khalifah, Z., Zakwan, N., & Valipour, A. (2015). Multiple criteria decision-making techniques and their applications – a review of the literature from 2000 to 2014. *Economic Research-Ekonomska Istraživanja, 28*(1), 516–571.

Moumane, A., Al Karkouri, J., & Batchi, M. (2025). Utilizing GIS, remote sensing, and AHP-multi-criteria decision analysis for optimal landfill site selection in Kenitra Province, Morocco: a step towards sustainable development goals. *Discover Environment, 3*(4).

Nobre, G. C., & Tavares, E. (2017). Scientific literature analysis on big data and internet of things applications on circular economy: a bibliometric study. *Scientometrics, 111,* 463–492.

Saaty, T. L. (1980). *The Analytic Hierarchy Process*. McGraw-Hill.

Yadav, V., & Karmakar, S. (2020). GIS-based landfill site selection using multi-criteria decision analysis. *Environmental Challenges, 1,* 100006.

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THE IMPACT OF THE FEAR AND GREED INDEX ON LIMIT ORDER BOOK MICROSTRUCTURE AND EXECUTION COSTS: AN AGENT-BASED SIMULATION OF CRYPTO MARKETS

Abstract: This paper investigates whether the Fear and Greed Index (FGI) influences cryptocurrency market microstructure and execution quality in an agent-based limit order book environment. The NetLogo model incorporates explicit buy and sell order books, a price-priority matching mechanism, mixed Poisson/Hawkes-like order arrivals, heavy-tailed order sizes, and rule-based cancellations. Sentiment enters the model parsimoniously, with the probability of a buy order set equal to FGI/100. The analysis is based on a single simulation horizon of 50,000 executed trades in event time. The results show that higher FGI regimes generate a pronounced directional shift in order flow, with the buy-order share increasing from 25.64% in the 20–35 FGI bin to 73.05% in the 65–80 bin, while average order-book imbalance shifts from -0.5175 to 0.4424. Quoted spread changes only modestly across sentiment regimes, whereas effective spread rises from 3.0029 to 3.9329, indicating materially poorer execution quality under greed-dominated conditions. The model also reproduces key stylized facts, including fat-tailed return distributions and persistent volatility clustering in mid-price returns. Overall, the findings suggest that sentiment affects market quality primarily through directional order-flow pressure and liquidity depletion rather than through a simple widening of top-of-book quotes.

Keywords: fear & greed index; limit order book; crypto markets; agent-based simulation; execution costs; volatility clustering

1. INTRODUCTION

Cryptocurrency markets provide a particularly useful environment for studying the interaction between investor sentiment and market microstructure (Almeida & Gonçalves, 2023). They operate continuously, are highly order-driven, and often exhibit rapid switches between fear- and greed-dominated trading regimes. In these markets, the limit order book (LOB) is the fundamental mechanism through which sentiment influences quotes, depth, imbalance, and execution costs. While the LOB literature (Hasbrouck, 2007; Gould et al., 2013; Abergel et al., 2016) demonstrates that order book states contain critical information for price formation, the specific link between aggregate sentiment proxies and granular LOB dynamics remains under-explored.

Furthermore, market quality research emphasizes that quoted spreads alone are insufficient metrics, as execution costs often deteriorate due to directional pressure. This study addresses this gap by employing an Agent-Based Modeling (ABM) framework to isolate sentiment as a structural driver of market outcomes. Unlike exogenous models, ABM allows liquidity and volatility to emerge endogenously from order submission and matching rules (Axtell & Farmer, 2022), consistent with the stylized facts of financial time series such as heavy tails and volatility clustering (Cont, 2001; Bacry et al., 2015). By incorporating self-exciting event dynamics (Bacry et al., 2015) and correlated order flow (Bouchaud et al., 2009), the model captures the clustering mechanisms typical of high-frequency activity, ensuring that emerging patterns are consistent with stylized facts such as heavy tails and persistent volatility (Cont, 2001).

The objective of this paper is to examine how the Fear and Greed Index (FGI) affects LOB microstructure and execution costs by integrating a sentiment proxy directly into a controlled NetLogo simulation (Wilensky, 1999). Specifically, the analysis addresses four questions: (1) whether higher FGI values systematically shift the direction of order flow, (2) whether they alter order-book imbalance and quoted spread, (3) whether they increase effective execution costs, and (4) whether the model reproduces stylized facts consistent with realistic market dynamics.
The remainder of the paper is organized as follows. Section 2 outlines the methodology and model design. Section 3 presents the simulation results. Section 4 discusses the findings and their implications. Section 5 concludes.

2. LITERATURE REVIEW

Recent literature suggests that sentiment is a central driver of trading patterns in cryptocurrency markets rather than a peripheral factor. Almeida and Gonçalves (2023) show that crypto-asset investment intentions are strongly shaped by social influence, often generating herding and speculative bubbles during periods of high volatility. In this context, the Fear and Greed Index (FGI) serves as a composite proxy for market sentiment by aggregating momentum, volatility, and social media activity (Kyriazis and Corbet, 2026). Its economic relevance is supported by evidence that sentiment-driven shifts affect the cross-section of cryptocurrency returns (Chowdhury et al., 2024). Although the index may partly reflect past price dynamics, which raises concerns about endogeneity (Bokhari, 2025), it remains useful in agent-based modeling as a regime indicator. Gessie (2026) further shows that Bitcoin returns Granger-cause changes in the FGI, suggesting that sentiment operates within a feedback loop rather than as a purely exogenous force.

Agent-based modeling is particularly well suited to studying such mechanisms in markets populated by heterogeneous agents with bounded rationality (Axtell and Farmer, 2022). Consistent with heuristic-based limit order book models, ABM allows stylized facts such as heavy tails and volatility clustering to emerge endogenously from local interactions rather than from externally imposed shocks (Gould et al., 2013). Fratrič et al. (2022) demonstrate this in a Bitcoin market setting, showing that polarized sentiment can increase fragility and create conditions conducive to manipulation. However, an important gap remains in the literature: sentiment studies typically focus on aggregate outcomes such as returns and volatility, whereas microstructure research emphasizes fine-scale limit order book variables such as quotes, depth, and spreads. This study addresses that gap by introducing a sentiment proxy directly into the order-submission structure of an explicit limit order book simulation, allowing an examination of how sentiment affects directional order flow, liquidity conditions, execution quality, and the emergence of stylized facts.

3. METHOD

3.1. Model design

The simulation was implemented in NetLogo (Wilensky, 1999) as an order-driven market with 100 trader agents, two explicit order books, and a price-priority matching mechanism. Each agent holds cash and inventory and can submit buy or sell limit orders. Orders are represented by trader identifier, limit price, quantity, side, and submission time. This explicit representation follows the central logic of continuous double-auction markets described in the market microstructure literature (Hasbrouck, 2007; Gould et al., 2013).
The model uses event time for order arrival and trade sequencing, while simulation ticks are used for snapshots and interval aggregation. This distinction is methodologically useful because it separates the stochastic clock of market events from the reporting clock used for tables, figures, and rolling diagnostics. In documentation terms, the model is presented in a compact form consistent with the ODD orientation toward transparent, reproducible simulation design (Grimm et al., 2020).
At the structural level, the model belongs to the family of agent-based LOB simulations in which aggregate market outcomes emerge from repeated order submission, cancellation, and matching rather than from an exogenously specified price process. This makes it suitable for examining whether a simple sentiment rule can be translated into measurable changes in spreads, imbalance, volatility and execution costs.

3.2. Order flow, sentiment and cancellation rules

Sentiment is introduced through a simple but transparent rule: the probability that the next order is a buy order equals FGI/100. Thus, if FGI = 25, the probability of a buy order is 0.25; if FGI = 75, the probability is 0.75. This parsimonious specification makes the economic interpretation of results straightforward because sentiment affects the market through the directional composition of order flow rather than through an externally forced price path.
Order arrival is generated by a mixed Poisson/Hawkes-like process. This mechanism ensures that order arrivals are not purely random but exhibit endogenous bursts, mimicking the latency and reaction patterns of algorithmic trading in crypto-markets. The Poisson component provides a baseline of independent arrivals, while the Hawkes-like component is implemented as a self-exciting intensity process where the arrival rate of new orders is temporarily increased by preceding market events. Although the implementation is deliberately simplified and avoids full parameter estimation to

remain parsimonious, this endogenous feedback loop is designed to capture the clustered nature of high-frequency trading activity and the resulting volatility persistence observed in empirical crypto-markets (Hawkes, 1971; Bacry, Mastromatteo, & Muzy, 2015).

Order prices are drawn around reference buy and sell prices, and order sizes can be generated under a heavy-tail mechanism based on a capped log-normal distribution. This choice is consistent with the broader empirical observation that financial and trading-related distributions are often heavy-tailed (Cont, 2001). It is also consistent with order-book research showing that order placement and cancellation rules can generate realistic spread and volatility patterns even in comparatively simple behavioral settings (Mike & Farmer, 2008).

The model also includes several cancellation policies: random agent-level cancellations, cancellations of orders too far from a reference price, cancellations of orders close to the reference price, and age-based removal of stale orders. These rules keep the book dynamic and prevent the accumulation of unrealistic inactive depth. They also provide a practical way to maintain a continuously evolving book without introducing explicit market-maker agents.

3.3. Key metrics and experiment design

The main microstructure metrics are quoted spread (S_t), midpoint (M_t), book depth, and order-book imbalance (It). If a_t denotes the best ask and b_t the best bid, the metrics are defined as follows:

$S_t = a_t - b_t$

$M_t = \frac{a_t + b_t}{2}$.

$I_t = \frac{\mathrm{BuyDepth_t} - \mathrm{SellDepth_t}}{\mathrm{BuyDepth_t} + \mathrm{SellDepth_t}}$.

Execution quality is evaluated primarily using the effective spread, $\mathrm{ES_t} = 2|\mathrm{p_t} - \mathrm{Mid_t}|$ where p_t is transaction price. This metric captures the realized distance between execution and the contemporaneous midpoint more accurately than the quoted spread, which may remain stable despite significant directional pressure (Bessembinder, 2003; Hasbrouck, 2007).

The reported experiment consists of a single 50,000-trade simulation. This horizon was selected to ensure the convergence of stylized facts and to provide a sufficiently large sample size across all FGI bins, thereby minimizing the impact of transient stochastic noise. The analysis draws from multiple output layers, including trade-level, interval-level, and sentiment-bin files, as well as rolling diagnostics for volatility clustering and agent-level performance. The following sections emphasize a compact set of tables and figures that capture baseline dynamics, FGI-dependent microstructure shifts, and evidence of empirical regularities such as fat tails. The core design choices and reporting structure are summarized in Table 1

Table 1: Core model components and experiment settings

Component	Implementation in the simulation
Market structure	Order-driven crypto market with explicit buy and sell order books and price-priority matching
Agents	100 trader agents with cash and inventory positions
Sentiment rule	Probability of a buy order = FGI/100
Arrival process	Mixed Poisson/Hawkes-like event arrivals
Order sizes	Baseline random quantities with optional capped log-normal heavy-tail mechanism
Cancellation rules	Random, far-from-reference, near-reference, and age-based cancellations
Main metrics	Quoted spread, midpoint, imbalance, VWAP, effective spread, rolling stylized facts
Reported experiment	Single run with 50,000 executed trades and multiple CSV output layers

Source: Author's systematization of the simulation design.

3.4. Output structure and validation strategy

The simulation generates several complementary output layers to ensure a granular analysis of market dynamics. Trade-level data records execution price, quantity, midpoint, spread, and sentiment conditions at the millisecond of execution. Interval-level output aggregates these events into discrete time bins, reporting Volume Weighted Average Price (VWAP), average spreads, and order-book imbalance. Additionally, sentiment-bin summaries aggregate data across predefined FGI regimes (e.g., Extreme Fear to Extreme Greed), allowing for a cross-sectional analysis of market quality. This categorical approach is consistent with recent evidence that sentiment effects, particularly those driven by heightened fear, operate non-linearly across different market states and impact broader investor behavior (Kyriazis & Corbet, 2026). Validation follows a dual-track strategy focusing on both microstructural coherence and statistical plausibility. The model should generate economically sensible relationships between sentiment, order-flow direction, imbalance, and execution costs. Statistical plausibility is assessed by verifying whether the simulated data reproduce a meaningful subset of stylized facts, most notably fat tails and volatility clustering. In this context, the application of rolling windows, midpoint diagnostics, and Ljung-Box statistics aligns the simulation with established empirical benchmarks in financial econometrics (Cont, 2001; Engle, 1982).

The mapping between research questions and observables is straightforward. The first question is evaluated through buy-order share across FGI bins. The second is evaluated through quoted spread and order-book imbalance. The third is evaluated through effective spread, which is closer to realized trading conditions than visible quotes alone. The fourth is evaluated through rolling excess kurtosis, return autocorrelation, midpoint-based volatility clustering, and the dispersion of final agent outcomes. Together, these observables allow the paper to move from sentiment input to market-quality output without leaving the order-book environment.

4. RESULTS

4.1. Baseline market behavior

The 50,000-trade simulation generated a total trading volume of 313,269 units, an average transaction price of 103.5479, and an average trade size of 6.2654 units. The discrepancy between the mean and the median trade size (4 units) indicates a right-skewed distribution consistent with the heavy-tail order-size mechanism. At the interval level, the model produced 4,549 reporting bins, with an average of 10.99 trades and 68.87 units of volume per bin. The average Volume Weighted Average Price (VWAP) across bins was 103.4046. The main baseline indicators are summarized in Table 2.

Table 2: Descriptive statistics for the 50,000-trade simulation

Indicator	Value
Number of trades	50,000
Total volume	313,269
Average transaction price	103.5479
Median transaction price	103.9133
Price standard deviation	2.6969
Average trade size	6.2654
Median trade size	4
Average VWAP across bins	103.4046
Average quoted spread at trade time	1.2721
Average end-of-bin spread	0.7735

Source: Author's calculation based on NetLogo simulation outputs

Quoted spreads remained moderate on average. The mean spread measured at trade time was 1.2721, while the mean end-of-bin spread was lower at 0.7735, reflecting the continuous replenishment of the limit order book. Average end-of-bin imbalance was close to zero (-0.0313), suggesting that the simulated market does not suffer from permanent directional bias; instead, it remains dynamically rebalanced through the interplay of order submissions and cancellations. While local sentiment regimes introduce significant temporary asymmetries, the market architecture ensures a return to structural equilibrium over the long term.

The overall price trajectory serves as a primary indicator of the model's structural stability. Figure 1 shows that transaction prices fluctuate within a relatively narrow but persistent corridor around the 100-105 range, with repeated short-lived deviations. This price path is stationary enough to sustain active matching, yet sufficiently variable to produce non-trivial return dynamics. This balance is desirable in an exploratory ABM, as it ensures that the simulation avoids the pitfalls of both explosive instability and trivial price constancy.

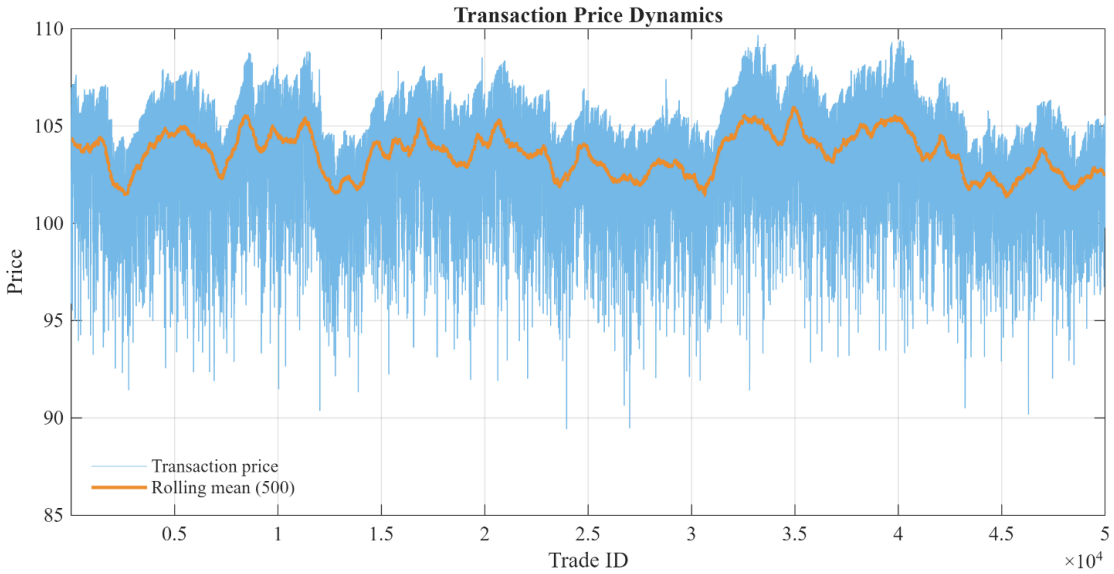


Figure 1: Transaction price dynamics over 50,000 trades
Source: Author's calculation based on NetLogo simulation outputs.

4.2. FGI effects on order flow, imbalance, and execution costs

The strongest result concerns the directional composition of order flow. As the FGI increases from the lowest-sentiment bin (20-35) to the high-sentiment bin (65-80) the share of buy orders rises monotonically from 25.64% to 73.05%. In parallel, average order-book imbalance shifts from -0.5175 to 0.4424. This means that low-FGI regimes are clearly sell-dominated, whereas high-FGI regimes are clearly buy-dominated. The sentiment-bin results are reported in Table 3.
An analysis of liquidity indicators reveals a notable divergence between visible and realized costs.Quoted spread reacts only mildly to sentiment. Mean spread falls from 1.3432 in the lowest FGI bin to 1.2726 in the 50-65 bin and then slightly increases to 1.2824 in the highest bin. By contrast, effective spread rises steadily from 3.0029 to 3.9329. This distinction is theoretically significant because it suggests that extreme sentiment does not merely widen visible top-of-the-book quotes, but instead increases realized execution costs through depth depletion. In economic terms, greed-dominated regimes appear to intensify directional pressure and liquidity depletion more than they mechanically affect the visible spread, highlighting the importance of using effective spread as a proxy for true market friction.

Table 3: FGI effects on microstructure and execution costs

FGI bin	Buy-order share	Trades	Quoted spread	Effective spread	Imbalance
20-35	25.64%	12,950	1.3432	3.0029	-0.5175
35-50	42.49%	11,700	1.3191	3.2789	-0.1673
50-65	57.37%	15,000	1.2726	3.5606	0.1933
65-80	73.05%	10,350	1.2824	3.9329	0.4424

Source: Author's calculation based on NetLogo simulation outputs
Note: Sample sizes vary across bins due to stochastic FGI distribution but remain statistically significant for all regimes (N > 10,000).

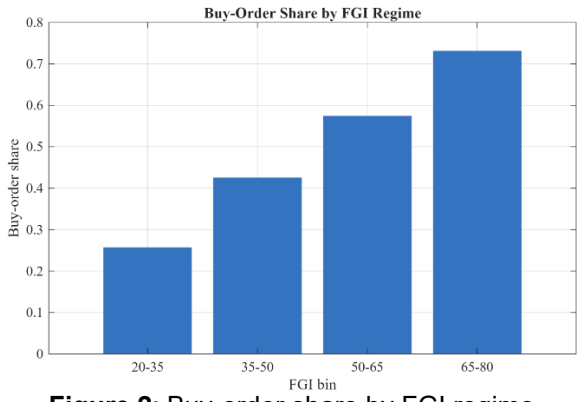


Figure 2: Buy-order share by FGI regime
Source: Author's calculation.

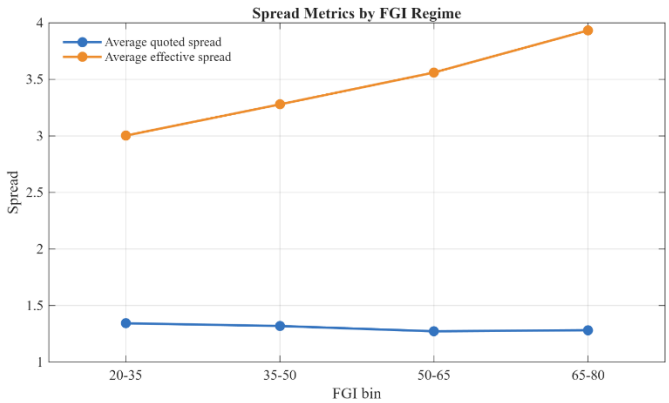


Figure 3: Spread metrics by FGI regime
Source: Author's calculation.

Figures 2 and 3 summarize the main sentiment effect visually. The monotonic increase in buy-order share confirms that the sentiment module transmits directly into order-flow direction. At the same time, the effective spread curve rises much more clearly than the quoted spread curve, reinforcing the conclusion that execution costs become worse under stronger

greed even when the top of the book does not deteriorate proportionally. This divergence confirms that intense greed deteriorates execution quality through increased liquidity consumption, meaning visible quoted spreads may mask the true cost of trading during high-sentiment regimes.

4.3. Stylized facts and agent-level outcomes

The simulation successfully reproduces key empirical regularities of cryptocurrency markets. Across rolling windows, the average excess kurtosis of log returns equals 4.2885, indicating fat tails. The average first-lag autocorrelation of raw log returns is -0.3010, which is plausible in an order-book environment affected by microstructure bounce. More importantly, the average first-lag autocorrelation of absolute log returns is 0.1334, showing persistence in volatility-related measures. Mid-price-based diagnostics provide even stronger evidence of volatility clustering. This persistence is visually summarized in Figure 4, which tracks the clustering diagnostics over the simulation horizon.

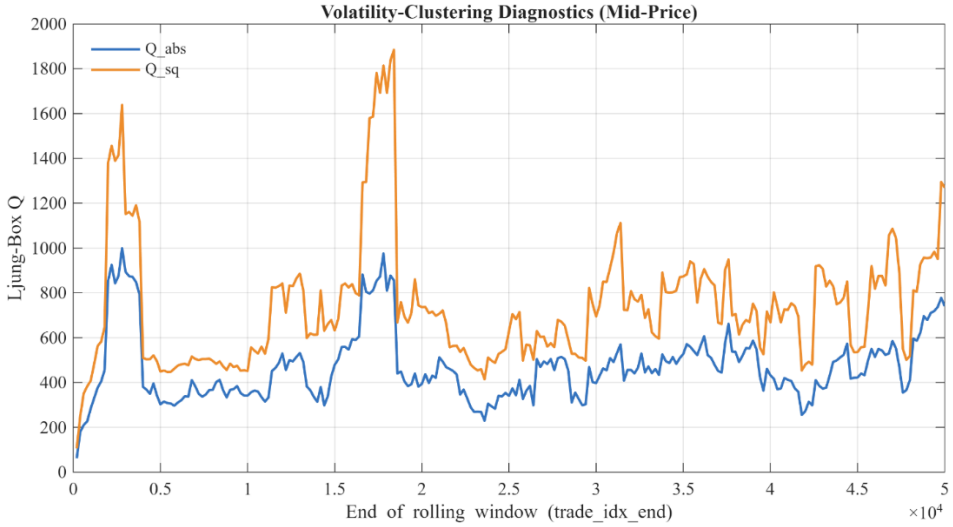


Figure 4: Volatility-clustering diagnostics based on mid-price returns
Source: Author's calculation based on NetLogo simulation outputs.

Across rolling windows, the average first-lag autocorrelation equals 0.4153 for absolute mid-price returns and 0.5375 for squared mid-price returns, while the mean Ljung-Box statistics are 467.89 for absolute returns and 740.79 for squared returns. These values strongly suggest that volatility is serially clustered even when the analysis moves from transaction prices to the cleaner mid-price series.
Beyond aggregate dynamics, agent-level outcomes remain heterogeneous. On the final snapshot, mean PnL is 7.61, median PnL is 13.61, the standard deviation is 1,087.12, and 52% of agents are profitable. The best agent reaches a PnL of 2,763.14, while the worst agent records -2,627.23. Although agent profitability is not the central focus of this paper, these results show that the same microstructure environment generates substantial dispersion in realized opportunities and risks. Table 4 consolidates the most important stylized-facts and agent-level diagnostics.

Table 4: Stylized-facts and agent-outcome diagnostics

Indicator	Value
Excess kurtosis of log returns	4.2885
ACF(1) of log returns	-0.3010
ACF(1) of absolute log returns	0.1334
ACF(1) of absolute mid returns	0.4153
ACF(1) of squared mid returns	0.5375
Ljung-Box Q for |mid returns|	467.89
Ljung-Box Q for squared mid returns	740.79
Mean final PnL	7.61
Median final PnL	13.61
Profitable agents	52%

Source: Author's calculation based on NetLogo simulation outputs.

5. DISCUSSION

The results demonstrate a coherent transmission mechanism where sentiment, captured by the FGI, materially alters market quality through directional order-flow pressure rather than exogenous price paths. This highlights the advantage

of using agent-based modeling (ABM) to capture how micro-behaviors aggregate into market-wide phenomena (Axtell & Farmer, 2022). The monotonic rise in buy-order share and the corresponding shift in imbalance confirm that FGI signals translate directly into one-sided liquidity pressure. A critical finding is the divergence between quoted and effective spreads; while the former remains stable, the latter increases significantly. This suggests a "walking the book" effect, where execution costs rise due to depth depletion, a phenomenon where visible liquidity masks actual deterioration in execution conditions (Hasbrouck, 2007; Bessembinder, 2003).

The main contribution of this paper is empirical rather than architectural. It demonstrates that even a robustly implemented, simple sentiment rule can materially alter order-flow direction, order-book pressure, and effective execution costs within an agent-based limit order book framework. This reinforces the idea that sentiment is a significant factor in shaping market friction in crypto-assets. This finding is consistent with empirical evidence highlighting the role of investor sentiment in shaping trading behavior and liquidity dynamics in cryptocurrency markets (Chowdhury et al., 2024). Furthermore, the observed sensitivity to sentiment regimes (e.g., Extreme Fear) aligns with recent evidence suggesting that cryptocurrency fear acts as a critical information channel for market participants (Kyriazis & Corbet, 2026). While some literature explores if returns themselves drive sentiment (Gessie, 2026), our simulation isolates the reverse path, showing that sentiment alone is a sufficient driver of liquidity friction.

A key implication is that quoted spread and effective spread capture different dimensions of market quality. From a practical perspective, the results suggest that execution strategies relying solely on quoted spreads are insufficient in sentiment-sensitive environments. More informative signals include the joint evolution of order-book imbalance and effective spread. For market participants, this implies that execution risk increases even when quoted liquidity appears stable; for exchange design, it highlights that apparent stability may coexist with hidden inefficiencies under directional stress (Bouchaud et al., 2009).

Furthermore, the model endogenously reproduces key stylized facts, such as fat-tailed returns and volatility clustering. These emerge from the interaction of order arrivals and heavy-tailed order sizes, consistent with established literature where such properties are emergent outcomes of heterogeneous agent interaction (Cont, 2001; Bacry et al., 2015). Importantly, a high FGI should not be viewed solely as a directional predictor, but also as a signal of market quality indicating increased execution costs due to concentrated order flow on one side of the book. This aligns with a systematic understanding of investor behavior in digital assets, where attention and sentiment often dictate market structure more than fundamental value (Almeida & Gonçalves, 2023; Aslanidis et al., 2022).

Table 5 provides a structured overview of the central empirical findings and their implications for understanding the relationship between sentiment and market microstructure.

Table 5: Interpretation of the main empirical findings

Finding block	Interpretation
Order-flow composition	Higher FGI values shift submitted order flow strongly toward the buy side.
LOB state	Sentiment pressure is expressed clearly in imbalance and only moderately in quoted spread.
Execution quality	Effective spread responds more strongly than quoted spread, indicating worse trading conditions under greed-dominated regimes.
Statistical plausibility	Fat tails, volatility clustering, and dispersed agent outcomes suggest that the sentiment effect emerges in a non-trivial market environment.

Source: Author's interpretation of simulation results

The paper nevertheless has several limitations. The implementation relies on price priority rather than full price–time priority (Abergel et al., 2016),, uses a simplified Hawkes-like process rather than a fully calibrated model and excludes explicit exchange fee structures. Accordingly, the simulation should be interpreted as a controlled experimental environment designed to isolate the sentiment transmission mechanism, rather than as a full replication of a specific exchange microstructure.

6. CONCLUSION

This study employs an agent-based simulation to investigate how market sentiment, proxied by the Crypto Fear and Greed Index (FGI), shapes the microstructure and execution costs of cryptocurrency limit order books.

The results show that a parsimonious sentiment rule generates economically meaningful microstructure effects. As the Fear & Greed Index increases, the simulated market becomes progressively more buy-driven, order-book imbalance shifts toward the demand side, and effective execution costs rise, even though quoted spread remains relatively stable.

The central empirical finding is that sentiment affects market quality primarily through directional pressure within the order book, rather than through direct price adjustments. This reinforces the view that sentiment should be incorporated into microstructure-based analyses of cryptocurrency markets, particularly when evaluating execution conditions and trading costs.

The validity of these findings is supported by the model's ability to endogenously reproduce key stylized facts, including fat-tailed returns and volatility clustering. This confirms that the observed sentiment effects are emergent properties of a non-trivial market environment rather than artifacts of a constrained price process. By highlighting that sentiment

materially alters execution quality, this research reinforces the necessity of incorporating behavioral indicators into microstructure-based analyses of digital assets.
Future research may extend this framework by implementing full price–time priority, increasing agent heterogeneity, and conducting broader multi-run sensitivity analyses to further refine the understanding of sentiment transmission in decentralized markets.

REFERENCES

Abergel, F., Chakrabarti, B. K., Chakraborti, A., & Mitra, M. (2016). *Limit Order Books*. Cambridge University Press.

Almeida, J., & Gonçalves, T. C. (2023). A systematic literature review of investor behavior in the cryptocurrency markets. *Journal of Behavioral and Experimental Finance*, 37, 100785. https://doi.org/10.1016/j.jbef.2022.100785

Aslanidis, N., Bariviera, A.F. and López, Ó.G. (2022) 'The link between cryptocurrencies and Google Trends attention', *Finance Research Letters*, 47, 102654. https://doi.org/10.1016/j.frl.2021.102654

Axtell, R. L., & Farmer, J. D. (2022). Agent-Based Modeling in Economics and Finance: Past, Present, and Future. *INET Oxford Working Paper* No. 2022-10. Institute for New Economic Thinking at the Oxford Martin School

Bacry, E., Mastromatteo, I., & Muzy, J. F. (2015). Hawkes processes in finance. Market Microstructure and Liquidity, 1(01), 1550005. https://doi.org/10.1142/S2382626615500057

Bessembinder, H. (2003). Issues in assessing trade execution costs. *Journal of Financial Markets*, 6 (3), 233-257. https://doi.org/10.1016/S1386-4181(02)00064-2

Bokhari, A. (2025). Unpacking Herding in Crypto Markets: An Agent-Based Study of True and Spurious Herding Dynamics', *Procedia Computer Science*, 274, pp. 463–476. https://doi.org/10.1016/j.procs.2025.12.046

Chowdhury, M. I. H., Hasan, M., Bouri, E., & Tang, Y. (2024). Emotional spillovers in the cryptocurrency market. *Journal of Behavioral and Experimental Finance*, 41, 100878. https://doi.org/10.1016/j.jbef.2023.100878

Cont, R. (2001). Empirical properties of asset returns: stylized facts and statistical issues. *Quantitative Finance*, 1(2), 223-236. https://doi.org/10.1080/713665670

Engle, R. F. (1982). Autoregressive conditional heteroscedasticity with estimates of the variance of United Kingdom inflation. *Econometrica*, 987-1007. DOI:10.2307/1912773

Fratrič, P., Sileno, G., Klous, S. et al. Manipulation of the Bitcoin market: an agent-based study. Financ Innov 8, 60 (2022). https://doi.org/10.1186/s40854-022-00364-3

Gessie, L. (2026). Do Bitcoin Returns Move Sentiment? Evidence from the Crypto Fear & Greed Index. *Finance Research Open,* 2 (2026) 100094. https://doi.org/10.1016/j.finr.2026.100094

Gould, M. D., Porter, M. A., Williams, S., McDonald, M., Fenn, D. J., & Howison, S. D. (2013). Limit order books. *Quantitative Finance*, 13(11), 1709–1742. https://doi.org/10.1080/14697688.2013.803148

Grimm, V., Railsback, S. F., Vincenot, C., Berger, U., Gallagher, C., DeAngelis, D., Edmonds, B., et al. (2020). The ODD protocol for describing agent-based and other simulation models: A second update to improve clarity, replication, and structural realism. *Journal of Artificial Societies and Social Simulation*, 23 (2), 7. https://doi.org/10.18564/jasss.4259

Hasbrouck, J. (2007). *Empirical Market Microstructure*. Oxford University Press

Hawkes, A. G. (1971). Spectra of some self-exciting and mutually exciting point processes. *Biometrika*, 58 (1), 83-90. https://doi.org/10.2307/2334319

Kyriazis, N., & Corbet, S. (2026). Can cryptocurrency fear influence technology firm investors? *International Review of Economics & Finance*, 107, 105043. https://doi.org/10.1016/j.iref.2026.105043

Mike, S., & Farmer, J. D. (2008). An empirical behavioral model of liquidity and volatility. *Journal of Economic Dynamics and Control,* 32(1), 200-234. https://doi.org/10.1016/j.jedc.2007.01.025

Wilensky, U. (1999) NetLogo. Center for Connected Learning and Computer-Based Modeling. Northwestern University, Evanston. http://ccl.northwestern.edu/netlogo/

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GLOBAL ECONOMIC INSTABILITY AND CORPORATE STRUCTURE: EVIDENCE FROM EMERGING MARKETS

Abstract: This study examines the influence of global economic instability on corporate capital structure of companies from selected emerging markets, focusing on publicly listed companies from Southeastern European countries over the period 2010–2024. The sample includes non-financial companies listed on stock exchanges from the Southeastern European region, involving a period characterized by significant external shocks, including the aftermath of the global financial crisis, the COVID-19 pandemic, and recent geopolitical tensions. Using a dynamic panel data framework, the study analyzes how the mixture of microeconomic, macroeconomic and corporate governance factors in the periods of global uncertainty influenced companies' leverage ratios. The findings indicate that heightened global instability leads to a reduction in long-term leverage and a greater reliance on short-term debt, reflecting precautionary financing behavior and constrained access to external capital markets. The results contribute to the capital structure literature by providing evidence from relatively underexplored Southeastern European emerging markets and by highlighting the sensitivity of corporate financing decisions to global instability. The findings have important implications for policymakers, investors, and corporate managers in designing resilient financial strategies in turbulent macroeconomic environments.

Keywords: Capital structure, debt, Emerging markets

1. INTRODUCTION

The main task of the company's financial manager is to formulate an efficient and effective financial strategy in order to maximize the company's profit and thus the overall value of the business. One of the key elements of an effective financial strategy is the construction of an optimal mix of debt and capital. In order to finance its activities, the company can use two types of sources of funds, namely debt and equity. The relationship created between these two elements is called the company's capital structure. The way of formulating and the structure itself depends on many factors such as the activity that the company performs and even the country in which it operates. At the same time, financial managers

have to "weigh" between the benefits for the company itself on the basis of the benefits from tax breaks due to debt and excessive indebtedness, i.e. insolvency of the business itself. It is this process of forming a balance between the benefits of tax savings and value maximization and bad outcomes due to insolvency and the risk of bankruptcy that gives great importance to the construction of the optimal combination of the financial mix. The formulation of the capital structure and its effect on the overall value of the company is one of the six main ideas in finance. Based on this, numerous theories have been developed, such as the theory of relevance and irrelevance, the theory of compromise, the theory of agency and the theory of hierarchical order. The authors have referred to them in the literature review section of this study. In this study, the authors try to show, through the use of dynamic econometric models, the tendency of companies to move the level of indebtedness towards some target level of the capital structure, as well as a comparison of that effect, called debt persistence, in periods of financial uncertainty.

The role of financial managers in designing an optimal capital structure becomes even more complex in the context of recent global disruptions such as the COVID-19 pandemic and heightened geopolitical tensions. These events have significantly altered the external environment in which companies operate, affecting access to financing, cost of capital, and overall risk perceptions. During crisis periods, such as the pandemic and subsequent geopolitical instability, companies often face declining revenues, supply chain disruptions, and increased uncertainty. Those uncertainticies can shift their preference toward more conservative financing strategies or, force greater reliance on debt due to constrained equity markets. In this regard, the traditional trade-off between the tax advantages of debt and the risks of financial distress become more pronounced. The study consists of five units and follows the classic imrad structure of composing a scientific article. The first and second parts include an introduction to the research and an overview of the relevant literature. The third part consists of an overview of the used methodology and data. The fourth and fifth parts include the interpretation of the results and the conclusion of the research. A detailed overview of the used models and diagnostic tests is provided in the methodology and data section.

2. LITERATURE REVIEW

The most important ideas in the field of capital structure should be mentioned when studying the capital structure of businesses. The theory of capital structure was based on Modigliani and Miller's (1963) notions of relevance and irrelevance. While the relevance theory takes into account things like taxes and bankruptcy expenses, the theory itself implies that in a perfect market, a firm's capital structure has no bearing on its market value. Over time, economists have developed a number of additional theories of capital structure, such as the Pecking order theory (Myers, 1984), which contends that in order to preserve financial flexibility, businesses should prioritize internal financing over external financing and favor debt issuance over stock. The trade-off theory and agency theory (Kraus & Litzenberger, 1973; Titman, 1984) represent additional theories in the field of capital structure. The trade-off theory is perhaps the most popular and it states that companies will increase debt as long ad the tax benefits of using it are postiive. On the other hand the agency theory delves into the problem of agency between stakeholders and managers, hence the name agency theory. The theory suggests that managers tend to not act in the best interests of shareholders in the case of adding debt to the companies liabilites.

Study by Reddy, Mirza & Yahanpath (2022), investigated companies from ten selected European countries, researching capital structure determinants in the crisis period. The findings suggested that size and tangiability had a significant effects on companies leverage while the improvement of institutional environment variables pointed to an increase in economic performance. Tripathy & Asija (2017), investigated listed companies in India during the period from 2003 to 2014. The study included the segmetation process, similar to this study, to the pre and post-crisis sections. The findings showed that factors such as tangiability and size showed a more significant influence on leverage during pre-crisis period. Also the study showed that profitability had a negative influence on capital structure. Investigating US listed companies, Harrison & Widjaja (2014), concluded that determinants such as tangiability and size had a stronger influence on capital structure choices during the crisis while profitability had less off an impact, thus proving the applicability of the pecking-order theory. Contrary to their findings, Tripathy & Asija (2017) uncovered that in the case of companies listed in India, size and tangiability showed a relatively weaker impact on capital structure during crisis periods. Moradi & Paulet (2019) detected that in the case of six selected European countries, economic growth, profitability, levels of tax shields had a significantly negative effects on companies leverage levels during the EuroCrisis period. Iqbal & Kume (2013) observed how the recent financial crisis affected the capital structure choices made by German, French, and UK companies. They found that debt and equity levels fluctuate both during and after the crisis. Additionally, the study discovered that leverage rose both during and after a crisis. Azhari., Mahmud, & Shaharuddin, (2022) investigatied listed Malasyan companies during the period before and after the COVID-19 pandemic. The results showed a statisticly significant impact of profitability in both periods. What was also concluded is that more profitable companies had lower levels of short-term debt before the crisis while long-term debt levels decrease more during the crisis. With the use of GMM model, similar to this study, Kalash (2023) investigated companies listed on Instanbul Stock Exhange and determined that companies that decreased their leverage levels during currency crisis periods had a greater effects on companies performance rather that companies who decreased the level

of debt in non-crisis periods. Neves et al. (2020) used dynamic GMM models to study non-financial listed companies in Portugal. They found that capital structure decisions are dependent on a number of company-specific factors and that the effects of the factors that determine the debt maturity ratios vary depending on the type of company and the economic cycle. According to Bvirindi & Inalegwu's (2024) , small and medium-sized businesses in the EU have greater reductions in loan maturity during times of crisis, indicating a reliance on short-term debt with significant rollover risks. The study also showed that for companies in the agriculture sector, this behavior is long-lasting. Leverage, long-term debt issuance, and debt maturity are all affected asymmetrically by the global financial crisis and the EU debt crisis across various industries and company sizes. Kenourgios et al. (2019) identified the factors that determine the capital structure of listed SMEs for the economies of new EU members. Based on a panel of 3,267 observations from 2005 to 2015, the author demonstrated that tangibility, sales (size), and business risk all had a beneficial impact on an organization's debt. The only factor that reduced debt was rising profitability. Gajdosikova, Lazaroiu & Valaskova (2023) and Gajdosikova, et al., (2023) found statistically significant differences in the leverage coefficient values based on the company's size and legal form organization. These findings supported previous research by Mazanec (2023), Ranjan (2021), Ersoy (2022), and Milovanović, Bašić & Bubaš (2022) that found significant internal factors impacting a company's debt.

Focusing on smiliar studies in the region, Mostarac & Petrovic (2013) conducted a study where they investigated capital structure determinants during financial crisis in Croatia. The sample included about 10000 companies and the research covered a short time frim from 2007 to 2010. The findings indicated that size of companies had a stronger impact during the crisis period compared to the period before the crisis. Tangiablity and profitability also showed a significant but negative impact on financial leverage. According to Jovanović's (2015) findings, leverage was adversely correlated with profitability, tangibility, and non-debt tax shield, but positively correlated with the size of Macedonian companies between 2000 and 2014 period. However, the pre-crisis level of leverage and shifts in enterprises' performance throughout the crisis had an impact on the leverage decisions made following the crisis. The significance of company size, profitability, tangibility, and risk in defining the capital structure of companies in Serbia is confirmed by the research findings of Stoiljkovic et al. (2023). However, contrasted to short-term and overall leverage, the study's findings indicate that the size, profitability, and tangibility of assets have the opposite influence on long-term leverage.
In order to establish the distinctiveness of the relationship between liquidity and capital structure characteristics throughout the crisis period from 2008 to 2011, Mihajlov, Malinić, & Grabinski (2014) examined 108 Serbian-listed companies. The primary finding of this study is that businesses shifted a sizable portion of the financing load to their suppliers during the crisis, which is pertinent to both company managers and policy makers. The issue of liquidity spiraled and the potential of bankruptcy grew larger in both individual businesses and the entire economy because suppliers were subject to similar issues during a crisis.

3. METHODOLOGY AND DATA

The research includes an analysis of 116 companies listed on the the benchmark stock indicies of stock exchanges of selected SouthEasterncountries. The sample includes 116 companies because of the avaliablity of the data. The data of the companies and relevent coefficients were calculated using the financial statements of available selected companies. The period from 2010 to 2024 was covered, while the segmentation process divided the data into two seperate sections. The first section was labeled as the pre crisis period and involved the time frame from 2010 till 2018 while the second section involved the timefrime of 2019 till 2024. The authors use dynamic panel data model of Generalized method of moments (GMM) to interpret the results. The dynamic model was identified to be the most suitable tool in analyzing the effects of persistince of debt, according to the past literature. The authors also used a number of different diagnostic tests, inlcuding stationarity testing, multicolinearity test, heteroscedasticity and cross-dependance test. The results confirmed that GMM models was the most adequate model to use in the case of selected data. The authors also compared the results of two-step difference GMM and two-step system GMM, similar to studies by (Nyeadi, Banyen & Mbawuni, 2017; Rehan, et al., 2023), and identified the adequate seletction using Sargan test and Autocorrelation tests. In table no.1 the authors show used dependant and independant variables. The independant variables are seperated into micro-economic, macro-economic and corporate governance groups. The use of macro-economic variables is tied to avoidance of omitted variable bias because the study incorporates the timeframe of multiple crisis periods.The authors for the calculation of dependant variables and micro-economic group of variables used their book value instead of market value.

Table 1: Dependant and independent variables

Variable	Measure	Symbol
Dependant variables		
Total debt (crisis)	Book value of total debt / Book value of total assets	CDEBT
Total debt (post-crisis)	Book value of total debt / Book value of total assets	PcDEBT
Independent variables - micro economic		
General liquidity	Current assets / Current liabilities	GL
Profitability	Net profit / Total assets	ROA
Size of the company	Logarithm on assets	LnSize
Tangibility	Tangible assets / Total assets	TAN
Idependant variables - macro economic		
Gross domestic product	% growth of GDP	GDP
Gross public debt	% of GDP	GROSSDE
Independant variables - corporate governance		
Size of the board	Number of board members	BN

Source: author's

According to the afformentioned criteria as well as dependent and independent variables, the authors generated the following equations:

$$CDEBT_{it} = \alpha + \beta_1 GL_{it} + \beta_2 ROA_{it} + \beta_3 LnSIZE_{it} + \beta_4 TAN_{it} + \beta_5 GDP_{it} + \beta_6 GROSSDE_{it} + \beta_7 BN_{it} + \varepsilon$$

$$PcDEBT_{it} = \alpha + \beta_1 GL_{it} + \beta_2 ROA_{it} + \beta_3 LnSIZE_{it} + \beta_4 TAN_{it} + \beta_5 GDP_{it} + \beta_6 GROSSDE_{it} + \beta_7 BN_{it} + \varepsilon$$

Where are:

CDebtit = Debt to assets in the crisis period ratio for company I in time period t
PcDebtit=Debt to assets in the post-crisis period ratio for company I in time period t
GLtit = Liquidity ratio for company I in time period t
ROAtit = Profitability ratio for company I in time period t
LnSizeit = Size of companies I in time period t
TANtit = Tangibility ratio for company I in time period t
GDPt= GDP growth rate in time period t
GROSSDEt= Gross debt percentage of countries in time period t
BNt= The number of board members of companies in the time period t

Table 2 presents the construction of the sample of data. The sample included 116 companies listed on the stock exchanges of developing South Eastern countries such as Serbia, Bulgaria, Romania, Bosnia & Hercegovina, Macedonia, Greece, Croatia and Montenegro. The companies that were selected were listed on the benchmark indicies of mention countries. The authors tried to construct the sample that included an even distribution, focusing the majority of companies on more developed stock exchanges and a smaller number of companies on less developed stock exchanges.

Table 2: Sample construction

Countries	% of the sample	Number
Serbia	21%	24
Bulgaria	15%	17
Romania	11%	13
Croatia	16%	18
Macedonia	4%	5
Greece	13%	15
Bosnia & Hercegovina	13%	15
Montenegro	8%	9
	100%	116

Source: author's

4. FINDINGS

Table 3 presents the summary desctiptive statistics of used dependant and independant variables. The statistics show mean, maximum, minimum and standard deviation values. In regards to the dependant variable of total debt of companies the statistics show the mean value of 0,45 witch represent the companies from the sample, on average , tend to use more of capital than debt in their financing. The maximum value of debt was reached by a company from Romania, while the minimum value was present in the company from Bosnia & Hercegovina. Observing micro-economic independant variables, the statistics show that variables of liquidity and size present the largest amounts of standard deviation. Elevated levels of standard deviation mean that these variables had the biggest distribution from minimum to maximum values in the sample. In the case of macro-economic variables, gross debt of countries also presented an elevated level of standard deviation, biggest in the sample of data. Observing the corporate governance variable of number of board members, the authors show that the maximum number of board members is 15 and it was achieved by a company from Greece while the minimum number of 2 board members was achieved by a number of companies from the sample.

Table 3: Descriptive statistics

Variable	Mean	Std. Dev.	Min	Max	Obs
TD	0,45	0,41	0,00	9,01	1605
LIQ	5,56	9,49	0,02	37,73	1605
ROA	0,04	0,11	-0,84	2,69	1605
TAN	0,49	0,45	0,00	0,97	1605
SIZE	12,59	5,87	3,85	23,84	1605
GDP	1,91	3,67	-15,31	13,04	1605
GROSSDE	65,84	47,28	14,07	212,45	1605
BN	5,30	2,52	2,00	15,00	1605

Source: author's

Table 4 presents the summary of diagnostics tests conducted in order to determine the adequacy of used econometrics models. For determining the pressence of heteroskedacticity of used data, the authors used the Breuch-Pagan test and concluded that, due to the significance level, the data does present heteroskedacticity. In order to determine the pressence of cross-sectional dependance, witch presents one of the relevant diagnostic tests in the case of panel data, the authors used the Pesaran and Friedman CD tests. Due to the values of coefficients and probabilty levels, the authors conclude that the panel data used, does not present cross-sectional dependancy. For determining multiconinearity of data, the authors used the variance inflation factor test and due to the value of the coefficient not exeeding the value of 10, the authors determine that the used independant variabls do not correlate with eachother and reject the hypothesis of the pressence of multicolinearity. The authors also determined the stationarity of data, using various tests such as Levin-Lin and Chu, Breitung, Augmented-Dickey Fuller tests. In order to present a more readable article, the authors decided just to sum up the results of the tests in table 4. The results showed that five variables showed stationarity at level while three of the variables presented stationarity after first difference. The authors conclude that dynamic model of generalized method of moments (GMM) presents the most adequate model for interpreting results.

Table 4: Diagnostic tests

	Coef.	Prob.
Heteroskedacticity	4970,5	0,0000
Pesaran CD	11,471	0,0000
Friedman CD	70,39	0,1096
Average VIF	1,15	
Stationarity	(0) - 5	(1) - 3

Source: author's

As previously stated, in this section of the study the authors present the main findings. The sites are divided into pre-crisis and post-crisis periods. The results include the presentation of coefficients, t statistics and p-values. The authors also used statistical significance levels of 1%, 5% and 10% for the interpretation of the results. In addition to the interpretation of the nature, direction and significance of the effects of the selected variables, the authors also interpret through the results the application of the aforementioned theories of capital structure, such as the trade-off theory and the pecking order theory. After the interpretation of the diagnostic tests carried out in table no. 4, authors in table no. 5 also perform additional diagnostic tests, namely the Arellano Bond (AR) autocorrelation test and the Hansen test. These two types of tests are applied to select between two types of two-stage dynamic model Gmm. Based on the interpretation of the results, the two-step system GMM is presented as a more robust and adequate model compared to the two-step difference GMM model. From the aspect of the first model, which refers to the period before the crisis, the variables of liquidity and the number of board members showed a statistically significant effect with a significance level of 1%, while GDP and profitability also showed a statistically significant effect but of 5% and 10%, respectively. Along with liquidity and the number of board members, the lagged version of the dependent variable of total debt also showed a statistically significant effect at 1%. In the case of the second model, similar to the first one, liquidity showed a statistically significant effect with a significance level of 1%. The number of board members showed a statistically significant impact at the 5% significance level, while asset tangibility and profitability showed a 10% statistical significance. Similar to the first model, the lagged version of the dependent variable total debt also showed a statistically significant positive effect at the 1% significance level. The positive effect of the lagged version of total debt indicates the presence of debt persistence in both cases, where the previous version of debt affects the future version of total indebtedness and shows the tendency of companies to gradually increase their debt level over time towards a target capital structure. These results are consistent with the dynamic trade-off theory, which tells us that companies increase their level of indebtedness over time due to the costs of sudden adjustments to their debt levels. Also, the results point to the need for financial management to pay attention to the very levels and structure of the debt as well as long-term financial planning due to the presence of a gradual increase in the level of indebtedness. What the results show is that debt persistence increased during the crisis period compared to the pre-crisis period. In the case of the first model, a growth of 1% causes a growth of 0.28%, while in the case of the second model, or the crisis period, a growth of 1% causes a growth of 0.71%, which indicates that the companies in the sample during the crisis period increased their level of indebtedness towards the target capital structure faster and to a greater extent.

Table 5: Regression results system GMM

	Pre crisis period			Crisis period		
Variables	Coef	t	P > t	Coef	t	P > t
L1 TD	0,28	2,41	0,018	0,712	2,69	0,008
LIQ	-0,459	-6,76	0,000	-0,524	-4,16	0,000
ROA	0,0416	1,86	0,065	0,044	1,65	0,100
SIZE	-0,0007	-0,11	0,909	-0,0866	-0,93	0,352
TAN	-0,0201	-0,61	0,540	0,2456	1,63	0,100
GDP	-0,057	-2,00	0,047	0,0039	0,79	0,430
INF	-0,0094	-0,52	0,606	0,0019	0,31	0,756
BN	0,0055	2,64	0,008	0,004	2,28	0,023
C	-0,375	-1,86	0,065	0,044	3,46	0,001
Arellano Bond AR(1)			0,045			0,017
Arellano Bond AR(2)			0,936			0,702
Hansen test			0,949			0,242

Source: author's

From the aspect of liquidity indicators, in the case of both models, there is a negative effect. A 1% increase in liquidity in the pre-crisis period causes a drop in total indebtedness by 0.46%, while in the crisis period it causes a drop of -

0.52%. These results initially indicate the tendency of companies to use surplus funds for debt repayment, which is in agreement with the pecking-order theory of capital structure, and indicate a slightly stronger effect in the crisis period. Profitability showed a positive effect in both models, but with a slightly lower level of statistical significance. In the pre-crisis period, an increase of 1% causes an increase in indebtedness by 0.042%, while in the case of a crisis period, it increases by 0.44%, which indicates the applicability of the trade-off theory, and indicates the tendency of companies to spread the profit before reinvesting it in the company. Looking at the corporate governance variable of the number of board members, the results indicated a positive effect in the case of both models with greater statistical significance and a slightly greater effect in the pre-crisis period. The results indicated that as the number of members of the board of directors of the selected companies increases, the companies tend to use additional borrowed capital. Especially for the pre-crisis model, the GDP variable showed a negative effect where a 1% increase in GDP causes a 0.06% decrease in indebtedness, indicating that companies in periods of economic expansion tend to lower their debt levels. Especially for the model during the crisis period, the asset tangibility variable showed a positive effect where a growth of 1% causes a debt growth of 0.25%, which further shows the tendency of companies to use their fixed assets as collateral for additional lending in crisis periods to a greater extent, which is in line with the trade-off theory of capital structure.

5. CONCLUSION

In the first three parts of the study the authors covered the main capital structure theories and also the similar conducted studies on the theme of capital structure determinants in crisis periods. Also, the authors used a dynamic two-step system GMM model to adequately interpret the results. Main contribution of this study is the comparison of the post and pre crisis sections of the use data and the presence of persistant effects of debt. The authors conclude that companies incorporating more debt in the structure of their liabilities tend to increase their indebtness in the future along side the increase in their profitability witch is in line with the main postulates of the dynamic trade-off theory. These findings are also confirmed by the negative influence of liquidity on total debt of companies. The finding also point to the greater presence of persistence of debt in the post-crisis period where companies overall, due to economic instability, tend do borrow more. The main limitations of this study is the use of just listed companies in the study. The authors suggest that more corporate governance indicators should be included, managers ages, managers genders to further investigate the influence on indebtness of companies. The authors also suggest further use of segmentation process of selected companies, such as, industry sector membership.

REFERENCES

Azhari, N. K. M., Mahmud, R., & Shaharuddin, S. N. H. (2022). Capital structure of Malaysian companies: Are they different during the COVID-19 pandemic?. *The Journal of Asian Finance, Economics and Business (JAFEB)*, *9*(4), 239-250.

Bvirindi, T. C., & Inalegwu, O. I. (2024). The impact of the global financial crisis and the European sovereign debt crisis on the capital structure of firms in Europe: do SMEs, and listed firms respond the same?. *The European Journal of Finance*, *30*(8), 889-913.

Denčić-Mihajlov, K., Malinić, D., & Grabiński, K. (2015). Capital structure and liquidity during the financial crisis in Serbia: implications for the sustainability of the economy. *Post-Communist Economies*, *27*(1), 91-105.

Ersoy, E. (2022). An Empirical Study on the Determinants of the Kapital Structure in Turkish Textile and Apparel Firms. *Sosyoekonomi*, *30*(54), 199-213.

Gajdosikova, D., Lăzăroiu, G., & Valaskova, K. (2023). How Particular Firm-Specific Features Influence Corporate Debt Level: A Case Study of Slovak Enterprises. *Axioms*, *12*(2), 183.

Gajdosikova, D., Valaskova, K., Kliestik, T., & Kovacova, M. (2023). Research on Corporate Indebtedness Determinants: A Case Study of Visegrad Group Countries. *Mathematics*, *11*(2), 299.

Harrison, B., & Widjaja, T. W. (2014). The determinants of capital structure: Comparison between before and after financial crisis. *Economic Issues*, *19*(2), 55-82.

Iqbal, A., & Kume, O. (2014). Impact of financial crisis on firms' capital structure in UK, France, and Germany. *Multinational Finance Journal*, *18*(3/4), 249-280.

Kalash, I. (2023). The financial leverage–financial performance relationship in the emerging market of Turkey: the role of financial distress risk and currency crisis. *EuroMed Journal of Business*, *18*(1), 1-20.

Kenourgios, D., Savvakis, G.A. and Papageorgiou, T. (2019), "The capital structure dynamics of European listed SMEs", Journal of Small Business and Entrepreneurship, Vol. 32, pp. 567-584.

Kraus, A., & Litzenberger, R. H. (1973). A state-preference model of optimal financial leverage. *The journal of finance*, 28(4), 911-922.

Mazanec, J. (2023). Kapital Structure and Corporate Performance: An Empirical Analysis from Central Europe. *Mathematics*, *11*(9), 2095.

Milovanović, B. M., Bašić, M., & Bubaš, Z. (2022). Examining the role of firm size in commitment small firm performance relationship among Southeast European Smes. *EMC Review-Economy and market communication review*, *23*(1), 266-278.

Modigliani, F., & Miller, M. H. (1963). Corporate income taxes and the cost of kapital: a correction. *The American economic review*, 433-443.

Moradi, A., & Paulet, E. (2019). The firm-specific determinants of capital structure–An empirical analysis of firms before and during the Euro Crisis. *Research in International Business and Finance*, *47*, 150-161.

Mostarac, E., & Petrovic, S. (2013). Determinants of capital structure of Croatian enterprises before and during the financial crisis. *utms Journal of Economics*, *4*(2), 153-162.

Myers, S. C., & Majluf, N. S. (1984). Corporate financing and investment decisions when firms have information that investors do not have. *Journal of financial economics*, 13(2), 187-221.

Neves, M. E., Serrasqueiro, Z., Dias, A., & Hermano, C. (2020). Capital structure decisions in a period of economic intervention: Empirical evidence of Portuguese companies with panel data. *International Journal of Accounting & Information Management*, *28*(3), 465-495.

Nyeadi, J. D., Banyen, K. T., & Mbawuni, J. (2017). Determinants of capital structure of listed firms in Ghana: Empirical evidence using a dynamic system GMM. *The Journal of Accounting and Management*, *7*(2).

Ranjan, A. (2021). The Determinants and Speed of Adjustment of Kapital Structure: Empirical Evidence from Listed Firms in India During Pre-and Post-Global Financial Crisis. *IUP Journal of Applied Finance*, *27*(3), 39-54.

Reddy, K., Mirza, N., & Yahanpath, N. (2022). Capital structure determinants during the sovereign debt crisis period. *Australasian Accounting, Business and Finance Journal*, *16*(4).

Rehan, R., Hadi, A. R. A., Hussain, H. I., & Hye, Q. M. A. (2023). Capital structure determinants across sectors: Comparison of observed evidences from the use of time series and panel data estimators. *Heliyon*, *9*(9).

Stoiljković, A., Tomić, S., Leković, B., & Matić, M. (2022). Determinants of capital structure: Empirical evidence of manufacturing companies in the Republic of Serbia. *Sustainability*, *15*(1), 778.

Titman, S. (1984). The effect of kapital structure on a firm's liquidation decision. *Journal of financial economics*, 13(1), 137-151.

Tripathy, N., & Asija, A. (2017). The impact of financial crisis on the determinants of capital structure of listed firms in India. *Journal of International Business and Economy*, *18*(1), 101-121.

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CREDIT RISK DETERMINANTS IN THE BANKING SYSTEM: EVIDENCE FROM WEST BALKAN COUNTRIES

Abstract: Credit risk is one of the major elements while taking banking management into account and therefore it is of the essence to habitually monitor what exerts a significant influence. West Balkan countries are prone to fluctutations of credit risk as the region is infulenced by turbulence of financial markets. For that reason, these countries are in the focus while conducting the research. The prime objective of this paper is to closely examine the factors which significantly contribute to the level of credit risk in the period from 2013 to 2025 in that effective credit risk management could be performed in the long-run. The research was conducted by using panel data regression analysis with random effects on variables. Credit risk, as a dependent variable, is measured in non-performing loans to total gross loans. On the other hand, explanatory variables include return on assets (ROA), reference interest rate, bank size, liquid assets to total assets, GDP growth and inflation.The results of a random effects model reveal that reference interest rate and GDP growth affect credit risk positively and significantly, whereas bank size, liquid assets to total assets and inflation rate have a negative and significant impact on credit risk.The limitation of the study refers to the fact that the time series covers the period 2013-2025. As well as that, the results of the research cannot be applied to developed countries since the West Balkan countries are considered as emerging countries.

Keywords: credit risk, West Balkan countries, panel-data regresssion, random-effects model

1. INTRODUCTION

It has been quite harder for banks to manage their performance after financial crisis left marks . An increasingly high number of banks across West Balkan market have greatly diminished in value, which led to jeopardizing financial markets. The banking sector is influenced by turbulence which results in great number of banks disappearing due to not being able to face the risks and failures (Beck, Jakubik, & Piloiu, 2015). The most common obstacle in banking management is credit risk, which is associated with non-performing loans (NPLs) (Ćurak, Poposki, & Pepur, 2013). Also, credit risk is considerable since the half of the bank assets are credit placements.Banks are obliged to regularly follow credit risk fluctutatins; otherwise, banks might easily come to an end with their performance. The definition of credit risk is based on the possibility of debtors not repaying a loan together with its interest for a particular period, which is approximately 90 days or more (Louzis, Vouldis, & Metaxas). Moreover, if a client is late with a loan repayment for more than a mentioned period, that loan becomes a non-performing one.

The level of non-performing loans always exerts a damaging effect on whole economy and it is representative of banking hazards and a sign of deeper troubles (Naili & Lahrichi, 2022). For that reason, it is of utmost importance to occasionally evaluate the risk and monitor the amount of non-performing loans on a national level. Apart from being a threat to an individual bank, the value of NPLs is an indication of the overall weekness of the banking system as well as a realiable determinant of banking crisis (Zawadzki, 2023). Credit risk is usually in the focus while typical risks evalution since loan origination highly depends on the quality of credit risk management. For that reason, it is essential to habitually monitor what contributes to the level of credit risk.

The concerning fact is that banks are usually in search of finding solutions to handle the risk, rather than prevent it (Cheng, Nsiah, Charles, & Ayisi, 2020). That is why it is advisable to proactively investigate what impacts NPLs and possibly take those determinants into consideration to maintain banking stability. This should be especially the case with West Balkan countries since they are all bank-oriented and their financial strenght highly depends on banking institutions.
As for our research, the topic of credit risk is investigated by using variables which include both bank-specific and macroeconomic factors. Bank-specifics cover ROA, liquid assets to total assets and bank size and they are used with the purpose of examining what influences NPLs from different perspestives inside banks. On the contrary, macroeconomic explanatory variables are reference interest rate, the rate of real GDP growth as well as inflation rate. These are usually put forward and emphasized under numerous academis discussions as the external indication of credit risk management.
Our study consists of several parts, where the first one is introduction which summarizes the key points of the demand of credit risk evaluation. Then, there is a literature review which is oriented towards other authors' contributions to the related topic. The third section about methodology and data covers the variable selection and suitable methods. After that, results and discussion cover main findings based on conducted calculation together with comparing it with the results of other studies. In the end, there is a part dedicated to concluding remarks as well as limitations of our research and possible recommendations for its development.

2. LITERATURE REVIEW

The research explains the influence of macroeconomic and bank-specific variables on credit risk and therefore in the following secton the authors emphasized their contributions on the same topic. As for macroeconomic variables, Hariyanti (2024) examined the influence of GDP growth and inflation rate on the level of NPLs by using fixed-effects model based on Indonesian commercial banks and concluded that neither GDP growth nor inflation rate significantly impacts credit risk. On the other side, Ćurak, Pepur and Poposki (2013) used a dynamic panel model to test the impact of ROA, bank size, GDP growth, inflation rate and reference rate on non-performing loans in Southeastern European banking systems. Their research revealed that inflation rate and interest rate positively influence non-performing loans, whereas ROA, GDP growth and bank size affect negatively. This was more expected rather than the results of Hariyanti (2024) since NPLs are at risk of increasing due to macroeconomic variables. This was also proven by the study of Zawadzki (2023) is based on panel data approach with the scope of both developed and developing countries. As a result, they expressed the opinion that inflation rate, GDP growth and reference interest rate do not significantly influence NPLs. In their findings based on dynamic panel approach Koju, Koju and Wang (2018) revealed that ROA affects credit risk negatively, whereas bank size impacts positively based on performance of Indian banking sector.

As far as bank size is concerned, Chaibi and Ftiti (2014) claimed that the larger banks take excessive risks and therefore it is better situation for banks to have larger bank size. By conducting a dynamic panel data regression in a cross-country study (Germany and France), they concluded that bank size exerts a positive and significant effect on credit risk. Together with bank size, they showed that both inflation rate and GDP growth negatively affect credit risk. The explanation is straightword for the dependance of GDP growth on credit risk where the market prosperity decreases the pontential of credit risk improvement. As for inflation, the authors claimed that higher inflation weakens borrowers' ability to service debt by reducing their real income. Also, Chaibi and Ftiti, (2014) point out that reference interest rate has a strong and positive effect on credit risk. On the contrary, Radivojević and Jovović (2017) investigated which determinants impact credit risk by using panel data approach on emerging countries. According to their research, there is a negative and significant relationship between ROA and credit risk as the lower ROA expresses bad management and consequently it results in higer credit risk. Along with that, the authors imply that GDP growth influences NPLs in a negative way in comparison with inflation which affects credit risk positively as higher inflation always puts banking sector at a higher credit risk than usual. Us, (2017) investigated the relationship between NPLs on one side and bank size as well as macroeconomic varaibles including GDP growth and inflaton rate on the other side. Panel data research has revealed that bank size and GDP growth negatively and significantly influence credit risk, whereas inflation rate influences in the oppposite way. The study of Jović (2017) explains the significance of certain determinants on credit risk in Serbia by using VAR model. The research presents reference interest rate does not significantly affect credit risk. However, GDP growth impacts credit risk in a negative way. Concerning bank performance and size, Godlewski (2005) used both 2SLS and 3SLS to test how the variables affect credit risk on emerging markets and consequently it was revealed that both ROA and size exert a negative and significant effect on credit risk. Taking Greece into consideration, Louzis, Vouldis and Metaxas (2012) conducted an in-depth analysis by examining the influence of variables on credit risk based on different types of loan portfolio. As a result of a dynamic panel data regression, the authors point out that size does not have a significant effect on credit risk, whereas GDP growth has a strong and negative influence.

The findings of Abdelaziz, Rim and Helmi (2022) are focused on reciprocal relationship between credit and liquidity risks. By performing seemingly unrelated regression in MENA region the authors presented that liquidity positively affects credit risk. Also, it is concluded that bank size and GDP growth influence credit risk in a negative and significant way, whereas inflation rate impacts positively. There is further discussion related to the impact of liquidity on credit risk in the study of Tran, Nguyen and Duong (2022) where they examined the relationship between the

variables based on panel data approach in Vietnam. They state that liquidity positively impacts credit risk as banks tend to create liquidity to support credit activities, which result in greater number of NPLs. Besides, Toh (2019) puts forward a view that banks are bound to increase liquidity to handle excessive credit risk. That was examined by implementing panel data approach in Malaysia.

In order to ensure better understanding of credit risk factors, in the following table 1 there is a list of authors according to results of their studies.

Table 1: List of authors according to research results

Variable	Negative impact (-)	No significant impact (0)	Positive impact (+)
Return on assets	(Ćurak, Poposki, & Pepur, 2013), (Koju, Koju, & Wang, 2018), (Radivojević & Jovović, 2017) (Godlewski, 2005)		
Reference interest rate		(Zawadzki, 2023), (Jović, 2017)	(Ćurak, Poposki, & Pepur, 2013), (Chaibi & Ftiti, 2014)
Bank size	(Ćurak, Poposki, & Pepur, 2013), (Us, 2017), (Godlewski, 2005), (Abdelaziz, Rim, & Helmi, 2022)	(Louzis, Vouldis, & Metaxas, 2012)	(Koju, Koju, & Wang, 2018), (Chaibi & Ftiti, 2014)
Liquid assets to total assets			(Abdelaziz, Rim, & Helmi, 2022), (Tran, Nguyen, & Duong, 2022), (Toh, 2019)
Real GDP rate	(Ćurak, Poposki, & Pepur, 2013), (Chaibi & Ftiti, 2014), (Radivojević & Jovović, 2017), (Us, 2017), (Jović, 2017), (Louzis, Vouldis, & Metaxas, 2012), (Abdelaziz, Rim, & Helmi, 2022)	(Hariyanti, 2024), (Zawadzki, 2023)	
Inflation rate	(Chaibi & Ftiti, 2014),	(Hariyanti, 2024), (Zawadzki, 2023), (Abdelaziz, Rim, & Helmi, 2022)	(Ćurak, Poposki, & Pepur, 2013), (Radivojević & Jovović, 2017), (Us, 2017)

3.METHODOLOGY AND DATA

Our research is based on data retrieved from the financial statements of a central bank related to a particular West Balkan country (Serbia, Bosnia and Herzegovina, Albania, Montenegro and North Macedonia). Concerning the period from the year 2013 to 2025, the study covers 65 observations. The authors used non-performing loans(NPL) as a dependent variable in order to express credit risk. However, independent variables include bank-specific variables which are reference interest rate (RIR), bank size (BS) and liquid assets to total assets (LATA). Together with them, macroeconomic ones cover real GDP rate (GDPR) and inflation rate (INF).
The table 2 below presents the overview of the variables along with their calculation.

Table 2: Selected variables

Symbol	**Variable**	**Expected effect**
Dependent variable		
NPL	Non-performing loans/total gross loans	/
Independent variable		
ROA	Net income/total assets	-
RIR	Annual rate	+
BS	The logarithm of bank size	-
LATA	Liquid assets/total assets	+
GDPR	Annual rate	-
INF	Annual rate	-

In order to test independent variables on non-performing loans, it is essential to formulate the hypotheses:

H_1: Return on assets negatively affects credit risk.
H_2: Reference interest rate positively affects credit risk.
H_3: Bank size negatively affects credit risk.
H_4: Liquid assets to total assets positively affect credit risk.
H_5: Real GDP rate negatively affects credit risk.
H_6: Inflation rate negatively affects credit risk.

Taking selected variables into account, there is an equation which represents panel model in the following form (Radovanov, Milenković, Kalaš, & Marcikić Horvat, 2023):

$$NPL_{it} = \alpha + \beta_1 ROA_{it} + \beta_2 RIR_{it} + \beta_3 \log(BS)_{it} + \beta_4 LATA_{it} + \beta_5 GDPR_{it} + \beta_6 INF_{it} + \varepsilon_{it}$$

α is an intercept coefficient; ε_{it} is an error term; β_{1it} - regression coefficient of independent variable
i stands for a country, whereas *t* stands for the time (the period from 2013 to 2025)

4.RESULTS AND DISCUSSION

This part of the research includes descriptive statistics, multicollinearity tests, Breusch-Pagan test for heteroskedasticity, augmented Dickey-Fuller test for stationarity as well as conducted panel data model with Hausman test.
STATA version 13 as statistical software is used in order to conduct a research.
Table 3 below presents descriptive statistics of the main variables.

Table 3: Descriptive statistics

Variable	Mean	St.dev.	Min	Max
NPL	8.7615	5.7258	2.2	22.2439
ROA	3.9061	2.3426	-0.1	9.4125
RIR	2.6896	3.0034	-1.6	14
log(BS)	6.4369	0.6763	5.2175	7.7049
LATA	20.7591	6.3021	11.4	38.0974
GDPR	10.5895	7.7232	-4.7	27.7
INF	3.7614	3.5761	-3.3	15.11

Source: Authors' calculations

Regarding multicollinearity, it is advisable to minimize it between the variables as much as possible. If there is a case of strong correlation between determinants, a model is at risk not to be well-performed and not suitable for further examination. To ensure validity of the model concerning multicollinearity, the authors conducted both correlation matrix and variance inflation test.

Table 4: Pearson's correlation coefficients

	NPL	RIR	INF	GDRP	ROA	log (BS)	LATA
NPL	1.0000	-0.0794	-0.3227	0.3013	-0.0866	0.0043	-0.3750
RIR	-0.0794	1.0000	0.1522	-0.2620	-0.2080	0.2547	0.0427
INF	-0.3227	0.1522	1.0000	0.0420	0.0490	0.1160	0.0447
GDRP	0.3013	-0.2620	0.0420	1.0000	0.2307	0.5184	0.2456
ROA	-0.0866	-0.2080	0.0490	0.2307	1.0000	-0.1529	0.4478
log (BS)	0.0043	0.2547	0.1160	0.5184	-0.1529	1.0000	0.1000
LATA	-0.3750	0.0427	0.0447	0.2456	0.4478	0.1000	1.0000

Source: Authors' calculations

According to Shrestha (2020), if the absolute value of Pearson correlation matrix is less than 0.8, there is no case of collinearity. Table 4 corresponds to the author and it can be concluded that there is no issue of multicollinearity.
Speaking of variance inflation (VIF) test, Kyriazos and Poga (2023) imply that VIF score between 5 and 10 indicates the presence of multicolllinearity. Table 5 presents that mean VIF amounts to 1.54, which is less than 5, which means that multicollinearity is not severe.

Table 5: VIF test

Variable	VIF	1/VIF
GDPR	2.02	0.4957
log(BS)	1.93	0.5171
ROA	1.47	0.6822
RIR	1.45	0.6904
LATA	1.34	0.7459
INF	1.04	0.9615
Mean VIF	1.54	

Source: Author's calculations

Augmented Dickey-Fuller test for stationarity is the unit root test of the essence while testing the validity of data and model and therefore the authors conducted the one for all the used variables. The model is suitable for further examintaion if the test proves the acceptance of stationarity.

Table 6: Augmented Dickey-Fuller unit root test

Variable	ADF t statistic	Level Prob
NPL	-3.8745	0.0001
ROA	-4.4752	0.0000
RIR	-2.2486	0.0123
log(BS)	-2.0278	0.0213
LATA	-3.3966	0.0003
GDPR	-2.9960	0.0014
INF	-2.5973	0.0047

Source: Authors' calculation

Apart from table 6, here are the hypotheses formulated to ensure the accuracy of the model:
H_0: All models contain unit roots.
H_1: At least one panel is stationary.

Considering all the variables, level probability is below 0.05 and therefore it can be concluded that the null hypothesis can be rejected meaning that panels are stationary.

As a result of all the previous tests proving to be satisfactory, the panel data regression together with Hausman test can be conducted. Hausman test offers the explanation whether fixed effects or random effects model is more suitable for the purpose of panel regression. As Đaković, Milenković and Andrašić (2024) outlined in their research, in order to test the suitability of a certain regression model, hypotheses are stated as it follows:
H_0: Random effects model is adequate.
H_1: Fixed effects model is adequate.

Table 7: Hausman test

Test summary	Chi-square statistic	Probability
	5.91	0.2057

Source: Authors' caluclation

According to table 7, probability amounts to 0.2057 by which the null hypothesis can be accepted and it can be concluded that random effects model is adequate. As a result, table 8 shows the results of random effects panel regression and after that there is an in-depth discussion considering all the variables.

Table 8: Random effects model

Variable	Coefficient	Std.Error	t-statistic	Prob.
ROA	0.014492	0.281551	0.05	0.959
RIR	0.472700	0.218290	2.17	0.030
log (BS)	-2.659138	1.120175	-2.37	0.018
LATA	-0.459378	0.100087	-4.59	0.000
GDPR	0.493523	0.100189	4.93	0.000
INF	-0.527531	0.155361	-3.4	0.001
constant	30.844510	6.780489	4.55	0.000
R2	0.475			
F-statistic	8.16			
Prob (F-statistic)	0.0000			

Source: Auhors' calculation

The results show that reference interest rate and GDP rate significantly and positively impact credit risk, which results in H_1 being accepted and H_5 being rejected. As for reference interest rate, our research corresponds to the studies of Chaibi and Ftiti (2014) and Ćurak, Poposki and Pepur (2013), whereas Zawadzki (2023) and Jović (2017) stated insignificance of the variable on credit risk. Higher referece interest rate enables banks to serve loans with the higher interest rate which leads to increase in debt and higher amount of non-performing loans as well. Besides, higher reference interest is the indication of potential recession on the market which always leads to customers' inability to pay off the loans. Ćurak, Poposki and Pepur (2013), Chaibi & Ftiti (2014), Radivojević and Jovović (2017) and Louzis, Vouldis and Metaxas (2012) revealed the opposite results of our research in the terms of the relationship between credit risk and GDP growth. The reason why our research differs up to an extent is the fact that economic prosperity of West Balkan markets depends on investment loans. Moreover, the loans are provided with the purpose of investing in certain economic activities and due to their great amount non-performing loans are considerable as well.

As for bank size, liquid assets to total assets and inflation rate, all of them exert a negative and significant influence on credit risk, meaning that H_3 and H_6 are accepted and H_4 is rejected. The results of Ćurak, Poposki and Pepur (2013), Us (2017), Abdelaziz, Rim and Helmi (2022) correspond to ours regarding bank size as greater bank assets ensure diversification. In other words, increased bank assets can offer banks other chances how to increase their portfolio apart from giving loans. By making the most of these alternatives West Balkan countries appear to decrease the level of credit risk. However, the research of Chaibi and Ftiti (2014) shows the same significance of inflation rate as ours, i.e inflation rate negatively impacts credit risk which does not correspond to Hariyanti (2024), Zawadzki (2023) and Abdelaziz, Rim and Helmi (2022). Even though it was expected that inflation rate positively impacts non-perfroming loans, the case in West Balkan countries is quite different where higher inflation is associated with diminishing in real value of outstanding loans in the banking sector and therefore the number of non-performing loans decreases accordingly. Also, higher inflation is connected to lower unemployment which additionally explains the negative relationship between inflation rate and credit risk. Even though Abdelaziz, Rim and Helmi (2022), Toh (2019), Tran, Nguyen and Duong (2022) presents that liquidity ratios positively impacts credit risk, our results attached to West Balkan market shows the opposite. The explanation is based on the fact that increased liquidity (expressed through liquid assets to total assets) enables banks to grant loans on a larger scale and it leads to greater amount of non-performing loans as a result of large credit exposure.

Our results show that the only variable which does not significantly affects credit risk is ROA which was not the case with the studies of Hariyanti (2024), Koju, Koju and Wang (2018) and Godlewski (2005). Their results emphasize the negative and significant relationship between the variable, which cannot be applied to our case. In the case of our mentioned region, certain banks can be profitable but still have an issue with credit risk as other aspects of banking activites are satisfactory. Also, credit risk exposure on West Balkan markets has mostly been influenced by external factors related to financial crisis whose outcomes are always a serious issue and sometimes are quite hard to control.

5.CONCLUSION

Credit risk management is of the great essence for banking institutions on turbulent markets, especially for bank-oriented countries since they highly depend on banks as leading financial institutions. Therefore, the main objective of the research is to outline the factors which play the key role in assessing credit risk.

Having conducted the research, the results show that all the variables, except from ROA, significantly impact credit risk on West Balkan market. A random-effects model summarized key relevant points which include both different countries as well as time range from 2013 to 2025. As a result, the research has proved that reference interest rate, real GDP rate, inflation rate, liquid assets to total assets and bank size should be regularly followed as they highly significantly contribute to the amount of non-performing loans on mentioned market.

This research would be highly beneficial to banking management to keep abreast of major credit risk factors, which would undoubtedly lead to better risk management. Permanent credit risk evaluation is essential as that is the only way how credit risk management can be monitored. Credit risk is attached to other aspects of the bank, e.g. liquidity risk as well as capital adequacy and for that reason an ongoing monitoring on certain factors is crucial.
As for limitations, this research cannot be applied to developed markets as West Balkan markets are emerging. Also, including data from the year 2013 to 2025 can be misleading for researchers whose aim is to cover longer time period.
The potential recommendation for further research would be to take additional determinants into consideration in order to have a thorough examination regarding credit risk factors. It is advisable to include more macroeconomic determinants as they might be quite challenging on the market.

REFERENCES

Abdelaziz, H., Rim, B., & Helmi, H. (2022). The Interactional Relationships Between Credit Risk, Liquidity Risk and Bank Profitability in MENA Region. Sage Journal, 1-15., DOI: https://doi.org/10.1177/0972150919879304

Beck, R., Jakubik, P., & Piloiu, A. (2015). Key Determinants of Non-performing Loans: New Evidence from a Global Sample. Open Economies Review, 525-550., DOI: https://doi.org/10.1007/s11079-015-9358-8

Chaibi, H., & Ftiti, Z. (2014). Credit risk determinants: Evidence from a cross-country study. Research in International Business and Finance, 1-13., DOI: https://doi.org/10.1016/j.ribaf.2014.06.001

Cheng, L., Nsiah, T. K., Charles, O., & Ayisi, A. L. (2020). Credit risk, operational risk, liquidity risk on profitability. A study on South Africa commercial banks. A PLS-SEM Analysis. Revista Argentina de Clínica Psicológica, 5-18., Available at: https://revistaclinicapsicologica.com/archivesarticle.php?id=110

Ćurak, M., Poposki, K., & Pepur, S. (2013). "Determinants of non-performing loans – evidence from Southeastern European. Banks and Bank Systems, 45-51.

Đaković, M., Milenković, N., & Andrašić, J. (2024). Factors affecting the profitability of banks - Evidence from Serbia's banking sector. Management: Journal of Sustainable Business and Management Solutions in Emerging Economies, 73-83., DOI: https://doi.org/10.7595/management.fon.2023.0006

Godlewski, C. J. (2005). Bank capital and credit risk taking in emerging market economies. Journal of Banking Regulation, 128-145., DOI: https://doi.org/10.1057/palgrave.jbr.2340187

Hariyanti, A. D. (2024). Macro Determinants on Non-Performing Loans of Indonesia Commercial Banks (Credit Risk Scenario). Jurnal Manajemen Indonesia, 235-256., DOI: https://doi.org/10.25124/jmi.v24i2.8214

Jović, Ž. (2017). Determinants of credit risk - the case of Serbia. Economic Annals, 155-185., DOI: https://doi.org/10.2298/EKA1712155J

Koju, L., Koju, R., & Wang, S. (2018). Does Banking Management Affect Credit Risk? Evidence from the Indian Banking System. International Journal of Financial Studies, 1-8., DOI: https://doi.org/10.3390/ijfs6030067

Kyriazos, T., & Poga, M. (2023). Dealing with Multicollinearity in Factor Analysis: The Problem, Detections, and Solutions. Open Journal of Statistics, 404-424., DOI: https://doi.org/10.4236/ojs.2023.133020

Louzis, D. P., Vouldis, A. T., & Metaxas, V. L. (2012). Macroeconomic and bank-specific determinants of non-performing loans in Greece: A comparative study of mortgage, business and consumer loan portfolios. Journal of Banking & Finance, 1012–1027., DOI: https://doi.org/10.1016/j.jbankfin.2011.10.012

Naili, M., & Lahrichi. (2022). Banks' credit risk, systematic determinants and specific factors: recent evidence from emerging markets. Heliyon, 1-7., DOI: https://doi.org/10.1016/j.heliyon.2022.e08960

Radivojević, N., & Jovović, J. (2017). Examining of determinants of non-performing loans. Prague Economic Papers, 300–316., DOI: https://doi.org/10.18267/j.pep.615

Radovanov, B., Milenković, N., Kalaš, B., & Marcikić Horvat, A. (2023). Do the Same Determinants Affect Banks' Profitability and Liquidity? Evidence fromWest Balkan Countries Using a Panel Data Regression Analysis. Mathematics, 1-17., DOI: https://doi.org/10.3390/math11194072

Shrestha, N. (2020). Detecting Multicollinearity in Regression Analysis. American Journal of Applied Mathematics and Statistics, 39-42., DOI: https://doi.org/10.12691/ajams-8-2-1

Toh, M. Y. (2019). Effects of bank capital on liquidity creation and business diversification: Evidence from Malaysia. Journal of Asian Economics, 1-19., DOI: https://doi.org/10.1016/j.asieco.2018.12.001

Tran, O., Nguyen, D., & Duong, K. (2022). How market concentration and liquidity affect non-performing loans: evidence from Vietnam. Polish journal of management studies, 1-10., DOI: https://doi.org/10.17512/pjms.2022.26.1.20

Us, V. (2017). Dynamics of non-performing loans in the Turkish banking sector by an ownership breakdown: The impact of the global crisis . Finance Research Letters, 109-117., DOI: https://doi.org/10.1016/j.frl.2016.09.016

Zawadzki, A. (2023). Macroeconomic Determinants of Credit Risk on the Example of Non-performing Loans. Central European Economic Journal, 275-286., DOI: https://doi.org/10.2478/ceej-2023-0016

DOI: 10.46541/978-86-7233-439-5_505



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THE RELATIONSHIP BETWEEN ECONOMIC POLICY UNCERTAINTY AND SERBIAN STOCK MARKET PERFORMANCE

Abstract: The stock market is often seen as an important indicator of the state of the economy, as it reflects the overall economic environment and the direction of its development, while at the same time it is influenced by numerous factors, including social, environmental and political circumstances. Therefore, it is of particular importance to analyze the impact of global economic policy uncertainty on the performance of stock markets, especially in the conditions of a changing macroeconomic environment. In this context, the aim of this research is to examine the relationship between the uncertainty of economic policy and the performance of the stock market in Serbia. In order to answer the goal of the research, data covering the period from 2012 to 2025 was used. The MSCI index was used as a measure of the performance of the stock market of the analyzed countries. The independent variable in the model is the Global Economic Policy Uncertainty Index (EPU). Also, World Governance Indicators are included in the model as explanatory variables. To examine the relationship between these variables, a regression analysis was conducted using the ordinary least squares (OLS) method. The results showed a significant negative impact of global economic instability on stock market performance, while the impacts of other variables are mostly significantly positive. Reducing global economic policy uncertainty is key to strengthening market stability, increasing investor confidence and encouraging domestic and foreign investment, which requires active measures by policy makers and market participants.
Keywords: Global Index of Economic Policy Uncertainty, MSCI Index, World Governance Indicators, Regression Analysis

1. INTRODUCTION

In the previous years, the world was faced with a series of serious challenges that increased uncertainty on the global political and economic level. As one of the key factors shaping economic performance and movements in financial markets, regardless of the current state of the global economic environment, authors often cite global economic-political uncertainty - GEPU (Yu & Song, 2018; Fang et al., 2018; Phan et al., 2018; Li et al., 2019, 2020; Odionye et al., 2024; Durmaz, 2024; Nguyen et al. al., 2025).

In Europe, as well as in the United States of America, concerns about unpredictable policies, especially in the area of economic and financial decisions, have become increasingly pronounced (Baker et al., 2016). The aforementioned authors describe economic-political uncertainty (EPU) as a condition resulting from changes in monetary, fiscal or regulatory policy, and the EPU index is formed by monitoring how often domestic newspaper articles contain three key

terms: economy (E), politics (P) and uncertainty (U). GEPU can then be considered a global extension of this concept, denoting a situation where economic actors cannot predict changes in government policies, which creates uncertain economic risks (Apergis et al., 2018).

The process of forming the GEPU index includes several stages: national indices are first standardized, then missing data are compensated by regression techniques, and the final index is obtained by calculating a weighted average based on GDP from the IMF database (Cao & Vo, 2025).

The stock market plays a key role in the economy because it allows companies to raise capital for investment and development, while providing investors with the opportunity to invest and diversify risks. Also, it functions as an indicator of economic activity and confidence in the economy, contributing to transparency and efficient allocation of resources. An active stock market therefore encourages the economic growth and financial stability of the country, which makes the monitoring of stock market movements particularly important in analyzing the impact of GEPU.
Numerous empirical studies have addressed the impact of EPU and GEPU on financial markets (Mbanyele, 2023; Pham & Nguyen, 2022; Umoru et al., 2025). Studies show a clear connection between economic and political uncertainty and stock market movements, especially when it comes to stocks. Interest in this topic further grew after Baker et al. (2016) calculated the American EPU index, while the works of Christou et al. (2017), Phan et al. (2018), Das and Kumar (2018), Chiang (2019) and Syed and Bouri (2022) confirm that this index strongly predicts the movement of stock market returns.

The relevant literature emphasizes the importance of monitoring the GEPU index in the analysis of financial markets, because uncertainty at the global level can significantly affect volatility, returns and investor behavior. Although there is a large amount of research on the impact of economic and political uncertainty on financial markets, based on a review of the literature, as far as the authors know, there are still no studies that investigate the connection between the index of global economic policy uncertainty and the performance of the Serbian stock market. Bearing in mind the stated subject, this research is the connection between global uncertainty of economic policy and the performance of the stock market in Serbia, while the aim of the research is to examine the influence of the index of global uncertainty of economic policy on the performance of the stock market in Serbia.

The work is divided into six parts. The first part of the paper presents the introductory presentation. The second part of the paper includes a review of the relevant literature. The third part describes the research methodology. The fourth part includes the research results. The fifth part presents a discussion of the results, while the sixth part presents the key conclusions, practical implications, limitations and possible future research directions on this topic.

2. LITERATURE REVIEW

The existing literature clearly indicates that economic uncertainty plays a key role in the formation of movements in financial markets, especially in stock markets. Empirical findings consistently confirm that an increase in uncertainty about economic policies negatively affects domestic capital markets. Accordingly, contemporary literature increasingly emphasizes the need for a deeper understanding of the mechanisms through which economic uncertainty affects stock markets, as well as for conducting empirical research that takes into account its dynamic and time-delayed effects. For example, Chen and Chiang (2015) show that growth in economic AND political uncertainty causes a decline in Chinese stock market returns, while a positive effect is observed in later periods, suggesting a gradual recovery in stock prices.
Dakhlaoui and Aloui (2016) point to strong evidence of a time-varying correlation between economic policy uncertainty (EPU) and stock market volatility in the BRIC countries (China, Russia, Brazil and India). The negative consequences of EPU on stock returns were also noted in the research of Kang and Ratti (2013). Guo et al. (2018) also showed that EPU reduces the stock market returns of the G7 and BRIC countries, except for France and the United Kingdom.
Similarly, Phan et al. (2018), on a sample of 16 countries (China, Italy, Netherlands, India, USA, Russia, Australia, Brazil, Germany, Korea, Japan, France, United Kingdom, Canada, Spain and Ireland) suggest that the ability to predict stock returns by EPU depends mostly on the sector.

Based on the research results of Christou et al. (2017), in Australia, USA, Canada, China, Korea, and Japan, from 1998 to 2014, growth in economic policy uncertainty negatively affects stock returns. Hu et al. (2018) conclude that, in America, with a one-week lag, shocks on the EPU side negatively and significantly affect Chinese A-share returns.
You et al. (2017) on the basis of research, which covered the period from 1995 to 2016, point to a strong connection between shocks on the oil price side and the EPU with the Chinese stock market. Similarly, Xiong et al. (2018) suggest that in China, absolute changes in economic policy uncertainty significantly affect stock returns over the period 1995 to 2016.

Das and Kumar (2018), conclude that the combined effects of the domestic and American EPU significantly affect stock prices when it comes to developed markets, while in developing markets the domestic EPU has a greater impact.

On the example of 823 Chinese companies, Nguyen et al. (2025) showed that an increase in Chinese EPU has a negative, while global EPU has a positive effect on stock returns at the level of the observed companies.
Based on the VAR methodology, Kang and Ratti (2013) indicate that the growth of EPU decreases the market returns in the USA. Antonakakis et al. (2013) based on their research suggest that in America, an increase in EPU leads to a decrease in stock returns using the DDC GARCH model. Chang et al. (2015) for a sample of seven OECD countries conclude that economic policy uncertainty in the US and the UK causes stock prices to decline, and that the US EPU significantly affects oil prices internationally.

Tran and Vo used an ARDL model to analyze the impact of EPU on US market volatility and volatility in 11 Asia-Pacific countries, covering the period 1985–2022. They concluded that EPU significantly affects returns in these markets. Li et al. (2019) investigated the effects of the Economic Policy Uncertainty (EPU) indices of China and G7 countries on Chinese stock market volatility and found that the EPU indices of China and some G7 countries show a significantly negative impact on future volatility.

Durmaz (2024) concluded that in the long run, high economic uncertainty is negatively related to stock prices in certain countries, while Odionye et al. (2024) conclude that in the short term EPU significantly reduces the stock market index, while in the long term this impact is negative, but insignificant.
Research on global economic political uncertainty (GEPU) largely follows the approach taken by the EPU, with the focus being on analyzing its impact on global financial and commodity markets (Li & Bai, 2023). Yu et al. (2018) point out that, with the further integration of China into the world economy, the uncertainty of global economic policy will become one of the key factors in the instability of the Chinese stock market and significantly contribute to its oscillations.

Umoru et al. (2025) examined the impact of stock market volatility and liquidity on returns in Middle East and North Africa markets, with the role of global economic uncertainty and exchange rate as moderating factors. Panel quantile regression was used on daily data (2000–2024). The results show that global economic uncertainty and exchange rate fluctuations negatively affect stock returns, with higher exchange rate volatility further reducing returns.
Yu & Song (2018) indicate that the inclusion of a regime-switching model can improve the accuracy of forecasting the impact of GEPU on US stock market movements. Namely, the mentioned authors investigated how the GEPU affects the total monthly volatility using a Markov model with changing regimes, and they find that the GEPU amplifies fluctuations while simultaneously improving forecasts. On the other hand, Qin et al. (2020) emphasize that gold can serve as an instrument of protection against risks associated with GEPU during economic crises, while gold prices not only react to changes in GEPU, but also affect the level of this uncertainty, in both directions.
Fang et al. (2018) analyze the information content of GEPU for the variance of gold futures returns through the GARCH-MIDAS model and point out that GEPU can significantly predict future monthly volatility in the gold market. Lee et al. (2020) found that the rise and fall of the GEPU can lead to significant volatility in the stock market in China.

3. RESEARCH METHODOLOGY

Annual data collected from relevant sources, namely the World Bank, the MSCI World Index and the Global Economic Policy Uncertainty Index, were used for the purposes of the research. The dependent variable in the model is the MSCI index that refers to Serbia, while the independent variables are the Global Economic Policy Uncertainty Index (GEPU) and world governance indicators for Serbia: Rule of Law, Government Effectiveness, Political Stability, Voice and Accountability, Regulatory Quality and Control of Corruption. Due to data availability, data for the period from 2012 to 2025 were analyzed, which makes a total of 14 observations. The list of variables, their definitions and data sources are shown in Table 1.

Table 1: List of variables, definitions, and data sources

Variable	Definition	Source
MSCI index (MSCI)	Measure market performance and allow investors to better understand the collective movement of a group of stocks, bonds or other types of securities.	https://www.msci.com/
Global Economic Policy Uncertainty Index (GEPU)	Measures the economic uncertainty associated with economic policy.	https://www.policyuncertainty.com/
Rule of Law (RL)	Measures trust in the rules of society, including the enforcement of contracts, the protection of property, and the quality of the police and courts.	The World Bank https://www.worldbank.org/en/publication/worldwide-governance-indicators/interactive-data-access
Government Effectiveness (GE)	Measures the quality of public services, state administration and policy implementation, as well as independence from political pressures.	
Political Stability (PS)	Measures the perception of the likelihood that the government will be destabilized. A higher value of the index indicates greater stability.	
Voice and Accountability (VA)	The extent to which citizens can participate in the election of the government as well as the level of freedom of expression, association and media.	
Regulatory Quality (RQ)	Measures the government's ability to enact and enforce quality regulations that encourage private sector development.	
Control of Corruption (CC)	Measures the extent to which public power is used for private gain, including corruption and elite influence over the state.	

Source: Authors

Table 2 shows the descriptive statistics of the variables used in the research. According to the results of descriptive statistics, the data have a normal distribution since the p value of the Jarque-Bera test is greater than 0.05. More detailed information on other measures of descriptive statistics is presented in Table 2.

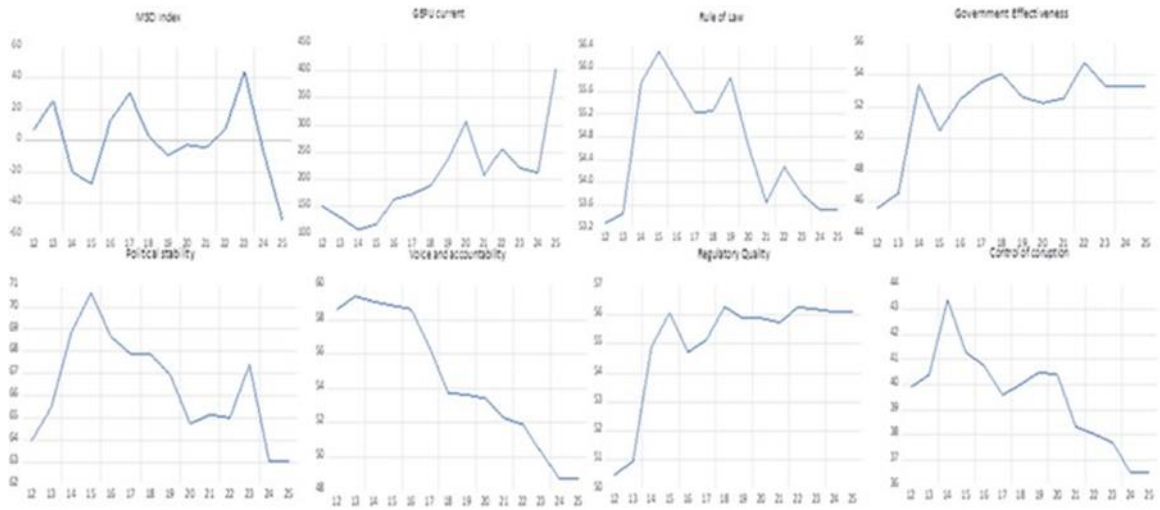
Table 2: Descriptive statistics of variables

	MSCI	GEPU	RL	GE	PS	VA	RQ	CC
Mean	0.487143	205.6253	54.59357	52.03643	66.33429	54.52429	55.05286	39.52286
Median	-0.145000	198.1307	54.46000	52.97500	66.22000	53.66500	55.88500	39.96500
Maximum	44.14000	403.9970	56.30000	54.82000	70.66000	59.36000	56.28000	43.38000
Minimum	-51.46000	107.9592	53.29000	45.65000	63.01000	48.70000	50.50000	36.50000
Std. Dev.	24.50341	79.64608	1.072220	2.709296	2.336683	3.918622	1.903747	1.914798
Skewness	-0.243289	1.057438	0.201787	-1.552031	0.146306	-0.104124	-1.775505	0.012205
Kurtosis	2.983155	3.821004	1.463590	4.116702	2.002597	1.606902	4.565712	2.592552
Jarque-Bera	0.138275	3.002269	1.471999	6.347961	0.630254	1.157385	8.785660	0.097189
Probability	0.933198	0.222877	0.479027	0.061837	0.729696	0.560631	0.072366	0.952567
Observations	14	14	14	14	14	14	14	14

Source: Authors

Figure 1 shows the movement of the observed variables in the period from 2012 to 2025. Based on the data, the variable MSCI shows a pronounced cyclical pattern of movement. After the decline in the period 2013–2015. followed by a phase of growth from 2015 to 2017, and then another decrease. After that, it records an upward trend that lasts until 2023, and then a new decline until the end of the observed period. According to the data, for the period 2012–2025, the movement of the global economic policy uncertainty index indicates an initial decline, then a phase of moderate oscillations and a marked upward trend with occasional sudden changes, whereby, despite occasional phases of stabilization, there is a long-term trend of global uncertainty growth, with increasingly pronounced and frequent shocks towards the end of the observed period. As for other explanatory variables, in the period 2012–2025. year, the variables

Voice and Accountability and Political Stability recorded a decreasing trend at the end of the observed period, while Government Effectiveness and Regulatory Quality showed a slight increase, Rule of Law remained relatively stable with a slight decrease, and Control of Corruption indicated a more pronounced volatility with an overall decrease compared to the initial value.



Picture 1: Movement of the observed variables over the period from 2012 to 2025
Source: Authors

The Ordinary Least Squares (OLS) model was used to measure the influence of independent variables on stock market performance. The model is specified as follows:

$$Y_t = \alpha + \beta_1 X_{1t} + \beta_2 X_{2t} + \beta_3 X_{3t} + \beta_4 X_{4t} + \beta_5 X_{5t} + \beta_6 X_{6t} + \beta_7 X_{7t} + \varepsilon_t$$

Where: Y_t – dependent variable (MSCI index) in year t (t: 1 = 2012,,…,14 = 2025), α – constant, β_1, β_2 ,..., β_7 – regression coefficients, X – independent variable (X_{1t} – GEPU in year t, X_{2t} – Rule of Low in year t, X_{3t} – Goverment Effectiveness in year t, X_{4t} – Policy Stability in year t, X_{5t} – Voice and Accountability in year t, X_{6t} – Requlatory Quality in year t, X_{7t} – Control of Coruption in year t), ε_t - random error of the model.
The following econometric diagnostic tests were conducted to confirm the assumptions of the model: ADF and PP unit root test, stability tests (Ramsey RESET test and Ramsey Estimates) and residual tests (histogram-normality test, serial correlation LM test and heteroskedasticity test).

Research hypotheses:
H1: The global index of economic policy uncertainty has a negative and statistically significant effect on the performance of stock market operations in Serbia.
H2: The rule of law has a positive and statistically significant influence on the performance of stock market operations in Serbia.
H3: The effectiveness of the government has a positive and statistically significant influence on the performance of the stock market in Serbia.
H4: Political stability has a positive and statistically significant influence on the performance of stock market operations in Serbia.
H5: Voice and responsibility has a positive and statistically significant influence on the performance of stock market operations in Serbia.
H6: The quality of regulation has a positive and statistically significant effect on the performance of stock market operations in Serbia.
H7: Corruption control has a positive and statistically significant impact on the performance of stock market operations in Serbia.

4. RESEARCH RESULTS

According to the results of the ADF and PP unit root tests, the variables GE and RQ are stationary at the level, while the other variables are stationary at the first differential, which is why the first differential of these variables was used in the further analysis.

Table 3: Results of unit root tests

Variable	ADF – Fisher chi-square		PP-Fisher chi-square	
	Level	1st diference	Level	1st diference
MSCI index	-2.266190	-3.316650**	-2.174266	-4.987658***
GEPU	-0.592925	-3.187446**	-0.141836	-3.262104**
CC	-0.662173	-3.742833***	-0.624138	-4.289560***
GE	-6.287121***		-4.438006***	
PS	-1.522925	-3.302361**	-1.645236	-3.388515**
RQ	-5.351040***		-6.757154***	
RL	-1.644827	-4.459578***	-1.644827	-6.297565***
VA	0.257868	-2.971002**	0.347175	-4.633210***

Source: Authors

According to the results shown in Table 4, the correlations between all observed independent variables are less than 0.7, which means that there is no multicollinearity and that all variables can independently contribute to the analysis.

Table 4: Results of correlation analysis

	GEPU	CC	GE	PS	RQ	RL	VA
GEPU	1	-0.6507	0.4027	-0.6158	0.4462	-0.3557	-0.4805
CC	-0.6207	1	-0.2540	0.5922	-0.2832	0.5975	0.3543
GE	0.4027	-0.2540	1	0.1412	0.6096	0.3170	-0.5782
PS	-0.6158	0.5922	0.1412	1	0.1808	0.4479	0.5810
RQ	0.4462	-0.2832	0.4096	0.1808	1	0.3580	-0.6223
RL	-0.3557	0.5975	0.3170	0.4479	0.3580	1	0.4563
VA	-0.4802	0.3543	-0.5782	0.5810	-0.6223	0.4563	1

Source: Authors

Based on the coefficient of determination (R^2), about 67% of the dependent variable (MSCI) was explained by the independent variables (GEPU, RL, GE, PS, VA, RQ and CC). The value of the F statistic ($F = 7.134849$; $p = 0.020369$) suggests that the proposed model is statistically significant. The results show a negative and statistically significant impact of GEPU on the MSCI index ($p < 0.05$), which means that when GEPU increases by one unit, MSCI would decrease by 0.146806 units and that this decrease is statistically significant. The impact of RQ I CC on MSCI is also negative, but insignificant ($p > 0.05$). On the other hand, the influence of RL, GE, PS and VA on MSCI is positive and statistically significant ($p < 0.05$). This means that an increase in RL by one unit is associated with an increase in the MSCI index by approximately 2.02 units, GE by 0.63 units, PS by 1.10 units and VA by 0.40 units and that this growth is at a statistically significant level. The results of the ordinary least squares model are shown in Table 5.

Table 5: Results of the Ordinary Least Squares model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GEPU	-0.146806	0.054961	-2.671114	0.0204
RL	2.024547	0.509813	3.971156	0.0022
GE	0.629292	0.093414	6.736572	0.0000
PS	1.097112	0.319960	3.428897	0.0050
VA	0.399789	0.162837	2.455150	0.0303
RQ	-0.281760	2.720799	-0.103558	0.9196
CC	-0.033421	1.230846	-0.027153	0.9789
C	27.14320	12.34183	2.199284	0.0482

Source: Authors

Based on Figure 2 and the Jarque-Bera test value of 0.236509 ($p > 0.05$), it can be concluded that the residuals in the model have a normal distribution.

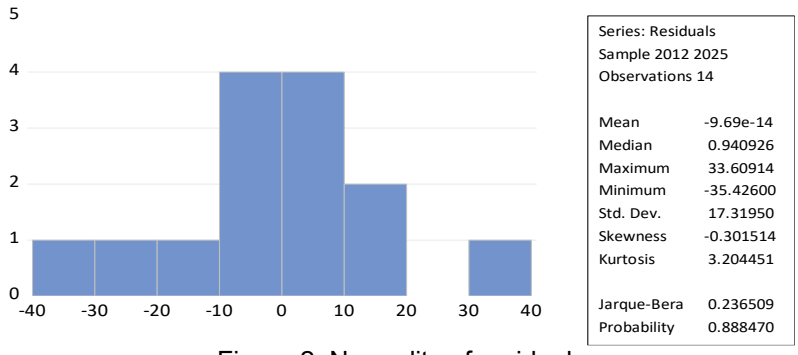


Figure 2: Normality of residuals
Source: Authors

According to the results of the Breusch–Godfrey LM test (Table 6), p-values for F-statistics (0.8591) and Chi-square statistics (0.5993) are greater than the significance level of 0.05, which indicates that the null hypothesis of no autocorrelation cannot be rejected, that is, that the model does not have a problem with autocorrelation of residuals.

Table 6: Breusch-Godfrey Serial Correlation LM test results

F-statistic	0.157831	Prob. F(2,4)
Obs*R-squared	1.024010	Prob. Chi-Square(2)

Source: Authors

The results of the Breusch–Pagan–Godfrey heteroscedasticity test, shown in Table 7, show that the null hypothesis of homoscedasticity cannot be rejected, since all p-values (for F-statistics = 0.1274; Obs*R-squared = 0.1579 and Scaled explained SS = 0.9515) are greater than the 0.05 significance level, indicating that the model does not have a problem with heteroscedasticity.

Table 7: Breusch-Godfrey Serial Correlation LM test results

F-statistic	2.655015	Prob. F(7,6)
Obs*R-squared	10.58330	Prob. Chi-Square(7)
Scaled explained SS	2.142584	Prob. Chi-Square(7)

Source: Authors

The results of the ARCH heteroscedasticity test (table 8) show that the null hypothesis of the absence of autocorrelation in the residual variance cannot be rejected, given that the p-values are greater than the 0.05 significance level (for F-statistics = 0.2736 and Chi-square statistics = 0.2366), which indicates that the model does not show the presence of ARCH-type heteroskedasticity.

Table 8: Results of the ARCH test

F-statistic	1.328230	Prob. F(1,11)
Obs*R-squared	1.400606	Prob. Chi-Square(1)

Source: Authors

The graph of the CUSUM test (Figure 3) shows that the movement of the CUSUM statistic remains within the significance limits of 5% throughout the entire period, which confirms the stability and consistency of the model parameters in the analyzed time frame.

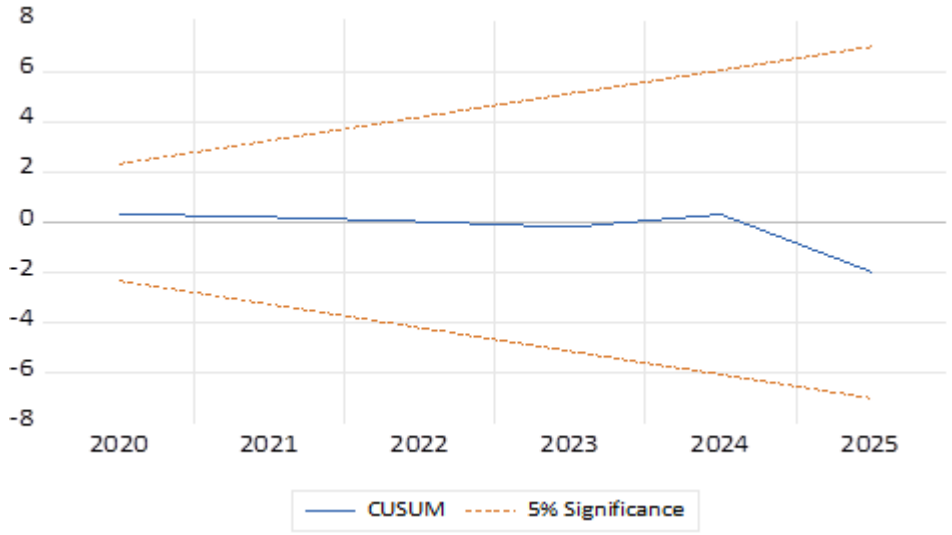


Figure 3: CUSUM model stability test
Source: Authors

The results of the Ramsey RESET (Table 9) test show that the null hypothesis of good model specification cannot be rejected, as the p-values for the t-statistic (0.3000) and F-statistic (0.3000) are greater than the 0.05 significance level, which suggests that the model has no significant problems with omitted variables or inadequate functional form. Although the p-value for the Likelihood ratio is slightly lower (0.0686), it still does not provide enough evidence to reject the null hypothesis.

Table 9: Results of the Ramsey RESET test

	Value	df	Probability
t-statistic	1.155852	5	0.3000
F-statistic	1.335993	(1, 5)	0.3000
Likelihood ratio	3.315321	1	0.0686

Source: Authors

5. DISCUSSION

The results of the conducted empirical research for Serbia showed that the effect of global economic policy uncertainty on stock market performance is negative and significant. The obtained results are consistent with the results of earlier research (Li et al., 2019; Li et al., 2020; Christou et al., 2017).

The results of the empirical research also indicate that the efficiency of the government achieves a statistically significant and positive influence on the movements of the stock market at a significance level of 1%. In other words, the successful implementation of public policies contributes to the growth of financial markets and overall economic prosperity. This finding is consistent with the literature that analyzes the relationship between economic policies and stock market performance (Mai et al., 2023). Generally speaking, research suggests that government measures can have both stimulating and disincentive effects on capital markets. Policies aimed at stimulating economic growth, such as investment in infrastructure or tax breaks for organizations, usually have a positive effect, as do measures that ensure a stable and predictable regulatory environment. Conversely, sudden changes in regulations, trade policies or an increase in the tax burden can generate uncertainty and have a negative impact on stock market movements. However, it should be borne in mind that this relationship is complex and conditioned by numerous additional factors, including macroeconomic indicators (interest rates, inflation, GDP growth), but also global shocks such as natural disasters or geopolitical events.

Furthermore, the results show that political stability has a statistically significant and positive impact on stock market performance. These findings are consistent with previous research (Mai et al., 2023; Akram et al., 2018; Sulehri & Ali 2020).

In addition, the results indicate that the rule of law (RL), as well as the variable voice and responsibility, have a positive and statistically significant impact on the stock market. This implies that the strengthening of the legal system and institutional responsibility contributes to the growth of investor confidence, which is reflected in the better performance of the capital market. Such findings are consistent with the existing literature that emphasizes the importance of good governance for the development of financial markets. For example, studies by Kaufmann & Roesch (2012), as well as Mai et al. (2023) show that the rule of law and voice and accountability are positively related to stock market returns in developing countries, emphasizing that these variables contribute to the creation of a stable and predictable business environment.

The obtained results also indicate that the effect of Regulatory Quality and Control of Corruption is negative and insignificant. Such results are consistent with the research of Mai et al. (2023) who also examined the impact of these variables on stock market performance.

6. CONCLUSION

The purpose of the conducted research was to examine the influence of the global economic policy uncertainty index on the performance of the stock market in Serbia. The obtained results showed that this influence is negative and significant. In addition, the results of the research showed that regulatory quality and corruption control also have a negative impact on stock market performance, but that this impact is not statistically significant. On the other hand, rule of low, political stability and voice and accountability have a significant and positive effect on the performance of the stock market.

The scientific contribution of this work is reflected in the fact that this research is the first to examine the relationship between GEPU and MSCI in Serbia. These findings have important implications for investors and policymakers: investors can use data on global economic policy uncertainty for better risk management and the formation of diversified portfolios, while policymakers can contribute to strengthening market confidence and stimulating foreign and domestic investment by reducing economic risks.

One of the shortcomings of the research is that this research includes data related only to Serbia, while the following research could be focused on other countries, for example in the region. Also, in the research, the OLS method was applied to prove the hypotheses, while other studies could also apply other econometric methods such as panel regression analysis.

REFERENCES

Akram, U., Hui, P., Kaleem Khan, M., Tanveer, Y., Mehmood, K., & Ahmad, W. (2018). How website quality affects online impulse buying: Moderating effects of sales promotion and credit card use. *Asia Pacific Journal of Marketing and Logistics*, *30*(1), 235-256.

Apergis, N., Bonato, M., Gupta, R., & Kyei, C. (2018). Does geopolitical risks predict stock returns and volatility of leading defense companies? Evidence from a nonparametric approach. *Defence and Peace Economics*, *29*(6), 684-696.

Arouri, M., Estay, C., Rault, C., & Roubaud, D. (2016). Economic policy uncertainty and stock markets: Long-run evidence from the US. *Finance Research Letters*, *18*, 136-141.

Baker, S. R., Bloom, N., & Davis, S. J. (2016). Measuring economic policy uncertainty. *The quarterly journal of economics*, *131*(4), 1593-1636.

Cao, P. T. H., & Vo, D. H. (2025). Market responses to geopolitical risk and economic policy uncertainty: Evidence from Vietnam. *Heliyon*, *11*(4).

Chang, T., Chen, W. Y., Gupta, R., & Nguyen, D. K. (2015). Are stock prices related to the political uncertainty index in OECD countries? Evidence from the bootstrap panel causality test. *Economic Systems*, *39*(2), 288-300.

Chen, X., & Chiang, T. C. (2020). Empirical investigation of changes in policy uncertainty on stock returns—evidence from China's market. *Research in International Business and Finance*, *53*, 101183.

Chiang, T. C. (2019). Economic policy uncertainty, risk and stock returns: Evidence from G7 stock markets. *Finance Research Letters*, *29*, 41-49.

Christou, C., Cunado, J., Gupta, R., & Hassapis, C. (2017). Economic policy uncertainty and stock market returns in PacificRim countries: Evidence based on a Bayesian panel VAR model. *Journal of multinational financial management*, *40*, 92-102.

Dakhlaoui, I., & Aloui, C. (2016). The interactive relationship between the US economic policy uncertainty and BRIC stock markets. *International Economics*, *146*, 141-157.

Das, D., & Kumar, S. B. (2018). International economic policy uncertainty and stock prices revisited: Multiple and Partial wavelet approach. *Economics Letters*, *164*, 100-108.

Durmaz N. (2024). The effects of policy uncertainty on stock prices: revisiting with selected countries. *Ekonomika, 103* (3), 57- 69.

Fang, L., Yu, H., & Xiao, W. (2018). Forecasting gold futures market volatility using macroeconomic variables in the United States. *Economic Modelling*, *72*, 249-259.

Guo, P., Zhu, H., & You, W. (2018). Asymmetric dependence between economic policy uncertainty and stock market returns in G7 and BRIC: A quantile regression approach. *Finance Research Letters*, *25*, 251-258.

Hu, Z., Kutan, A. M., & Sun, P. W. (2018). Is US economic policy uncertainty priced in China's A-shares market? Evidence from market, industry, and individual stocks. *International Review of Financial Analysis*, *57*, 207-220.

Kang, W., & Ratti, R. A. (2013). Oil shocks, policy uncertainty and stock market return. *Journal of International Financial Markets, Institutions and Money*, *26*, 305-318.

Kang, W., & Ratti, R. A. (2014). Policy uncertainty in China, oil shocks and stock returns. Australian National University, Centre for Applied Macroeconomic Analysis.

Kaufmann, L., & Roesch, J. F. (2012). Constraints to building and deploying marketing capabilities by emerging market firms in advanced markets. *Journal of International Marketing*, *20*(4), 1-24.

Li, T., Ma, F., Zhang, X., & Zhang, Y. (2020). Economic policy uncertainty and the Chinese stock market volatility: Novel evidence. *Economic Modelling*, *87*, 24-33.

Li, Y., & Bai, Y. (2023). Research on the Impact of Global Economic Policy Uncertainty on Manufacturing: Evidence from China, the United States, and the European Union. *Sustainability*, *15*(14), 11217.

Li, Y., Ma, F., Zhang, Y., & Xiao, Z. (2019). Economic policy uncertainty and the Chinese stock market volatility: new evidence. *Applied Economics*, *51*(49), 5398-5410.

Mai, Z., Nawaz Saleem, H. M., & Kamran, M. (2023). The relationship between political instability and stock market performance: An analysis of the MSCI index in the case of Pakistan. *Plos one*, *18*(10), e0292284.

Mbanyele, W. (2023). Economic policy uncertainty and stock liquidity: the role of board networks in an emerging market. *International Journal of Emerging Markets*, *18*(1), 122-147.

Nguyen, C. P., Schinckus, C., Nguyen, B. Q., Lai, T. T., & Nguyen, N. A. (2025). Economic policy uncertainty and firmlevel stock returns: Further evidence from China. *Journal of International Studies (2071-8330)*, *18*(1), 216-231.

Odionye J. C., Ojiaku E. U., Okpara G. C., Agoh N., Okpara R. M. (2024). Economic policy uncertainty and stock market index: fresh insights from augmented-ARDL and multiple structural breaks. *Journal of International Commerce, Economics and Policy (JICEP)*, 15(02), 1-24.

Pham, L., & Nguyen, C. P. (2022). How do stock, oil, and economic policy uncertainty influence the green bond market?. *Finance Research Letters*, *45*, 102128.

Phan, D. H. B., Sharma, S. S., & Tran, V. T. (2018). Can economic policy uncertainty predict stock returns? Global evidence. *Journal of International Financial Markets, Institutions and Money*, *55*, 134-150.

Qin, M., Su, C. W., Xiao, Y. D., & Zhang, S. (2020). Should gold be held under global economic policy uncertainty?. *Journal of Business Economics and Management*, *21*(3), 725-742.

Sulehri, F. A., & Ali, A. (2020). Impact of political uncertainty on Pakistan stock exchange: An event study approach. *Journal of Advanced Studies in Finance*, *11*(2), 194-207.

Syed, Q. R., & Bouri, E. (2022). Spillovers from global economic policy uncertainty and oil price volatility to the volatility of stock markets of oil importers and exporters. *Environmental Science and Pollution Research*, *29*(11), 15603-15613.

Tran, M. P. B., & Vo, D. H. (2023). Asia-Pacific stock market return and volatility in the uncertain world: Evidence from the nonlinear autoregressive distributed lag approach. *PLoS One*, *18*(5), e0285279.

Umoru, D., Abu, E. I., Igbinovia, B., Asemota, G., Igbafe, A., & Idogun, H. I. (2025). Stock markets returns and interactive effects of economic policy uncertainty and exchange rate volatility: Evidence from MENA markets. *BRICS Journal of Economics*, *6*(1), 91-117.

Xiong, X., Bian, Y., & Shen, D. (2018). The time-varying correlation between policy uncertainty and stock returns: Evidence from China. *Physica A: Statistical Mechanics and Its Applications*, *499*, 413-419.

You, W., Guo, Y., Zhu, H., & Tang, Y. (2017). Oil price shocks, economic policy uncertainty and industry stock returns in China: Asymmetric effects with quantile regression. *Energy Economics*, *68*, 1-18.

Yu, H., Fang, L., & Sun, W. (2018). Forecasting performance of global economic policy uncertainty for volatility of Chinese stock market. *Physica A: Statistical Mechanics and Its Applications*, *505*, 931-940.

Yu, M., & Song, J. (2018). Volatility forecasting: Global economic policy uncertainty and regime switching. *Physica A: Statistical Mechanics and Its Applications*, *511*, 316-323.

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DETERMINANTS OF SUSTAINABILITY REPORTING: THE INFLUENCE OF OWNER GENDER AND FINANCIAL INDICATORS

Abstract: In contemporary business conditions, sustainability reporting is becoming an increasingly important component of corporate transparency and accountability toward a wide range of stakeholders. Although the practice of preparing sustainability reports is continuously developing, significant differences still exist among companies in terms of their readiness to adopt and implement this form of reporting. Against this background, the subject of this study is to examine the factors influencing the likelihood of sustainability reporting. Particular attention is devoted to the gender of the company owner, as well as to key financial indicators reflecting liquidity, profitability, and leverage.
The aim of this study is to determine whether the financial position of a company and the gender structure of ownership represent significant determinants of sustainability reporting. The empirical analysis is based on a dataset in which sustainability reporting is treated as a binary variable, while the independent variables include indicators of liquidity, profitability, and leverage, along with the gender of the owner. Binary logistic regression is employed to test the proposed relationships.
The expected contribution of this study lies in identifying the characteristics of companies that are more inclined to adopt sustainability reporting practices, as well as in providing a better understanding of the relationship between financial performance, ownership structure, and sustainable corporate behavior. The findings of this research may be of importance to both the academic community and practitioners, including company decision-makers and policymakers aiming to promote and enhance sustainable business practices.
Keywords: sustainability reporting; financial performance; liquidity; profitability; leverage; owner gender

1. INTRODUCTION

In contemporary business conditions, characterized by rapid changes, market globalization, and increasing demands for transparency, sustainability reporting is becoming an increasingly important component of corporate reporting. Traditional financial statements, although still essential for assessing business performance, are no longer sufficient to provide a comprehensive picture of a company's performance. Growing importance is therefore attributed to non-financial information related to a company's impact on the environment, society, and corporate governance, in line with the principles of sustainable development and responsible business practices.

Sustainability reports represent an important communication tool between a company and its stakeholders, providing insight into how the company manages its resources, risks, and social impact. In addition, such reports contribute to

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strengthening reputation, increasing the trust of investors and other interested parties, and enhancing a company's competitive position in the market. In this sense, sustainability reporting is not merely a regulatory obligation, but also a strategic tool that can contribute to the long-term sustainability and stability of business operations.

Despite the growing importance of this form of reporting and the existence of a regulatory framework that encourages the disclosure of non-financial information, the practice of preparing sustainability reports in the Republic of Serbia remains insufficiently developed. Although certain categories of companies are required to publish non-financial reports, it is often observed in practice that companies either do not prepare such reports or limit themselves to partial and insufficiently systematized disclosures. This situation indicates the existence of a gap between formally established requirements and actual business practice, thereby creating a basis for analyzing the factors that influence the decision to engage in sustainability reporting.

Against this background, the subject of this study is to examine the determinants of sustainability reporting, with a particular focus on the financial characteristics of companies and ownership structure. The analysis investigates whether and to what extent profitability, liquidity, and leverage—as key indicators of a company's financial position—affect the likelihood of preparing sustainability reports. In addition, special attention is given to the gender of the owner as a variable that may play a significant role in shaping business decisions and the adoption of sustainable business practices, given the growing interest in the literature regarding the impact of gender diversity on corporate governance and corporate social responsibility.

The empirical analysis is conducted using binary logistic regression on a sample of companies in the Republic of Serbia, where sustainability reporting is treated as a dichotomous variable. This approach enables the assessment of the impact of the selected independent variables on the likelihood that a company prepares a sustainability report, as well as the identification of the key determinants of this practice.
The aim of this study is to identify the factors that determine the practice of sustainability reporting, as well as to contribute to a better understanding of the relationship between financial performance, ownership characteristics, and sustainable corporate behavior. The findings of this research may have significant implications for both the academic community and practitioners, including company management and policymakers, particularly in the context of enhancing transparency, strengthening stakeholder trust, and promoting the development of sustainable business models.

The paper is structured as follows. The first section presents the theoretical framework and a review of the relevant literature on sustainability reporting and its determinants. The second section outlines the research methodology, including a description of the sample, variables, and applied analytical methods. The third section provides the results of the empirical analysis and their interpretation. Finally, the concluding section presents the main findings, limitations of the study, and recommendations for future research.

2. THEORETIC BACKGROUND

Sustainability reporting represents one of the most significant directions in the development of contemporary corporate reporting. Unlike traditional financial reporting, which is primarily focused on presenting a company's financial position and performance, sustainability reporting encompasses a broader range of information related to the economic, environmental, and social impact of a company. In this way, it enables a more comprehensive understanding of business operations and contributes to a better assessment of a company's long-term ability to create value for various stakeholders. In modern business conditions, where investors, creditors, consumers, employees, and regulatory bodies increasingly demand information that goes beyond the scope of financial statements, sustainability reporting has become an important instrument of transparency, accountability, and corporate legitimacy.

The importance of sustainability reporting is particularly evident in the context of reducing information asymmetry between a company and its stakeholders. By disclosing information on environmental impact, employee relations, social responsibility, human rights, and anti-corruption policies, companies signal their level of responsibility and their commitment to operating in accordance with the principles of sustainable development. Buallay (2019) highlights that sustainability reporting is associated with corporate performance and can play a significant role in shaping investors' and market perceptions. Similarly, Novićević Čečević, Janković Milić & Nikolić (2024) emphasize that, within the Serbian business environment, sustainability reporting can be considered a factor of business success, as it contributes to greater visibility, transparency, and corporate accountability.

The theoretical foundations of sustainability reporting are most commonly found in stakeholder theory and legitimacy theory. According to stakeholder theory, a company does not operate solely in the interest of its owners, but also in the interest of a broader group of stakeholders, including employees, creditors, customers, suppliers, the government, and the local community. In this context, sustainability reporting represents a communication tool through which a company demonstrates its recognition of and responsiveness to the interests and expectations of different stakeholder groups.

Legitimacy theory, on the other hand, is based on the idea that companies seek to ensure the social acceptance of their operations. This is particularly important for companies operating in sectors with significant environmental, social, or regulatory risks, where the disclosure of sustainability-related information serves to reduce public pressure and affirm the legitimacy of business activities.

At the international level, sustainability reporting initially developed as a voluntary practice, but has increasingly evolved into a legal and regulatory requirement. In practice, the Global Reporting Initiative (GRI) is most commonly used as one of the most widely accepted frameworks for disclosing economic, environmental, and social information. In addition to GRI standards, the ESG (Environmental, Social, Governance) concept and integrated reporting have gained increasing importance in contemporary business reporting, as they enable the integration of financial and non-financial information into a comprehensive representation of a company's performance. Velte (2017) emphasizes that the quality of sustainability reporting depends not only on regulatory requirements but also on corporate governance characteristics, including gender diversity and the structure of governing bodies.

The regulatory framework for sustainability reporting is particularly well developed within the European Union. The Non-Financial Reporting Directive (NFRD) introduced an obligation for certain large companies to disclose information related to environmental, social, and employee matters, respect for human rights, and anti-corruption practices. Subsequently, the Corporate Sustainability Reporting Directive (CSRD) was adopted, introducing a more detailed and standardized reporting system based on the European Sustainability Reporting Standards (ESRS). Companies subject to CSRD requirements are obliged to report in accordance with ESRS standards developed by EFRAG, reflecting the EU's objective to ensure greater comparability, reliability, and verifiability of disclosed information.

In the Republic of Serbia, sustainability reporting, i.e., non-financial reporting, is legally regulated by the Law on Accounting. This law governs, among other things, the preparation, submission, and public disclosure of financial statements, annual business reports, corporate governance reports, reports on payments to governments, and non-financial reporting. It is particularly important to emphasize that, pursuant to Article 37 of the Law on Accounting, entities obliged to prepare non-financial reports are large legal entities that are public-interest entities and meet the prescribed criteria. The non-financial report includes information related to environmental protection, social and employee-related matters, respect for human rights, as well as anti-corruption and anti-bribery issues. In this way, the domestic regulatory framework is aligned with European requirements, although the practice of implementation is still evolving.

Despite the existence of a legal obligation, the practice of sustainability reporting in Serbia is still not fully developed. It is observed that a certain number of companies do not prepare formal sustainability reports or disclose only partial non-financial information, often lacking clear structure, standardized content, and comparability over time. Such a situation indicates the existence of a gap between the regulatory framework and its practical implementation. This gap may be the result of limited resources, insufficient awareness among management regarding the importance of sustainable business practices, underdeveloped control mechanisms, as well as the fact that non-financial reporting in domestic practice is often perceived as a formal requirement rather than as a strategic management and stakeholder communication tool.

Similar challenges are observed in other developing and transition economies. Usman (2024), analyzing industrial companies in Nigeria, finds that firm characteristics influence the practice of sustainability reporting, but also that the implementation of such reporting depends on the institutional environment and the level of market development. Ariswari & Damayanthi (2019), using the case of Indonesia, highlight the importance of profitability and leverage as factors that may shape the practice of sustainability disclosure. Shinta, Deniswara & Liu (2023) also demonstrate that audit quality, institutional ownership, profitability, and firm size can influence the assurance of sustainability reports among companies listed on the SRI-KEHATI index in Indonesia. These findings suggest that the existence of legal requirements alone is not sufficient for the consistent and high-quality implementation of sustainability reporting, but that well-developed market, institutional, and professional mechanisms are also necessary.

In the literature, particular attention is given to the relationship between sustainability reporting and financial performance. Profitability is most often considered an indicator of a company's ability to finance activities that go beyond core operational needs, including investments in sustainability, data collection systems, and the preparation of reports. More profitable companies possess greater resources and may therefore be more willing to adopt transparent reporting practices. Juliana & Sembiring (2025) indicate that sustainability reporting can strengthen the relationship between profitability and firm value, confirming that sustainability reporting can be viewed as a factor contributing to market valuation. Similarly, Werastuti, Atmadja & Adiputra (2021) emphasize the value relevance of sustainability reports and their potential impact on firm value.

However, the relationship between profitability and sustainability reporting is not unambiguous. One stream of the literature assumes that more profitable companies have greater financial resources to invest in sustainable practices, while another suggests that companies may engage in sustainability reporting as a response to external pressures, regardless of their current level of profitability. Studies examining the relationship between capital structure and profitability, such as Abor (2005), Akhtar (2012), Akinlo & Asaolu (2012), Dada & Ghazali (2016), Fama & French (1998), Rajan & Zingales (1995), Rao, Al-Yahyaee & Syed (2007), and Ramnoher & Seetah (2020), are useful for understanding corporate financial behavior and justify the inclusion of profitability and leverage in the empirical model. Although these studies do not always directly address sustainability reporting, they demonstrate that financial structure influences corporate behavior, risk exposure, and overall firm performance.

Leverage represents a particularly important determinant of sustainability reporting, as companies with higher levels of debt may have a stronger incentive to reduce information asymmetry toward creditors, investors, and other report users. Higher leverage may encourage management to disclose additional information in order to demonstrate risk management capabilities, long-term stability, and a responsible approach to financial obligations. In this context, studies such as Long & Malitz (1986), Sarkar & Zapatero (2003), Pradhan & Khadka (2017), and Stanišić, Janković & Čavić (2016) provide a theoretical foundation for considering leverage as an important characteristic of business operations. Within the context of sustainability reporting, leverage can also be interpreted as a factor that increases the pressure for greater transparency.

Liquidity is generally regarded as an indicator of short-term financial stability. Companies with higher levels of liquidity have a greater capacity to meet their obligations on a regular basis and potentially possess greater operational flexibility to develop additional reporting systems. However, empirical findings regarding the direct impact of liquidity on sustainability reporting are not always consistent. Liquidity may be significant when reporting is viewed as an activity that requires organizational and financial resources, but it may also prove to be less relevant when the decision to report is primarily driven by regulatory requirements, stakeholder pressure, or reputational considerations.

A specific strand of the literature focuses on the role of ownership and governance structures in sustainability reporting. Although a large body of research examines gender diversity within boards of directors and management, its findings are also relevant for considering the gender of the owner as a potential determinant. Velte (2017) demonstrates that gender diversity in governance structures can contribute to improving the quality of sustainability reporting. This finding is significant as it suggests that decisions related to non-financial reporting are not driven solely by financial factors, but also by value-based, managerial, and organizational characteristics. In this regard, the gender of the owner may be important, as owners influence the strategic orientation of the company, the level of transparency, and the approach to stakeholder demands.

The issue of compliance with legal obligations in the field of sustainability reporting is particularly important in countries where the regulatory framework is relatively new or in the process of alignment with European standards. Evidence from other countries suggests that the mere existence of legal requirements does not automatically ensure a high level of reporting quality. In practice, differences often arise between companies that prepare sustainability reports substantively, applying international standards and presenting clearly structured data, and those that fulfill the obligation only formally, through limited and descriptive disclosures. Therefore, increasing attention is being paid to the need for standardization, external verification, and the development of assurance services. Simnett (2012) emphasizes that the assurance of sustainability reports enhances the reliability of disclosed information and strengthens user confidence.

Based on previous research, it can be concluded that the determinants of sustainability reporting are multidimensional. They include financial performance, leverage, liquidity, ownership and governance characteristics, the regulatory framework, institutional pressures, and stakeholder expectations. In the Republic of Serbia, where non-financial reporting is legally regulated but practice is still not fully standardized, it is particularly important to examine the factors influencing companies' decisions to prepare sustainability reports. For this reason, the present study analyzes the factors that may affect the practice of sustainability reporting.

3. METHODIOLGY

The aim of this study is to examine whether the practice of preparing sustainability reports depends on the financial characteristics of companies, namely their profitability, liquidity, and leverage, as well as on the gender of the director.

The initial basis for the research was a dataset of the most successful companies for which relevant financial and non-financial data were available. The data were collected for a five-year period, from 2019 to 2023, based on publicly available financial statements obtained from the website of the Serbian Business Registers Agency, as well as other official sources.

During the data collection process, it was observed that certain companies did not have continuity of operations throughout the observed period or had incomplete data for the analyzed variables. For this reason, the initial sample was adjusted, resulting in a final sample consisting of 92 companies, i.e., 460 observations. Table 1 presents the structure of the observed sample according to different aspects.

Table 1 Some Characteristics of the sample

Karakteristika	**Kategorija**	**Broj**	**%**
Sustainability Reporting	**No sustainability report**	44	47.8%
	Sustainability report	48	52.2%
Region	Belgrade	55	59.8%
	Vojvodina	21	22.8%
	Central and Western Serbia	11	11.95%
	Southern and Eastern Serbia	5	5.4 %
Industry	Trade	34	37.0%

	Manufacturing	31	33.7%
	Transportation and Storage	8	8.7%
	Energy Supply	6	6.5%
	Construction	4	4.3%
	Information and Communication	4	4.3%
	Mining	3	3.3%
	Water Management	1	1.1%
	Arts and Recreation	1	1.1%
Gender of the Director	Male	76	82.6%
	Female	16	17.4%
	Ukupno	**92**	**100%**

Source: author's own account

It should be noted that, from the perspective of legal form, limited liability companies dominate the structure of the sample. Out of a total of 92 companies, 75 (81.5%) are organized as limited liability companies, while 11 companies (12.0%) are joint-stock companies. Public enterprises are the least represented, with 6 companies (6.5%) in the sample. Within the sample of 92 companies, 44 companies (47.8%) do not prepare sustainability reports, whereas 48 companies (52.2%) engage in this practice. In terms of regional distribution, the largest number of companies is located in Belgrade, accounting for 55 companies (59.8%), followed by Vojvodina with 21 companies (22.8%), while Central and Western Serbia are represented by 11 companies (11.95%) and Southern and Eastern Serbia by 5 companies (5.4%). Regarding industry structure, the sample is dominated by companies operating in the trade sector (34 companies; 37.0%) and manufacturing (31 companies; 33.7%). These are followed by transportation and storage (8 companies; 8.7%) and the energy supply sector (6 companies; 6.5%). Construction and information and communication sectors are each represented by 4 companies (4.3%), mining by 3 companies (3.3%), and water management as well as arts and recreation by 1 company each (1.1%). With respect to the gender of directors, male directors are present in 76 companies (82.6%), while female directors are represented in 16 companies (17.4%).

Given that the aim of this study is to examine the impact of financial performance and ownership characteristics on the practice of sustainability reporting, sustainability reporting is defined as the dependent variable and is operationalized as a dichotomous variable. The independent variables included in the model are profitability, liquidity, and leverage, as key indicators of a company's financial position. In addition, a variable related to the gender of the owner is incorporated into the model, considering that contemporary literature increasingly emphasizes the importance of gender structure in shaping business decisions and the adoption of sustainable business practices. The inclusion of these variables enables a more precise assessment of their individual and joint effects on the likelihood of preparing sustainability reports. An overview of the variables used, their measurement methods, and the expected relationships is presented in Table 2.

Table 2. Description of all variables

Variable	Type of Variable	Measurement
SR (sustainability reporting)	Dependent	0 = does not prepare, 1 = prepares report
ROA (profitability)	Independent	Net income / total assets
LIQ (liquidity)	Independent	Current assets / current liabilities
LEV (leverage)	Independent	Total liabilities / total assets
POL (owner gender)	Independent	0 = male, 1 = female

Source: author's own account

Testing the impact of selected financial indicators and ownership characteristics on sustainability reporting, as well as their predictive value, requires the application of binary logistic regression. The developed regression model takes the following form:

$$SR_i = \beta_0 + \beta_1 ROA_i + \beta_2 LIQ_i + \beta_3 LEV_i + \beta_4 POL_i + \varepsilon_i$$

where *i* denotes the observed company, while the independent variables represent the financial performance and ownership characteristics of the company.

4. RESEARCH RESULTS

The results of the analysis first refer to descriptive statistics, which were used to examine measures of central tendency, including the mean, median, and mode, as well as to assess data variability through the standard deviation. These indicators were calculated for each variable based on a sample of 92 observations and are presented in Table 3.

Table 3. Descriptive Statistics

Variable	**Minimum**	**Maximum**	**Mean**	**Std. Dev.**
SR	0	1	0.52	0.50
LIQ	0.00	16.16	2.49	2.01
ROA	-7.24	2.49	-0.07	0.59
LEV	0.03	15.05	0.99	1.72
POL	0	1	0.17	0.38

Source: author's own account

The sustainability reporting variable (SR) takes values ranging from 0 to 1, with a mean of 0.52 and a standard deviation of 0.50. This indicates an approximately balanced representation of companies that prepare and those that do not prepare sustainability reports within the observed sample. For the profitability variable (ROA), the mean value is -0.07, suggesting a low level of profitability among the observed companies, with values ranging from -7.24 to 2.49. The standard deviation is 0.59, indicating the presence of certain differences in profitability across companies. Liquidity (LIQ) ranges from 0 to 16.16, with a mean of 2.49 and a standard deviation of 2.01, pointing to significant differences among companies in their ability to meet short-term obligations. The leverage variable (LEV) has a mean value of 0.99, accompanied by considerable variability, indicating differing levels of reliance on external financing sources among the observed companies. Finally, the owner gender variable (POL) takes values from 0 to 1, with a mean of 0.17 and a standard deviation of 0.38, suggesting a lower representation of female ownership within the sample.
In the next stage of the analysis, a point-biserial correlation analysis was conducted in order to examine the relationship between sustainability reporting and the observed independent variables, as well as the strength and direction of these relationships. Point-biserial correlation is a statistical technique used to assess the relationship between a dichotomous variable and continuous variables. This method is particularly suitable when the objective of the research is to determine whether and to what extent a linear relationship exists between, for example, the presence of a specific characteristic (expressed in binary form: yes/no) and quantitative indicators such as profitability, liquidity, or leverage. The results of the correlation analysis are presented in Table 4, which contains the matrix of correlation coefficients among the observed variables.

Table 4 Correlation matrix

Varijable	**SR**	**LIQ**	**ROA**	**LEV**	**POL**
SR	1	-.019	.012	.091	-.095*
		.013	.090	.032	.042
LIQ		1	.012	-.447**	-.078
			.790	.000	.035
ROA			1	.022	-.047
				.638	.010
LEV				1	.107*
					.022
POL					1

The results of the point-biserial correlation analysis presented in Table 5 indicate that the dependent variable, sustainability reporting (SR), does not exhibit a statistically significant relationship with most of the observed independent variables. Specifically, the correlation between SR and liquidity (LIQ) is negative and very weak ($r = -0.019$), and it is not statistically significant ($p = 0.683$). Similarly, the relationship between SR and profitability (ROA) is positive but negligible and statistically insignificant ($r = 0.012$, $p = 0.790$). The correlation between SR and leverage (LEV) is positive and weak ($r = 0.091$), but it lies on the borderline of statistical significance ($p = 0.052$) and therefore cannot be considered statistically significant at the conventional 5% significance level.

On the other hand, a negative and weak, yet statistically significant relationship is observed between sustainability reporting (SR) and the gender of the owner (POL) ($r = -0.095$, $p = 0.042$), indicating the existence of a statistically significant association between these variables.
Regarding the relationships among the independent variables, a statistically significant negative correlation is found between liquidity and leverage ($r = -0.447$, $p < 0.01$), suggesting that companies with higher levels of liquidity tend to have lower levels of leverage. Additionally, a weak but statistically significant positive relationship is identified between leverage and the gender of the owner ($r = 0.107$, $p = 0.022$). Other correlations among the independent variables are not statistically significant.

Following the examination of correlation relationships, multicollinearity among the independent variables was tested. For this purpose, the Variance Inflation Factor (VIF) and Tolerance were used, which are standard statistical measures for detecting multicollinearity in regression models.
High VIF values indicate the presence of multicollinearity, meaning a strong relationship among independent variables, which may lead to instability of the estimated coefficients and reduce the reliability of the model results. Conversely, Tolerance represents the reciprocal of VIF (Tolerance = 1/VIF), where lower values indicate a higher degree of multicollinearity, while higher values suggest weaker intercorrelation among variables.
The results presented in Table 5 show that all VIF values are below 10, while Tolerance values are greater than 0.10, indicating an acceptable level of multicollinearity among the independent variables included in the model. Based on these findings, it can be concluded that multicollinearity does not pose a significant issue that could affect the results of the logistic regression analysis.
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Table 5. Multicollinearity of independent variables

Varijable	Tolerance	VIF
LIQ	0.799	1.252
ROA	0.996	1.004
LEV	0.794	1.259
POL	0.985	1.015

For the estimated regression model, it was first examined whether the key assumptions required for its application were satisfied. To this end, the results of the Hosmer–Lemeshow test were analyzed, as this test is used to assess the goodness of fit of the model, i.e., its predictive performance. The obtained results indicate that the p-value of this test is greater than 0.05, suggesting that the model fits the observed data well and that there is no statistically significant difference between the predicted and actual values of the dependent variable.
In addition to evaluating the model's goodness of fit, its overall statistical significance was tested using the Omnibus test. The results of this test indicate that the model as a whole is statistically significant ($p < 0.05$), meaning that the set of included independent variables contributes to explaining the variation in the dependent variable, i.e., sustainability reporting.
Based on the above, it can be concluded that the model has adequate explanatory power and that the included variables are relevant for the analysis. After confirming that the key assumptions were satisfied, a binary logistic regression analysis was conducted using SPSS software. The results of the model estimation, i.e., the impact of individual independent variables on the likelihood of preparing sustainability reports, are presented in Table 6.

Table 6. Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	Constant	-.459	.302	2.314	1	.028	.632		
	LIQ	.045	.102	.200	1	.655	1.046	.858	1.277
	ROA	.024	.242	.010	1	.020	1.025	.637	1.647
	LEV	.937	.439	4.549	1	.033	2.553	1.079	6.039
	POL	-.572	.257	4.934	1	.026	.565	.341	.935

5. DISCUSSION

The results of the binary logistic regression presented in Table 6 indicate that, among the observed independent variables, profitability (ROA), leverage (LEV), and the gender of the director (POL) have a statistically significant impact on the likelihood of preparing sustainability reports. In contrast, the liquidity variable (LIQ) does not show a statistically significant effect, suggesting that a company's ability to meet its short-term obligations is not a key factor in the decision to engage in sustainability reporting within the observed sample.

Considering liquidity as a potential factor influencing the practice of sustainability reporting, it can be observed that the value of the coefficient Exp(B) is 1.046, with the corresponding confidence interval, indicating that companies with higher levels of liquidity have a slightly higher likelihood of engaging in sustainability reporting. However, given that the level of statistical significance is $p = 0.655$, it can be concluded that the ratio of current assets to current liabilities does not have a statistically significant impact on this practice.This finding suggests that liquidity, although an important indicator of short-term financial stability, may not be a decisive factor in the decision to engage in

sustainability reporting. This further supports the view in the literature that the decision to prepare sustainability reports often goes beyond purely financial determinants and is more strongly influenced by regulatory requirements, the institutional environment, and the strategic orientation of companies toward transparency and sustainable business practices.

Profitability is measured using the ROA indicator, defined as the ratio of net income to total assets. The results indicate that this factor has a statistically significant impact on the practice of sustainability reporting, with the positive coefficient suggesting that companies with higher levels of profitability are more likely to prepare sustainability reports as separate disclosures. This finding can be explained by the fact that more profitable companies possess greater financial and organizational resources, enabling them to invest in the development of systems for collecting, processing, and disclosing non-financial information. In addition, financially successful companies often seek to strengthen their reputation and market position, whereby sustainability reporting serves as an important tool for communication with stakeholders and for demonstrating responsible business conduct. Furthermore, profitable companies tend to attract greater attention from investors and the public, which further encourages the need for more transparent reporting.

For the leverage variable (LEV), the value of the coefficient Exp(B) is 2.553, with statistical significance at the level of $p = 0.033$, indicating that leverage represents a significant factor in explaining the likelihood of sustainability reporting. Specifically, the obtained result suggests that as the level of leverage increases, so does the probability that a company will prepare a sustainability report.This finding can be explained by the need for more highly leveraged companies to ensure a greater level of transparency toward creditors, investors, and other stakeholders. The increased financial risk arising from a higher reliance on external financing sources encourages management to use additional reporting as a signal of responsible debt management and effective risk control. In this context, sustainability reporting can be viewed as a tool through which companies seek to reduce information asymmetry and build trust, demonstrating the absence of hidden issues and a commitment to transparent and responsible business practices.

With regard to the final observed variable—the gender of the director (POL)—the results indicate that when the director is female, the likelihood of preparing a sustainability report as a separate document is lower. Specifically, the value of Exp(B) suggests reduced odds of sustainability reporting in companies led by female directors compared to those led by male directors, holding other variables constant. This result should be interpreted in the context of the sample structure, where male directors are present in 82.6% of companies, while female directors account for only 17.4%. Such an uneven distribution may partially influence the results and their interpretation, indicating the need for cautious conclusions. The findings suggest that the gender of the director may play a role in shaping sustainability reporting practices; however, its effect should be considered within a broader context of organizational, institutional, and market-related factors.

Overall, the results indicate that slightly more than half of the observed companies in Serbia prepare sustainability reports, while a substantial proportion still does not engage in this practice, highlighting an uneven level of implementation. Among the examined determinants, profitability, leverage, and the gender of the director emerge as statistically significant factors, while liquidity does not have a statistically significant impact on sustainability reporting.

6. CONCLUSION

The primary objective of this study was to examine the impact of financial performance—specifically profitability, liquidity, and leverage—as well as ownership characteristics, particularly the gender of the owner, on the likelihood of sustainability reporting in companies in the Republic of Serbia. By applying binary logistic regression to a sample of 460 observations over the period from 2019 to 2023, the analysis identified varying effects of the observed variables on the practice of preparing sustainability reports.

The empirical results indicate that profitability (ROA) has a statistically significant, albeit relatively weak, positive effect on sustainability reporting, suggesting that more profitable companies are more likely to adopt this practice. In contrast, liquidity (LIQ) does not exhibit a statistically significant effect, indicating that short-term financial stability is not a key determinant of sustainability reporting decisions. Leverage (LEV) is identified as a statistically significant positive determinant, implying that companies with higher levels of indebtedness have greater odds of preparing sustainability reports. Finally, the gender of the director (POL) also shows a statistically significant effect, with the results indicating that companies led by female directors have lower odds of preparing sustainability reports compared to those led by male directors.

A particularly important finding relates to the owner gender variable, which also exhibits a statistically significant effect on sustainability reporting. The results suggest the existence of differences in reporting practices depending on ownership structure, thereby confirming the relevance of the gender dimension in the context of corporate behavior and decision-making.

The findings contribute to a better understanding of the determinants of sustainability reporting, indicating that financial indicators do not exert a uniform influence. Instead, leverage and ownership structure stand out as significant factors, while profitability shows a limited effect and liquidity remains statistically insignificant. These results have practical implications for corporate management and policymakers, particularly in the context of enhancing transparency and promoting the adoption of sustainable business practices.

Although the study provides valuable insights, certain limitations should be acknowledged. The focus on a limited sample of companies and the observed time period may affect the generalizability of the findings. Future research could extend the analysis by including a larger number of companies from different sectors, as well as a longer time horizon, in order to capture dynamic changes in sustainability reporting practices. Additionally, incorporating further variables, such as corporate governance characteristics or institutional factors, could contribute to a deeper understanding of this phenomenon.

Overall, this research contributes to the existing literature on sustainability reporting and corporate behavior by highlighting the importance of financial and ownership characteristics in shaping reporting practices within the context of the Serbian economy.

REFERENCES

Abor, J. (2005) 'The effect of capital structure on profitability: an empirical analysis of listed firms in Ghana', *The Journal of Risk Finance*, 6(5), pp. 438–445.

Akhtar, S.J. (2012) 'Relationship between financial leverage and financial performance: Evidence from fuel & energy sector of Pakistan', *European Journal of Business and Management*, pp. 7–17.

Akinlo, O. and Asaolu, T. (2012) 'Profitability and leverage: evidence from Nigerian firms', *Global Journal of Business Research*, 6(1), pp. 17–26.

Ariswari, P.M. and Damayanthi, I.G. (2019) 'Pengaruh profitabilitas, leverage', *E-Jurnal Akuntansi*, p. 372.

Buallay, A. (2019) 'Is sustainability reporting associated with performance?', *Sustainability*, 11(23), 6597. Available at: https://www.mdpi.com/2071-1050/11/23/6597

Dada, A.O. and Ghazali, Z.B. (2016) 'The impact of capital structure on firm performance: Empirical evidence from Nigeria', *IOSR Journal of Economics and Finance*, 7(4), pp. 23–30.

Fama, E.F. and French, K.R. (1998) 'Taxes, financing decisions, and firm value', *Journal of Finance*, 53, pp. 819–843.

Juliana, C. and Sembiring, V.V. (2025) 'How sustainability reporting strengthens the profitability–firm value link in coal mining companies', *Jurnal Akuntansi*, 29(1), pp. 1–24.

Long, M. and Malitz, I. (1986) 'The investment financing nexus: Some empirical evidence', *Midland Corporate Finance Journal*, 3, pp. 53–59.

Nirino, N. et al. (2020) 'Corporate governance and sustainability', *Sustainability*, 12(4), 1621. Available at: https://www.mdpi.com/2071-1050/12/4/1621

Novićević Čečević, B., Janković Milić, V. and Nikolić, S. (2024) 'Can sustainability reporting be a factor of business success? The case of Serbia', *Journal of Regenerative Economics*, 1(2), pp. 177–189. Available at: https://crossreis.com/journal/2024/JRE-Vol1-Issue2-2024-4.pdf.

Pradhan, R. and Khadka, N. (2017) 'The effect of debt financing on profitability of Nepalese commercial banks'. Available at: https://ssrn.com/abstract=3044107.

Rajan, R.G. and Zingales, L. (1995) 'What do we know about capital structure? Some evidence from international data', *Journal of Finance*, 50(5), pp. 1421–1460.

Ramnoher, L. and Seetah, K. (2020) 'The link between profitability and financial leverage: Evidence from a small island economy', *Asian Journal of Finance & Accounting*, 12(1).

Rao, N., Al-Yahyaee, K. and Syed, L. (2007) 'Capital structure and financial performance: evidence from Oman', *Indian Journal of Economics and Business*, 7, pp. 1–14.

Reverte, C. (2009) 'Determinants of corporate social responsibility disclosure ratings', *Journal of Business Ethics*. Available at: https://www.sciencedirect.com/science/article/pii/S0148296309000683

Sarkar, S. and Zapatero, F. (2003) 'The trade-off model with mean reverting earnings: Theory and empirical tests', *The Economic Journal*, 113(490), pp. 834–860.

Shinta, A.D., Deniswara, K. and Liu, V.T. (2023) 'The effect of audit quality, institutional ownership, profitability, and firm size on sustainability reporting assurance of companies listed on SRI-KEHATI index in 2019–2021', *E3S Web of Conferences*, 426.

Simnett, R. (2012) 'Assurance of sustainability reports: Revision of ISAE 3000 and associated research opportunities', *Sustainability Accounting, Management and Policy Journal*, 3(1), pp. 89–98.

Spence, C. and Gray, R. (2007) *Social and environmental reporting and the business case*. London: The Association of Chartered Certified Accountants (ACCA).

Stanišić, N., Janković, M. and Čavić, M. (2016) 'Testing the relevance of alternative capital structure theories in Serbian economy', *Teme*, 40(4), pp. 1309–1325.

Usman, Y. (2024) 'Effect of firm characteristics on sustainability reporting of listed industrial goods firms in Nigeria', *Academy Journal of Multidisciplinary Doctoral Research*.

Velte, P. (2017) 'Does gender diversity improve sustainability reporting?', *Sustainability*, 9(6), 1047. Available at: https://www.mdpi.com/2071-1050/9/6/1047

Velte, P. (2017) 'Does gender diversity improve sustainability reporting?', *Sustainability*, 9(6), 1047. Available at: https://www.mdpi.com/2071-1050/9/6/1047.

Werastuti, D.N., Atmadja, A.T. and Adiputra, I.M. (2021) 'Value relevance of sustainability report and its impact on value of companies', *Advances in Economics, Business and Management Research*.

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FROM SCOREKEEPER TO BUSINESS PARTNER: THE CHANGING ROLE OF CONTROLLERS UNDER BUSINESS UNCERTAINTY

Abstract: In conditions of global instability characterized by geopolitical turbulence, increasingly aggressive competition, and growing changes in regulatory and market requirements, the controller's function is undergoing rapid transformation. The traditional role of the "scorekeeper", focused on retrospective reporting, is increasingly giving way to the role of a strategic business partner who actively participates in planning, risk management, and decision-making. This paper aims to identify the key drivers, trajectory, and organizational implications of this change. Particular emphasis is placed on the digitalization and automation of reporting, the growing complexity of business systems, and the increasing demands of management for timely, reliable, and predictive information. Furthermore, the paper examines barriers to this transition, including institutional inertia, insufficient analytical and digital competencies, poorly defined role expectations, and resistance to organizational change. The findings suggest that companies adopting the business partner model enhance the quality of strategic decision-making, responsiveness, and organizational resilience under conditions of global instability. In addition to the literature review, a case study of a Serbian company was conducted to examine the extent to which contemporary trends in the transformation of the controller's role are reflected in the Serbian business context. The results of the in-depth interview indicate that a hybrid role of the controller is present in the observed company and that there is no exclusivity between the different roles. The controller simultaneously performs the roles of scorekeeper, supervisor, and business partner, suggesting a gradual and context-dependent transformation process.

Keywords: Controlling; Controller role transformation; Business partner; Business uncertainty.

1. INTRODUCTION

In a turbulent and complex global environment, primarily characterized by frequent geopolitical conflicts and rising protectionism, risk management is becoming crucial for business survival and the achievement of corporate performance (Shen et al., 2025). Many organizations are facing a new challenge which, in addition to profit maximization, involves defining resilience strategies that will ensure survival and recovery after adverse events in an uncertain business environment (Conz & Magnani, 2020). Geopolitical tensions, disruptions in global supply chains, accelerated technological development, and increasing regulatory requirements contribute to the growing complexity of

business operations and make the decision-making process more demanding than before. Under such conditions, organizations are forced to make strategic decisions more rapidly and under a higher level of risk, which makes the quality and availability of relevant information crucial for the successful management of organizations (Todorović-Dudić et al., 2016).

Changes in the business environment are also reflected in the transformation of the controlling function. Traditionally, controllers were primarily focused on collecting, processing, and reporting financial data, as well as monitoring deviations between planned and actual results. In this context, their role is often described as that of a "scorekeeper," i.e., a function predominantly focused on retrospective reporting and financial control of business operations (Granlund & Lukka, 1998). However, numerous studies indicate that the role of controllers and management accountants has significantly changed over the past decades. Changes in organizational structures, technological development, and the growing demand from management for analytical support have led to the expansion of the traditional responsibilities of controlling (Burns & Baldvinsdottir, 2005). Instead of being exclusively focused on financial reporting, controllers are increasingly involved in activities such as business performance analysis, evaluation of business alternatives, and providing support to management in the decision-making process.

Research focusing on the role of controlling indicates that controllers are increasingly expected to assume the role of business partners who are involved in strategic and operational decision-making processes (Burns & Baldvinsdottir, 2005; Maas & Matějka, 2009). This concept implies that controllers actively participate in management processes, provide analytical support to management, and contribute to the interpretation of financial and non-financial information with the aim of improving the quality of business decisions (Järvenpää, 2007). Furthermore, research shows that the development of this role often involves a process of professional transformation in which controllers attempt to expand their position from a reporting function toward a function of strategic support to management (Goretzki, Strauss, & Weber, 2013).

Although the concept of the controller as a business partner is widely present in contemporary literature, empirical research indicates that in practice different controller roles often coexist. In many organizations, controllers simultaneously perform activities related to reporting, control, and analytical support for management, while the relative importance of individual roles may vary depending on the organizational context and the needs of management (Burns & Baldvinsdottir, 2005). Understanding how these roles develop and manifest in organizational practice is particularly important in conditions of global instability, when organizations require both a reliable system of performance control and proactive analytical support in the process of strategic decision-making. In such an environment, controllers can play an important role in reducing uncertainty by providing relevant information, evaluating business alternatives, and identifying potential risks.

The aim of this paper is to review the relevant literature on the transformation of the controller's role under conditions of global business instability and to analyze how different controller roles manifest in domestic organizational practice. In addition to reviewing relevant scientific literature, the paper includes a qualitative case study conducted in a Serbian company. Data were collected through an in-depth interview designed to examine the perception of the controller's role in the organization from the perspective of the controller as the provider of information and the manager as the user of that information. In this way, the paper provides insight into how contemporary trends in the transformation of the controller's role are reflected in the domestic business context. This paper contributes to the existing literature in two ways. First, it provides empirical insight into how the contemporary concept of the controller as a business partner manifests itself in organizational practice in a developing economy. Second, by comparing the perceptions of managers and controllers, it enables the identification of a potential perception gap regarding the role of controlling in the business decision-making process.

The remainder of the paper is structured as follows. The next section presents a review of the relevant literature on the evolution of the controller's role and the factors influencing changes within the controlling function. This is followed by the presentation of the research methodology and the results of the case study, while the final part of the paper contains the research findings, conclusions, and implications for future research and practice.

2. LITERATURE REVIEW

Uncertainty in the business environment increases the need for control activities aimed at reducing the gap between what is known and what should be known by decision-makers in order for business operations to be successful (Hartmann & Maas, 2011). Under conditions of globalization and increasing internationalization of markets, companies face growing competition and increasing environmental uncertainty. In such circumstances, controlling assumes an increasingly important role in the management process, as it enables the efficient use of large amounts of information and the development of systems that support long-term business success and the competitive advantage of organizations (Todorović-Dudić et al., 2016). Financial controllers support and advise management in achieving organizational

economic and financial objectives through the design and maintenance of management control systems and accounting information systems, as well as through the collection and distribution of relevant information (Verstegen et al., 2007).

Some authors have examined the role of controlling under conditions of an uncertain business environment, particularly investigating whether a higher quality of the informational output of this function can contribute to more effective organizational management. Tworek (2022) examines the role of controlling in organizations operating under conditions of significant disruptions caused by the COVID-19 pandemic. The results of a study conducted on a sample of 1,133 organizations from Poland, Italy, and the United States indicate that a higher quality of controlling can mitigate the negative effects of organizational disruptions on organizational performance and contribute to greater organizational resilience in uncertain and dynamic environments. Further, Pires et al. (2023) conducted a study on a sample of 114 large manufacturing companies in Portugal, examining the relationship between environmental uncertainty, the usefulness of accounting information, and the application of management accounting practices (MAPs). The results show that higher environmental uncertainty increases the importance of timely accounting information. It was also found that the greater usefulness of broad-scope and timely information encourages a higher adoption of modern management accounting practices, although traditional practices remain the most commonly used. Therefore, the research conducted by Zhang et al. (2020) indicates that financial business partnering contributes to improving firm performance, with non-financial performance playing an important mediating role between controller activities and the overall organization's results.

The role of controllers in organizations has evolved significantly over the past several decades. Traditionally, controllers were primarily responsible for preparing financial reports, analyzing deviations between planned and actual results, and monitoring the financial performance of organizations. Such a role was predominantly focused on retrospective reporting and business control. Contemporary literature increasingly discusses the concept of the controller as a business partner. In this role, controllers do not perform only reporting functions but also participate in interpreting business data and providing analytical support to management. Spraakman et al. (2020) point out that the development of this role implies a greater involvement of controllers in planning processes and business performance analysis. Controllers acting as business partners are recognized as internal consultants whose responsibilities extend significantly beyond merely recording and delivering aggregated financial information to management (Karlsson et al., 2019).

Empirical research of Budding & Wassenaar (2021) based on a survey of management accountants and their managers in the public and non-profit sectors shows that an "expectation gap" exists regarding the role of management accountants. The findings indicate that managers expect a greater advisory contribution from management accountants in the management process, while the extent to which these expectations are fulfilled often remains limited. Research by Spraakman et al. (2020) also suggests that controllers in the role of business partners can contribute to improving organizational performance through active participation in planning processes, performance evaluation, and the identification of business risks. Controllers acting as business partners have a positive impact on the quality of strategic decisions, which is significantly mediated by greater cognitive flexibility compared with controllers acting as watchdogs or scorekeepers (Fourné et al., 2023).

Despite the significant benefits associated with controllers' orientation toward the business partner role highlighted in the literature, it remains important to examine to what extent controllers have actually adopted the role of management's business partner in comparison with their traditional tasks of reporting and budgetary control. Research conducted by Graham et al. (2012) in the United Kingdom based on the analysis of 95 job advertisements for the position of financial controller also indicates that the role of the financial controller has not been transformed but rather expanded, incorporating an increasing number of forward-looking activities. Byrne & Pierce (2007) carried out a study based on interviews with 18 financial managers and 18 operational managers in medium-sized and large manufacturing companies which examines the antecedents, characteristics, and consequences of management accountants' roles. The results indicate that management accountants' roles are contingent and shaped through interaction with managers, while communication and collaboration between management accountants and operational managers have significant implications for managerial control. The study also shows that the adoption of the business partner role is often ambivalent and depends on the organizational context, while a certain level of conflict between these actors may contribute to more effective managerial control. Moreover, findings from a study conducted in the manufacturing sector of a multinational pharmaceutical company indicate that changes in the roles of management accountants arise through the interaction of institutional factors and the active role of actors within organizations. Institutional contradictions create space for the transformation of traditional accounting roles, indicating that the evolution of management accountants' roles is contextual and connected with organizational change and processes of institutional transformation (Burns & Baldvinsdottir, 2005). More recent research also suggests that the development of modern controller roles is not always a linear process. Tillema, Trapp, and van Veen-Dirks (2022) emphasize that the transition toward modern roles such as the business partner role often depends on the organizational context, the professional identity of controllers, and management expectations.

Overall, the literature indicates that contemporary controlling encompasses a combination of traditional financial reporting functions and increasingly pronounced analytical and advisory roles in relation to management. As business environments become more uncertain, requiring faster, data-driven decisions, and as digital tools reduce the time needed for routine controller tasks, controllers are increasingly involved in the analysis of business information and the interpretation of results, thereby contributing to more effective decision-making. However, although numerous studies examine the transformation of the controller's role and the concept of the financial business partner, empirical research on how these roles manifest in organizations operating under conditions of global instability and within developing economies remains limited. In particular, there is a lack of qualitative studies exploring managers' and controllers' perceptions of the actual role of controlling in the decision-making process. In response to this gap, this paper contributes to the existing literature through a case study of a Serbian company.

3. METHODOLOGY

The objectives of the case study were achieved through the use of in-depth interviews, which enabled the direct examination of the perceptions of managers and controllers. The primary criterion for selecting the company was the presence of a formal control department separate from other business functions. The research methodology was based on an approach used in similar studies (Byrne & Pierce, 2007; Goretzki, Strauss, & Weber, 2013). The study data were collected through in-depth semi-structured interviews. Semi-structured interviews are frequently used in research analyzing the roles of management accountants and controllers because they allow respondents to describe their professional activities and relationships with management within an organizational context (Byrne & Pierce, 2007).

The key research questions of the study were as follows:

- How do the manager and the controller describe the role of controlling within the company?
- Which activities do the manager and the controller associate with the work of the controller?
- Which competencies and resources enable (or constrain) the controller's role as a business partner?

The empirical part of the research is based on a case study of a company operating in the Republic of Serbia, where interviews were conducted with a controller and the Chief Financial Officer. The collected data were analyzed using qualitative content analysis, coding respondents' answers according to three theoretical controller roles: scorekeeper, watchdog, and business partner, which are frequently discussed in contemporary literature as defining the activities performed by controllers within organizations (Fourné et al., 2018; Fourné et al., 2023).

Business Partner Role

- Conducts scenario analyses to support strategic planning
- Discusses future business prospects with management
- Performs sensitivity analyses of key business performance drivers
- Proactively explains to management how changes in non-financial performance measures affect profitability
- Discusses strategic issues with senior management
- Participates in management committees to present the financial implications of strategic options

Watchdog Role

- Analyzes which organizational units have not achieved their performance targets
- Analyzes deviations between actual and planned performance of organizational units for control purposes
- Jointly informs responsible managers and their superiors about deviations from budget targets
- Highlights negative budget deviations in official reports to ensure that they are noticed by higher-level managers
- Revises budget targets in order to ensure that they serve as an up-to-date basis for control

Scorekeeper Role

- Trains others on how to correctly enter data into internal financial systems
- Checks whether interfaces between data systems function properly
- Cooperates with colleagues from the financial accounting department to clarify data entry errors in financial systems
- Updates cost center plans within the organization's financial systems
- Corrects data entry errors within the organization's financial systems
- Collects data on operational processes to be included in periodic reports

In order to identify a potential perception gap, a comparison of the responses provided by the financial manager and the controller was conducted. For controllers to contribute effectively to the success of their organization, it is essential to establish mutual understanding between controllers and the managers who rely on the information they provide.

4. RESEARCH RESULTS AND DISCUSSION

The company was selected using purposive sampling because it has a formalized controlling function and a developed financial reporting system. Both respondents agreed to participate in the interview but declined audio recording due to personal data protection concerns. The research was conducted in March 2026. The interviews lasted approximately 60 minutes and were conducted according to a predefined interview guide. The respondents' answers were analyzed using qualitative content analysis through thematic coding in accordance with the three theoretical types of controller roles. The interview results were analyzed through a descriptive analysis of the individual responses of the controller and the manager, with particular emphasis on comparing their perceptions regarding the role of controlling within the organization.

The company selected for the sample represents a medium-sized legal entity operating as a group of related companies in the business activity category of web portals. The respondents consisted of a controller employed in the position of Senior Controlling Specialist with five years of experience in the current position and a total of 32 years of professional experience, and a Chief Financial Officer with eight years of experience in the current position and a total of 20 years of professional experience. The controller holds a bachelor's degree in economics, while the Chief Financial Officer holds a master's degree in economics.

Research Question 1: How do the manager and the controller describe the role of controlling within the organization?

Controller's response

The controller points out that the controlling function in the organization is not yet fully developed and is still in an early stage of development. In his opinion, the role of the controller in the organization is often incorrectly reduced to the function of control rather than the broader concept of controlling. He identifies top management as the primary users of controlling information, while expecting that in the future the circle of users will expand to include middle management as well. The controller emphasizes that accounting has a predominantly recording function, while controlling is responsible for planning, comparing actual and planned results, analyzing deviations, and providing recommendations to management.

Manager's response

The manager describes controllers primarily as scorekeepers and supervisors of business performance and does not fully recognize their role as business partners. According to him, the key activities of controllers include reporting, ad hoc analyses, budgeting, and variance analysis. He also notes that controllers may assume a broader analytical role in certain situations, particularly when they are involved in specific projects or tasks assigned by management. The results indicate that the manager and the controller similarly identify the core activities of controlling and the primary users of controlling information, mainly top management. However, a certain perception gap can be observed regarding the level of development of the business partner role. While the manager believes that this role has not yet been developed in the organization, the controller states that certain elements of this role already appear through providing recommendations and analytical support to management.

Research Question 2: Which activities do the manager and the controller associate with the controller's role?

The respondents were introduced to the three different controller roles emphasized in the literature and were asked to assess the controller's role in their company based on the activities performed.

Controller's response

The controller states that in practice, he performs activities that encompass all three theoretical controller roles: scorekeeper, watchdog, and business partner. However, he emphasizes that the majority of his time is still devoted to activities related to reporting, variance analysis, and monitoring the implementation of plans. To a lesser extent, he participates in advisory activities that involve providing recommendations and analyzing business alternatives.

Manager's response

The manager primarily associates the controller's activities with traditional controlling functions such as reporting, analysis of business results, and budgetary control. Although he recognizes that controllers may contribute analytical support to management in certain situations, he believes that their dominant role remains focused on control and performance monitoring. Both respondents confirm that controllers in the organization perform activities related to all three theoretical controller roles. However, the results indicate that traditional activities of reporting and control still dominate, while the advisory role of the business partner has a smaller presence in everyday work. The estimated relative distribution of roles shows a high degree of agreement between respondents: the manager estimates the distribution of activities at approximately 20% business partner, 30% watchdog, and 50% scorekeeper, while the controller estimates the distribution at 25%, 25%, and 50%, respectively.

Research Question 3: Which competencies and resources enable or constrain the controller's role as a business partner?

Controller's response

The controller emphasizes that analytical knowledge, a strong understanding of accounting and financial statements, and the ability to perceive the broader business context are particularly important for the development of modern professional roles of controllers. In addition to technical competencies, he highlights the importance of communication and negotiation skills that enable effective cooperation with management.

Manager's response

The manager also emphasizes the importance of analytical capabilities and a good understanding of accounting but additionally stresses the need for controllers to present financial information in a clear and understandable manner. According to him, an important competence of controllers is the ability to connect financial and business information and to assess the future implications of business decisions. The results indicate a high level of agreement between the manager and the controller regarding the necessary knowledge and skills of controllers. Both respondents highlight that technical competencies in accounting and financial analysis are largely taken for granted, while communication, analytical, and advisory competencies are becoming increasingly important. As limitations for the development of the controlling profession in the domestic context, the respondents mention the lack of professional associations and the limited exchange of knowledge and experience among professionals in the field of controlling. Finally, the results of the conducted case study indicate that in the observed organization the role of the controller currently represents a combination of the traditional functions of reporting and control with elements of advisory and analytical support to management. These results confirm the findings of previous studies suggesting that the development of the controller's role represents an evolutionary and contextual process in which different professional roles often coexist within organizations (Karlsson et al., 2019; Burns & Baldvinsdottir, 2005; Byrne & Pierce, 2007; Rieg, 2018).

5. CONCLUSION

The contemporary business environment, characterized by increasing global instability, accelerated technological change, and growing complexity of business systems, places new demands on the controlling function and the role of controllers within organizations. The professional literature increasingly emphasizes that under such conditions the traditional model of the controller predominantly focused on retrospective financial reporting and budgetary control is gradually giving way to a broader concept of the controller as a business partner who actively participates in the analysis of business performance and supports management in the decision-making process.

With the aim of examining the role of controllers in the domestic business context, a case study was conducted on a company operating in the Republic of Serbia. Particular emphasis was placed on the comparative analysis of the perceptions of controllers and managers, based on the assumption that a prerequisite for successful cooperation between controllers and managers is their mutual understanding of the key activities and responsibilities associated with the controller profession. The obtained results confirm the findings of contemporary literature indicating that the development of the controller's role as a business partner represents a gradual and context-dependent process in which different professional roles often coexist within the same organization. The findings suggest that controllers in organizational practice still perform traditional reporting and control activities to a considerable extent, while the analytical and advisory role develops gradually. In this context, controlling can play an important role in improving the quality of business decision-making by providing relevant and timely information for management.

The paper contributes to the existing literature by providing empirical insight into how the contemporary concept of the controller as a business partner manifests itself in organizational practice within the domestic business context. At the same time, the results highlight the importance of developing analytical, communication, and advisory competencies of controllers, as well as the need to strengthen professional cooperation and knowledge exchange among professionals in the field of controlling. A limitation of the research lies in the application of a case study in a single organization, which restricts the possibility of generalizing the findings. Future research could extend the analysis to a larger number of organizations and different sectors in order to examine more thoroughly the factors influencing the development of modern controller roles and their contribution to the quality of business decision-making under conditions of an uncertain business environment.

REFERENCES

Budding, T., & Wassenaar, M. (2021). New development: Is there a management accountants' expectation gap? *Public Money & Management, 41*(4), 346–350. https://doi.org/10.1080/09540962.2020.1726612

Burns, J., & Baldvinsdottir, G. (2005). An institutional perspective of accountants' new roles – The interplay of contradictions and praxis. *European Accounting Review, 14*(4), 725–757. https://doi.org/10.1080/09638180500194171

Byrne, S., & Pierce, B. (2007). Towards a more comprehensive understanding of the roles of management accountants. *European Accounting Review, 16*(3), 469–498. https://doi.org/10.1080/09638180701507114

Conz, E., & Magnani, G. (2020). A dynamic perspective on the resilience of firms: A systematic literature review and a framework for future research. *European Management Journal, 38*(3), 400–412. https://doi.org/10.1016/j.emj.2019.12.004

Fourné, S., Guessow, D., & Schäffer, U. (2018). Controller roles: Scale development and validation. https://doi.org/10.1108/S1479-351220180000033007

Fourné, S. P., Guessow, D., Margolin, M., & Schäffer, U. (2023). Controllers and strategic decision-making: The role of cognitive flexibility in controller–manager collaboration. *Management Accounting Research, 60*, 100840. https://doi.org/10.1016/j.mar.2023.100840

Goretzki, L., Strauss, E., & Weber, J. (2013). An institutional perspective on the changes in management accountants' professional role. *Management Accounting Research, 24*(1), 41–63. https://doi.org/10.1016/j.mar.2012.11.002

Graham, A., Davey-Evans, S., & Toon, I. (2012). The developing role of the financial controller: Evidence from the UK. *Journal of Applied Accounting Research, 13*(1), 71–88. https://doi.org/10.1108/09675421211231934

Granlund, M., & Lukka, K. (1998). Towards increasing business orientation: Finnish management accountants in a changing cultural context. *Management Accounting Research, 9*(2), 185–211. https://doi.org/10.1006/mare.1998.0076

Hartmann, F. G. H., & Maas, V. S. (2011). The effects of uncertainty on the roles of controllers and budgets: An exploratory study. *Accounting and Business Research, 41*(5), 439–458. https://doi.org/10.1080/00014788.2011.597656

Järvenpää, M. (2007). Making business partners: A case study on how management accounting culture was changed. *European Accounting Review, 16*(1), 99–142. https://doi.org/10.1080/09638180701265903

Karlsson, B., Hersinger, A., & Kurkkio, M. (2019). Hybrid accountants in the age of the business partner: Exploring institutional drivers in a mining company. *Journal of Management Control, 30*(2), 185–211. https://doi.org/10.1007/s00187-019-00280-1

Maas, V. S., & Matějka, M. (2009). Balancing the dual responsibilities of business unit controllers: Field and survey evidence. *The Accounting Review, 84*(4), 1233–1253. https://doi.org/10.2308/accr.2009.84.4.1233

Pires, R., Alves, M. C. G., & Fernandes, C. (2023). The usefulness of accounting information and management accounting practices under environmental uncertainty. *Journal of Risk and Financial Management, 16*(2), 102. https://doi.org/10.3390/jrfm16020102

Rieg, R. (2018). Tasks, interaction and role perception of management accountants: Evidence from Germany. *Journal of Management Control, 29*(2), 183–220. https://doi.org/10.1007/s00187-018-0266-0

Shen, Y., Giroud, A., & Han, X. (2025). Navigating turbulent waters: A literature review of socio-political risks and multinational enterprises' nonmarket strategies. *International Business Review, 34*(6), 102498. https://doi.org/10.1016/j.ibusrev.2025.102498

Spraakman, G., Sanchez-Rodriguez, C., & Tuck-Riggs, C. (2020). Data analytics and management accounting: The rise of the data-driven business partner. *Journal of Accounting & Organizational Change, 16*(3), 453–474. https://doi.org/10.1108/JAOC-03-2020-0033

Tillema, S., Trapp, R., & van Veen-Dirks, P. (2022). The management accountant as business partner: Exploring the role through identity work. *Management Accounting Research, 54*, 100760. https://doi.org/10.1016/j.mar.2021.100760

Todorović-Dudić, A., Petrović, V., & Bojanić, R. (2016). Proaktivno upravljanje rizicima: Kontroling. In *Proceedings of the International Scientific Conference FINIZ 2016* (pp. 102–106). https://doi.org/10.15308/finiz-2016-102-106

Tworek, K. (2022). Controlling quality and organizational performance during the COVID-19 pandemic: The moderating role of organizational disruptions. *Sustainability, 14*(5), 2839. https://doi.org/10.3390/su14052839

Verstegen, B., De Loo, I., Mol, P., Slagter, K., & Geerkens, H. (2007). Classifying controllers by activities: An exploratory study. *Journal of Applied Management Accounting Research, 5*(2), 9–22. https://cmaaustralia.edu.au/wp-content/uploads/2021/10/JAMAR-Classifying-Controllers-Edited2.pdf

Zhang, Y. F., Namazi, M., Guo, Y. Q., & Li, X. (2020). Finance business partnering and manufacturing firms' performance: A mediating role of non-financial performance. *Journal of Business Economics and Management, 21*(2), 473–496. https://doi.org/10.3846/jbem.2020.12002

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COST ACCOUNTING IN TIMES OF GLOBAL INSTABILITY: FROM COST CONTROL TO STRATEGIC RESILIENCE

Abstract: In recent years, the global business environment has been increasingly shaped by various forms of instability, including geopolitical tensions, supply chain disruptions, inflationary pressures, and energy market volatility. Such conditions challenge the traditional role of cost accounting, which has historically been focused on cost control, efficiency, and short-term performance measurement. This paper aims to examine how cost accounting can evolve to support organizational resilience in the context of global uncertainty.

The research adopts a conceptual approach, relying on a structured review of relevant literature in cost and management accounting, as well as recent developments related to risk management and business resilience. The paper critically analyzes the limitations of traditional cost accounting systems in unstable environments and highlights the need for more flexible and forward-looking approaches. In particular, it explores the potential of tools such as flexible budgeting, scenario-based costing, and real-time cost monitoring to enhance decision-making under uncertainty.

The main contribution of the paper lies in proposing a conceptual framework that redefines the role of cost accounting from a tool of cost minimization toward a strategic instrument for managing risk and supporting resilience. The findings suggest that integrating risk considerations into cost structures and decision-making processes can significantly improve an organization's ability to respond to external shocks and maintain sustainable performance.

The paper contributes to the ongoing discussion on the transformation of cost and management accounting practices in turbulent environments and provides practical implications for both academics and practitioners seeking to align cost systems with the demands of global instability.

Keywords: cost accounting, global instability, strategic resilience, risk management, decision-making, management accounting

1. INTRODUCTION

In recent years, the global business environment has been increasingly characterized by heightened levels of uncertainty and instability. A combination of geopolitical tensions, supply chain disruptions, inflationary pressures, energy market volatility and natural catastrophes has significantly altered the conditions under which organizations operate. These developments have exposed the vulnerability of traditional business models and emphasized the need for greater adaptability and resilience (Guo et al, 2025; Sudan et al, 2023; OECD, 2025). In such a context, the role of accounting,

and particularly cost and management accounting, is being reconsidered beyond its conventional boundaries (Medved et al, 2025; Medved & Jovanović, 2020).

Traditionally, cost accounting has been primarily oriented toward (Ardila-Rueda et al, 2025; Klink & Budding, 2025):

- cost control,
- maximimizing business efficiency, and
- short-term performance measurement.

The fundamental objective of cost accounting has been to support managerial decision-making through accurate cost allocation and analysis, often under relatively stable operating conditions (Drury & Tayles, 2024). But, in an environment marked by frequent disruptions and rapid changes in input prices, demand patterns, and operational constraints, the assumptions underlying traditional cost accounting systems are increasingly challenged (Nørgaard et al, 2025). Static budgeting, standard costing, and variance analysis, while still relevant, may prove insufficient for capturing the dynamic nature of contemporary business risks (Medved & Đorđević, 2022). This gap is particularly relevant given that cost accounting systems represent the primary source of internal financial information for operational and strategic decision-making, especially under conditions of cost volatility and resource constraints (Ardila-Rueda et al, 2025; Drury & Tayles, 2024).

The emerging literature in management accounting suggests a growing need to integrate flexibility, forward-looking information, and risk awareness into cost accounting practices (Ascani et al, 2021). Concepts such as flexible budgeting, scenario analysis, and real-time cost monitoring are gaining prominence as tools that can better support decision-making under uncertainty. At the same time, the notion of organizational resilience, defined as the ability to anticipate, absorb, and adapt to external shocks, has become central to both academic research and managerial practice. Despite this, the explicit connection between cost accounting systems and resilience-building capabilities remains underexplored (Alem Fonseca et al, 2026).

Against this background, the main objective of this paper is to examine how cost accounting can evolve from a predominantly control-oriented function toward a strategic tool that supports resilience in conditions of global instability. The paper adopts a conceptual approach, aiming to identify key limitations of traditional cost accounting systems and to explore potential directions for their transformation. In doing so, it seeks to contribute to the ongoing discussion on the role of management accounting in turbulent environments by proposing a framework that integrates cost information with risk considerations and strategic decision-making.

The remainder of the paper is structured as follows. The next section provides a brief overview of the traditional role and theoretical framework of cost accounting and resilience interaction. The subsequent section discusses emerging approaches and tools that enhance flexibility and resilience in modern cost accounting framework. The paper concludes with conclusions and implications for future research and practice.

2. THEORETICAL FRAMEWORK

2.1. Traditional Role and Limitations of Cost Accounting

Cost accounting has traditionally been developed as a key component of management accounting systems, primarily oriented toward cost measurement, cost control, and performance evaluation. Its fundamental purpose has been to support managerial decision-making by providing relevant and reliable information on cost behavior, cost allocation, and profitability analysis (Drury & Tayles, 2024). In stable and predictable business environments, such systems have proven effective in facilitating operational efficiency and supporting short-term planning and control.

Historically, cost accounting systems have relied on structured tools such as standard costing, variance analysis, and static budgeting. These instruments are designed to establish predefined cost benchmarks and evaluate deviations from expected performance. In such a framework, efficiency is typically assessed by comparing actual costs with planned or standard costs, while managerial attention is directed toward identifying and correcting deviations. This approach reflects a control-oriented philosophy, where cost minimization and operational discipline are the primary objectives.

However, the relevance of traditional cost accounting systems has been questioned for several decades. Early critiques emphasized that conventional cost systems often fail to provide timely and decision-relevant information in increasingly complex and competitive environments (Kaplan & Johnson, 1987). These critiques highlighted issues such as excessive focus on historical data, inadequate reflection of indirect costs, and limited support for strategic decision-making.

In contemporary business settings, these limitations have become even more pronounced (Kamal, 2015). The assumptions underlying traditional cost accounting, such as stable input prices, predictable demand patterns, and relatively linear cost behavior, are increasingly unrealistic. As a result, cost information based on static assumptions may quickly become outdated, reducing its usefulness for decision-making (Bromwich & Scapens, 2016). Global instability has introduced significant volatility in cost structures, particularly in areas such as raw materials, energy, and logistics (Almatarneh et al, 2022).

Furthermore, traditional cost accounting systems are often characterized by a time lag between data collection and reporting. In environments where rapid responses are required, delayed information can hinder managerial action and increase exposure to risk. In addition, variance analysis, while useful for retrospective evaluation, provides limited guidance for proactive decision-making under uncertainty. These challenges suggest that the conventional role of cost accounting as a tool for ex post control needs to be reconsidered in favor of more dynamic and forward-looking approaches (Bukh et al, 2025).

2.2. Management Accounting in Conditions of Uncertainty and Instability

The growing complexity and volatility of the global business environment have significantly influenced the development of management accounting practices. In recent decades, organizations have increasingly faced conditions characterized by uncertainty, discontinuity, and frequent disruptions. These include geopolitical risks, supply chain interruptions, technological changes, and macroeconomic fluctuations, all of which affect cost structures and decision-making processes (Medved et al, 2025; Medved & Jovanović, 2020).

In such an environment, the limitations of traditional planning and control systems become evident. Fixed annual budgets, for example, are often based on assumptions that may quickly become obsolete. As a result, organizations are increasingly adopting more flexible and adaptive approaches to planning and control. The literature highlights the importance of reconciling budgetary control with flexibility, particularly in uncertain environments where frequent adjustments are necessary (Frow et al., 2010).

Flexible budgeting represents one of the key tools in this transformation. Unlike static budgets, flexible budgets adjust cost expectations based on changes in activity levels, thereby providing a more realistic basis for performance evaluation. Similarly, rolling forecasts and continuous planning processes enable organizations to update their expectations more frequently and respond to emerging trends in a timely manner. These approaches shift the focus from rigid control toward ongoing adaptation.

Another important development is the increasing use of scenario analysis in managerial decision-making. Scenario-based approaches allow organizations to evaluate the potential impact of different future conditions, such as changes in input prices, demand fluctuations, or supply disruptions. By considering multiple possible outcomes, managers can better prepare for uncertainty and reduce the risk of adverse consequences.

In addition, advances in digital technologies have facilitated the emergence of real-time cost monitoring and data analytics. The availability of timely and detailed cost information enables organizations to detect changes more quickly and respond more effectively. This represents a significant departure from traditional cost accounting systems, which often rely on periodic reporting and aggregated data.

Overall, the evolution of management accounting in conditions of instability reflects a broader shift from control-oriented systems toward decision-support systems. In this context, cost accounting is no longer viewed solely as a tool for measuring efficiency, but as a critical component of organizational adaptability. The integration of flexibility, timeliness, and forward-looking information becomes essential for effective decision-making in uncertain environments (Branicki, et al, 2023).

2.3. Organizational Resilience as a Theoretical Framework

The concept of organizational resilience has gained increasing attention in business and management research, particularly in response to the growing prevalence of disruptions and crises. Organizational resilience is commonly defined as the ability of an organization to anticipate, absorb, and adapt to adverse events while maintaining its core functions and performance (Mikael K. Linnenluecke, 2017; Sophie Duchek, 2020).

Resilience is not a static attribute but a dynamic capability that develops over time. It encompasses multiple dimensions, including preparedness, response, and recovery. Preparedness involves the ability to anticipate potential disruptions and develop contingency plans. Response refers to the capacity to react effectively during a disruption, while recovery focuses on the ability to restore operations and adapt to new conditions.

Recent research emphasizes that resilience is closely linked to organizational capabilities, such as flexibility, learning, and resource reconfiguration. Rather than merely returning to a previous state, resilient organizations are often able to transform and improve their processes in response to external shocks. This perspective highlights the importance of proactive and adaptive behavior, as opposed to reactive responses.

From an accounting perspective, resilience has important implications for information systems and decision-making processes. In order to support resilience, organizations require timely, relevant, and forward-looking information that enables them to identify risks, evaluate alternatives, and make informed decisions under uncertainty. Traditional accounting systems, which focus primarily on historical performance, may not fully meet these requirements.

In this context, management control systems play a crucial role in enabling resilience. They provide the mechanisms through which organizations monitor performance, allocate resources, and coordinate activities. When designed appropriately, these systems can enhance organizational awareness of risks and support adaptive responses. Conversely, rigid and inflexible systems may constrain managerial action and reduce the ability to respond to changing conditions.

2.4. Integrating Cost Accounting and Resilience

The integration of cost accounting and organizational resilience represents an emerging area of research within management accounting. While cost accounting has traditionally focused on efficiency and cost minimization, its potential role in supporting resilience has only recently begun to receive attention.

The transformation of cost accounting in conditions of global instability can be summarized through a shift from a traditional control-oriented approach toward a resilience-oriented framework. Table 1 presents a comparative overview of the key differences between these two paradigms, highlighting changes in objectives, tools, and managerial roles. The comparison illustrates that contemporary cost accounting systems increasingly emphasize flexibility, risk integration, and forward-looking information, thereby supporting organizational adaptability and strategic resilience. In particular, the

transition from static and control-oriented systems to adaptive and risk-integrated frameworks reflects a fundamental shift in the role of cost accounting in contemporary organizations.

Table 1: From Traditional Cost Accounting to Resilience-Oriented Cost Accounting

Dimension	Traditional Cost Accounting	Resilience-Oriented Cost Accounting
Primary objective	Cost control and efficiency	Cost resilience and adaptability
Time orientation	Historical, ex post analysis	Forward-looking, predictive orientation
Decision focus	Operational efficiency	Strategic decision-making under uncertainty
View of environment	Stable and predictable	Volatile, uncertain, and dynamic
Cost behavior assumptions	Relatively stable and linear	Volatile, non-linear, and scenario-dependent
Budgeting approach	Static, annual budgets	Flexible budgets and rolling forecasts
Costing approach	Standard costing, variance analysis	Scenario-based costing, dynamic costing
Role of variance analysis	Retrospective performance evaluation	Complemented by proactive and real-time analysis
Information timeliness	Periodic, delayed reporting	Real-time or near real-time information
Risk consideration	Limited or implicit	Explicit integration of risk into cost analysis
Flexibility of systems	Low (rigid structures)	High (adaptive and responsive systems)
Managerial role	Monitoring and control	Interpretation, adaptation, and strategic response
Supply chain perspective	Efficiency-driven (lean focus)	Balance between efficiency and resilience
Resource allocation	Based on planned efficiency targets	Based on scenarios and risk-adjusted priorities
Performance measurement	Cost minimization, variance reduction	Sustainable performance and continuity
Strategic role of cost accounting	Supporting operational control	Supporting resilience and long-term sustainability

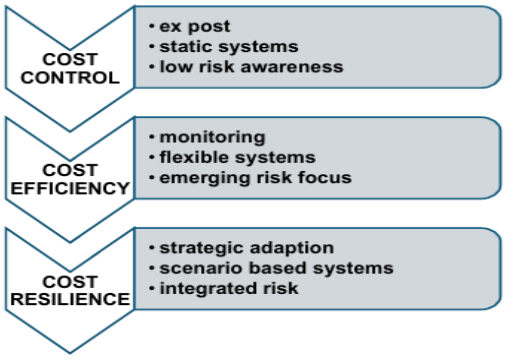
Source: Author's conceptualization based on Drury & Tayles (2024); Frow et al. (2010); Linnenluecke (2017); Duchek (2020).

One of the key challenges in this integration lies in reconciling the objectives of cost efficiency and adaptability. Traditional cost accounting systems are designed to minimize costs and eliminate inefficiencies, often under the assumption of stable operating conditions. However, in volatile environments, strict cost minimization may reduce flexibility and increase vulnerability to disruptions. For example, lean supply chains and minimal inventory levels may enhance efficiency under normal conditions but can lead to significant risks in the event of supply disruptions.

In this regard, cost accounting needs to evolve toward a more balanced approach that considers both efficiency and resilience. This involves incorporating risk considerations into cost analysis and decision-making processes. For instance, scenario-based costing can be used to evaluate the financial implications of different risk scenarios, while flexible budgeting can support adaptive planning. Similarly, real-time cost monitoring can enhance visibility and enable quicker responses to changes.

Another important aspect is the role of cost information in strategic decision-making. Cost accounting systems can provide valuable insights into the cost implications of alternative strategies, such as diversification, localization, or investment in redundancy. By integrating cost and risk information, organizations can make more informed decisions that balance efficiency with resilience.

Figure 1: Evolution of Cost Accounting toward Resilience-Oriented Systems



Source: Author's conceptualization

Figure 1 illustrates the conceptual evolution of cost accounting from a traditional control-oriented approach toward a resilience-oriented framework. The model highlights a gradual shift from ex post cost control, focused on monitoring and efficiency, toward more flexible and adaptive systems, culminating in a resilience-oriented perspective where cost

accounting integrates risk considerations and supports strategic decision-making. This transition reflects the increasing importance of adaptability and forward-looking information in environments characterized by uncertainty and volatility. The evolution of cost accounting can be understood as a gradual shift from a control-oriented approach toward a more adaptive and resilience-oriented framework.

Recent studies also suggest that the planning function of budgeting, when combined with a strong risk management orientation, can significantly enhance organizational resilience. In this context, budgeting is not merely a tool for financial control but a mechanism for anticipating uncertainties and preparing for different scenarios. This perspective aligns with the broader shift in management accounting toward supporting strategic objectives and long-term sustainability.

Overall, the integration of cost accounting and resilience requires a redefinition of the role of cost systems. Rather than focusing solely on cost control, these systems should be designed to support adaptability, risk awareness, and strategic decision-making. This transformation reflects the changing demands of the business environment and highlights the importance of aligning accounting practices with organizational objectives in conditions of global instability.

3. Redefining Cost Accounting under Global Instability

While the existing literature provides extensive insights into the limitations of traditional cost accounting systems and highlights the growing importance of flexibility and adaptability, it often stops short of offering an integrated conceptualization of how cost accounting can actively support organizational resilience under conditions of global instability. Building on these insights, this paper proposes a redefinition of cost accounting as a cost–risk–decision system, in which cost information is not treated as static or deterministic, but as inherently uncertain and closely linked to risk factors and managerial choices.

In this context, the role of cost accounting shifts from a predominantly control-oriented function toward a dynamic and decision-support framework. Rather than focusing exclusively on cost minimization and variance control, cost accounting is conceptualized as a mechanism that enables organizations to interpret cost variability, assess risk exposure, and support strategic decision-making in volatile environments. This perspective reflects a broader transformation in management accounting, where the emphasis is placed on forward-looking information, adaptability, and the integration of financial and non-financial considerations.

The following sections build on the theoretical foundations discussed earlier and extend them by identifying the key limitations of traditional cost accounting under uncertainty, as well as by proposing contemporary tools and approaches that operationalize the cost–risk–decision framework.

3.1. Limitations of Traditional Cost Accounting under Uncertainty

Building on the previously identified limitations of traditional cost accounting systems, their reliance on static and predetermined frameworks becomes particularly problematic under conditions of uncertainty. Standard costing and fixed budgeting systems are based on predefined expectations that may quickly become obsolete in dynamic environments. When input costs fluctuate significantly, as is often the case with energy prices or raw materials, standard cost benchmarks lose their relevance. Consequently, variance analysis may produce misleading signals, as deviations from planned values may reflect external volatility rather than inefficiencies in operations.

Another critical limitation is the predominantly retrospective nature of cost accounting information. Traditional systems focus on historical data and ex post performance evaluation, which limits their usefulness in situations that require rapid decision-making. In environments characterized by uncertainty, managers need timely and forward-looking information that allows them to anticipate changes and respond proactively. The time lag inherent in conventional reporting systems can therefore reduce organizational responsiveness and increase exposure to risk.

Furthermore, traditional cost accounting often assumes relatively stable relationships between costs and activity levels. However, under conditions of uncertainty, cost behavior becomes increasingly complex and non-linear. Supply chain disruptions, for instance, may lead to sudden increases in logistics costs or require alternative sourcing strategies, thereby altering cost structures in unpredictable ways. Similarly, fluctuations in demand may lead to underutilization of capacity, affecting cost allocation and profitability analysis. In addition, traditional cost accounting systems tend to treat risk as an external factor, rather than integrating it into cost analysis and decision-making processes. As a result, cost information may not fully reflect the uncertainty associated with different operational and strategic choices. This separation between cost accounting and risk management can lead to suboptimal decisions, particularly in volatile environments where risk considerations are central (Eichholz et al, 2024).

These limitations suggest that the traditional role of cost accounting as a tool for cost control and efficiency optimization needs to be redefined. In conditions of global instability, cost accounting must evolve to provide more flexible, timely, and risk-informed information that supports adaptive decision-making. Empirical evidence further suggests that cost accounting practices are often difficult to implement effectively in turbulent environments, particularly in smaller organizations, where instability amplifies existing system limitations (Roffia et al., 2024).

3.2. Redefining Cost Accounting: Integrating Risk and Forward-Looking Perspectives

In response to the limitations outlined above, there is a growing need to reconceptualize cost accounting as a system that integrates cost information with risk considerations and supports forward-looking decision-making. This transformation reflects a broader shift in management accounting from a control-oriented paradigm toward a decision-support paradigm.

A key element of this transformation is the integration of risk into cost analysis. Rather than treating costs as deterministic values, organizations need to recognize that cost outcomes are often subject to uncertainty. This implies a shift toward probabilistic and scenario-based approaches, where cost estimates are evaluated under different assumptions about future conditions. By explicitly incorporating risk into cost calculations, managers can better assess the potential variability of outcomes and make more informed decisions (Barreto et al, 2025).

Another important aspect is the adoption of forward-looking perspectives in cost accounting. Traditional systems emphasize historical performance, but in volatile environments, past data may have limited predictive value. Instead, organizations need to focus on forecasting and simulation, using available information to anticipate future developments. This requires the use of analytical tools that can model different scenarios and evaluate their implications for costs and performance (Barreto et al, 2025).

Flexibility also becomes a central characteristic of modern cost accounting systems. Rigid structures and fixed assumptions are incompatible with environments that require frequent adjustments. Flexible budgeting, rolling forecasts, and adaptive cost models allow organizations to update their expectations and respond to changes more effectively. These tools enable a continuous planning process, where decisions are revised as new information becomes available (Bukh et al, 2025; Medved & Đorđević, 2022).

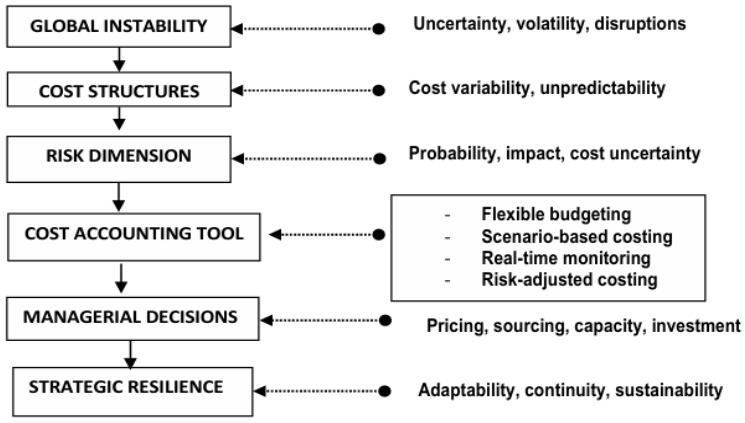
Moreover, the role of cost accounting in strategic decision-making becomes increasingly important. In unstable environments, decisions such as supplier selection, pricing strategies, capacity utilization, and investment in redundancy or diversification have significant cost implications. Cost accounting systems must therefore provide relevant and timely information that supports these decisions, taking into account both efficiency and resilience considerations. Managing trade-offs between cost efficiency and resilience has become a central challenge in contemporary organizations (Alem Fonseca et al., 2026).

This transformation also implies a change in the role of managers and cost accountants. Rather than focusing solely on monitoring performance and controlling costs, managers are expected to interpret complex information, evaluate trade-offs, and make decisions under uncertainty (Branicki et al, 2023; Zhu et al, 2026). Cost accounting systems should support this role by providing insights that are not only accurate but also meaningful in a strategic context.

3.3. Operationalizing Cost-Risk-Decision Framework

Real-time cost monitoring and data analytics further contribute to the effectiveness of cost accounting systems. Advances in digital technologies have made it possible to collect and analyze cost data in near real time, providing managers with up-to-date information on operational performance. This enables quicker detection of deviations and more timely responses to emerging issues. Real-time information also enhances transparency and supports more informed decision-making. In addition, the integration of risk-adjusted cost measures can improve the relevance of cost information. This involves incorporating risk factors, such as volatility or uncertainty, into cost calculations and performance evaluation. For example, risk-adjusted costing may consider not only expected costs but also the variability and potential downside risks associated with different options. This approach aligns cost accounting with risk management and supports more balanced decision-making (Zhu et al, 2026).

Figure 2: Cost–Risk–Decision Framework under Global Instability



Source: Author's conceptualization

Building on the evolutionary perspective presented in Figure 1, Figure 2 provides a more detailed conceptualization of how modern cost accounting systems operate under conditions of global instability. Figure 2 illustrates the proposed cost–risk–decision framework, emphasizing the sequential and interdependent relationship between external instability, cost

structures, risk dimensions, and managerial decision-making. The model highlights that cost accounting systems do not operate in isolation, but rather function as integrative mechanisms that translate environmental uncertainty into actionable managerial insights. In this way, cost accounting becomes a critical enabler of strategic resilience.

These tools collectively form the basis of a conceptual *cost–risk–decision* model, in which cost information is not analyzed in isolation but in conjunction with risk factors and decision-making requirements. In this model, cost accounting serves as a bridge between operational data and strategic choices, enabling organizations to evaluate alternatives in terms of both efficiency and resilience.

The *cost–risk–decision* model emphasizes three key relationships. First, it recognizes that cost structures are influenced by external uncertainties, and therefore must be analyzed in a dynamic and scenario-based manner. Second, it highlights the role of risk as an integral component of cost analysis, rather than an external consideration. Third, it positions decision-making as the ultimate objective of cost accounting, with information systems designed to support informed and timely choices (Burke et al, 2025; Eichholz et al, 2024).

The transformation of cost accounting toward a cost–risk–decision framework has important implications for organizational resilience. By providing more relevant and timely information, modern cost accounting systems can enhance the ability of organizations to anticipate and respond to external shocks (Burke et al, 2025).

First, the integration of risk into cost analysis improves organizational awareness of potential vulnerabilities. By understanding how different risk factors affect cost structures, managers can identify areas of exposure and develop appropriate mitigation strategies. This contributes to the absorptive capacity of the organization, enabling it to withstand disruptions more effectively.

Second, the use of flexible and adaptive tools supports organizational responsiveness. When cost accounting systems allow for continuous updates and scenario analysis, organizations can adjust their plans and actions more quickly in response to changing conditions. This enhances adaptive capacity, which is a key dimension of resilience.

Third, the alignment of cost accounting with strategic decision-making enables organizations to balance efficiency and resilience. Rather than focusing solely on cost minimization, managers can consider the long-term implications of their decisions, including the potential benefits of redundancy, diversification, or investment in flexibility. This supports sustainable performance and reduces the likelihood of severe disruptions.

Finally, the transformation of cost accounting contributes to organizational learning. By analyzing different scenarios and evaluating their outcomes, organizations can gain insights into the effectiveness of their strategies and improve their decision-making processes over time. This continuous learning process is essential for building resilience in an increasingly uncertain environment.

4. CONCLUSION

The increasing instability of the global business environment has fundamentally challenged the assumptions underlying traditional cost accounting systems. As organizations face growing uncertainty driven by geopolitical tensions, supply chain disruptions, inflationary pressures, and market volatility, the limitations of conventional cost accounting, particularly its static, retrospective, and control-oriented nature become increasingly evident. In such conditions, reliance on historical cost information and rigid planning frameworks may hinder timely and effective decision-making.

This paper has argued that cost accounting needs to be redefined in order to remain relevant in contemporary business environments. Building on insights from the existing literature, the study has proposed a shift from a traditional cost control paradigm toward a resilience-oriented perspective, in which cost accounting serves as a strategic tool for managing uncertainty and supporting adaptive decision-making. Rather than focusing exclusively on efficiency and variance reduction, modern cost accounting systems should integrate flexibility, forward-looking information, and risk considerations.

The main contribution of the paper lies in the development of a conceptual *cost–risk–decision* framework, which positions cost accounting as a bridge between operational data, risk exposure, and managerial decision-making. In this context, cost information is not treated as static or deterministic, but as inherently uncertain and dependent on evolving environmental conditions.

Furthermore, the paper has identified a set of contemporary cost accounting tools that support this transformation, including flexible budgeting, scenario-based costing, real-time cost monitoring, and risk-adjusted cost analysis. As summarized in Table 1, these tools enhance the ability of organizations to respond to changing conditions, improve the relevance of cost information, and support more informed and timely decisions. Together, they operationalize the transition from a control-oriented to a resilience-oriented cost accounting system.

The findings suggest that the integration of cost and risk perspectives can significantly enhance organizational resilience. By providing timely and forward-looking information, modern cost accounting systems contribute to improved risk awareness, greater adaptability, and more balanced decision-making. This enables organizations not only to withstand external shocks but also to maintain continuity and achieve sustainable performance in the long term.

Despite its contributions, this paper is subject to certain limitations. As a conceptual study, it does not provide empirical validation of the proposed framework. Future research could address this limitation by testing the applicability of the *cost–risk–decision* model in different industries and organizational contexts. In addition, further studies could explore the role of digital technologies and advanced analytics in enhancing the integration of cost accounting and risk management.

In conclusion, the transformation of cost accounting toward a resilience-oriented framework represents a necessary response to the challenges of global instability. By aligning cost systems with the demands of uncertainty and strategic decision-making, organizations can strengthen their capacity to navigate complex environments and build long-term resilience.

REFERENCES

Ardila-Rueda, W., Savachkin, A., Romero-Rodriguez, D., Navarro, J. (2025). Balancing the costs and benefits of resilience-based decision making, *Decision Support Systems*. Vol. 191. 114425, ISSN 0167-9236, https://doi.org/10.1016/j.dss.2025.114425.

Alem Fonseca, M., Tsolakis, N., & Kumar, M. (2026). Managing supply chain resilience and cost trade-offs: aligning resources, competencies and capabilities. *Production Planning & Control*, 1–44. https://doi.org/10.1080/09537287.2026.2618640

Ascani, I., Ciccola, R., & Chiucchi, M. S. (2021). A Structured Literature Review about the Role of Management Accountants in Sustainability Accounting and Reporting. *Sustainability*, *13*(4), 2357. https://doi.org/10.3390/su13042357

Almatarneh, Z., Jarah, B. A. F., & AL Jarrah, M. A. (2022). The role of management accounting in the development of supply chain performance in logistics manufacturing companies. *Uncertain Supply Chain Management*, 10(1), 13–18. doi: 10.5267/j.uscm.2021.10.015

Barreto, A., Gomes, P., Quesado, P., & O'Sullivan, S. (2025). Advancements in Management Accounting and Digital Technologies: A Systematic Literature Review. *Accounting, Finance & Governance Review*, *34*. https://doi.org/10.52399/001c.137301

Branicki, L., Brammer, S., Linnenluecke, M., & Houghton, D. (2023). Accounting for resilience: the role of the accounting professions in promoting resilience. *Accounting and Business Research*, *53*(5), 508–536. https://doi.org/10.1080/00014788.2023.2219148

Bromwich, M., & Scapens, R. (2016). Management accounting research: 25 years on. *Management Accounting Research*, *31*, 1–9. https://doi.org/10.1016/j.mar.2016.03.002

Bukh, P.N., Ringgaard, A., Sandalgaard, N. (2025). Moving beyond Beyond Budgeting: A case study of the dynamic interrelationships between budgets and forecasts. *European Accounting Review*. 34(3), 1–27. https://doi.org/10.1080/09638180.2024.2362681

Burke, D., Capucci, L., Dolya, A., Kim, E., Rafih, R. (2025). Balancing Cost and Resilience: The New Supply Chain Challenge. Boston Consulting Group. Retrieved April 5, 2026, from https://www.bcg.com/publications/2025/cost-resilience-new-supply-chain-challenge

Drury, C., Tayles, M. (2024). *Management and Cost Accounting.* 12th edition. Cengage. ISBN: 9781473792319

Duchek, S. (2020).Organizational resilience: A capability-based conceptualization. *Business Research*. 13, 215–246. https://doi.org/10.1007/s40685-019-0085-7

Eichholz, J., Hoffmann, N. & Schwering, A. (2024). The role of risk management orientation and the planning function of budgeting in enhancing organizational resilience and its effect on competitive advantages during times of crises. *Journal of Management Control,* 35, 17–58. https://doi.org/10.1007/s00187-024-00371-8

Frow, N., Marginson, D., & Ogden, S. (2010). "Continuous" budgeting: Reconciling budget flexibility with budgetary control.
Accounting, Organizations and Society, 35(4), 444–461.

Guo, Y., Liu, F., Song, J.-S., & Wang, S. (2025). Supply chain resilience: A review from the inventory management perspective. *Fundamental Research*. 5(2), 450-463. ISSN 2667-3258. https://doi.org/10.1016/j.fmre.2024.08.002.

Kamal, S. (2015). Historical Evolution on Management Acounting. *The Cost and Management.* 43(4), 12-19.

Kaplan, R. S., & Johnson, H. T. (1987). *Relevance lost: The rise and fall of management accounting*. Harvard Business School Press.

Klink, J., Budding, T. (2025). Antecedents and use of cost accounting systems in Dutch executive agencies. *Public Money & Management*. 46(1), 32-42. 10.1080/09540962.2025.2478177

Linnenluecke, M. K. (2017). Resilience in business and management research: A review of influential publications and a research agenda. *International Journal of Management Reviews*. 19(1), 4–30. https://doi.org/10.1111/ijmr.12076

Medved, I., Jovanović, D. (2020). Industry 4.0 Incentives for Environmental Management Accounting. *Proceedings of the 25th International Scientific Conference Strategic Management and Decision Support Systems in Strategic Management.* https://doi.org/10.46541/978-86-7233-386-2_36

Medved, I., Đorđević, D. (2022). Podsticaji savremenog poslovnog okruženja u budžetiranju. *Zbornik radova „Računovodstvena znanja kao činilac ekonomskog i društvenog napretka".* Ekonomski fakultet Univerziteta u Kragujevcu, Kragujevac. ISBN 9788660911294. 301-315.

Medved, I., Peštović, K., Đorđević, D., Đuričić, B., & Saković, D. (2025). The Importance of Management Accounting in Supply Chain Management – Theoretical Framework and Implementation Opportunities. *International Scientific Conference Strategic Management and Decision Support Systems in Strategic Management*. 92-99. https://doi.org/10.46541/978-86-7233-443-2_474

Nørgaard, M., Grønvald, J. M., Christensen, C. K. F., & Mortensen, N. H. (2025). How Traditional Costing Methods Hinder the Development of Modular Product Architectures. *Applied Sciences*, *15*(11), 6307. https://doi.org/10.3390/app15116307

OECD (2025). *OECD Supply Chain Resilience Review: Navigating Risks*. OECD Publishing. Retrieved March 30, 2026, from https://www.oecd.org/content/dam/oecd/en/publications/reports/2025/06/oecd-supply-chain-resilience-review_9930d256/94e3a8ea-en.pdf

Roffia, P., Benavides, M.M. & Carrilero, A. (2024). Cost accounting practices in SMEs: liability of age and other factors that hinder or burst its implementation in turbulent years. *International Entrepreneurship Management Journal.* 20, 115–139. https://doi.org/10.1007/s11365-023-00938-2

Sudan, T,.Taggar, R., Jena, P., & Sharma, D. (2023). Supply chain disruption mitigation strategies to advance future research agenda: A systematic literature review. *Journal of Cleaner Production*. Vol. 425. 138643. 10.1016/j.jclepro.2023.138643.

Zhu, M., Sharma, P., Almasabi, S. S., Chotia, V., Gregori, G. L., Giudice, M. D. (2026). Reinforcing financial and accounting resilience in digital circular platforms: The strategic role of digital governance and organizational culture. Technology in Society. 85. 103239. ISSN 0160-791X. https://doi.org/10.1016/j.techsoc.2026.103239.

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FINANCIAL STATEMENT QUALITY AS A FACTOR OF STRATEGIC BUSINESS DEVELOPMENT

Abstract: In an increasingly complex and competitive business environment, the quality of financial statements has become a critical determinant of sustainable growth and long-term organizational success. High-quality financial reporting enhances transparency, reduces information asymmetry, strengthens stakeholder trust, and supports more effective strategic decision-making. This paper explores financial statement quality as a strategic tool for business development, emphasizing its role not only as a compliance requirement but also as a driver of organizational performance and competitive advantage.

This study examines the quality of financial statements in accordance with the requirements of professional accounting regulation. Financial statement quality will be assessed through key qualitative characteristics defined by professional accounting standards, such as relevance, faithful representation, comparability, verifiability, timeliness, and understandability. Particular attention will be given to the extent to which financial reports comply with regulatory requirements and reflect a true and fair view of an entity's financial position and performance.

Beyond the normative and regulatory perspective, the research aims to empirically investigate whether financial statement quality has a measurable impact on organizational performance. To achieve this objective, regression analysis will be employed to test the relationship between financial reporting quality and selected performance indicators. Organizational performance will be evaluated using relevant financial metrics, such as profitability, return on assets, return on equity, and other appropriate measures of business success.

Importantly, the empirical model will incorporate a set of relevant control variables to ensure the robustness and reliability of the findings. These control variables may include firm size, leverage, industry affiliation, ownership structure, and other contextual factors that could influence performance outcomes. By controlling for these variables, the study seeks to isolate the specific effect of financial statement quality on business performance and provide more accurate and meaningful conclusions.

The expected contribution of this research is twofold. First, it provides a structured framework for assessing financial statement quality in line with professional accounting regulation, thereby reinforcing the importance of regulatory compliance and high reporting standards. Second, it offers empirical evidence on whether and to what extent financial reporting quality serves as a strategic resource that enhances organizational performance and supports long-term business development.

By integrating regulatory analysis with quantitative empirical testing, this paper aims to demonstrate that financial statement quality is not merely a formal requirement, but a strategic instrument that can significantly influence

enterprise growth, market credibility, and overall business sustainability.

Keywords: Quality of Financial Statements, Strategic, Business Performances

INTRODUCTION

The quality of financial reporting represents one of the fundamental pillars of modern business operations and corporate governance. In an increasingly globalized and competitive business environment, financial statements are not merely formal documents prepared to comply with legal requirements; they are essential communication tools that convey vital information about a company's financial position, performance, and cash flows. High-quality financial reports enable stakeholders to make informed economic decisions, reduce uncertainty, and enhance trust between companies and their investors, creditors, regulators, and other interested parties. Consequently, the quality of financial reporting has a direct and significant impact on the overall success and sustainability of an enterprise.

Financial statements, typically consisting of the balance sheet, income statement, cash flow statement, and statement of changes in equity, serve as the primary source of financial information for both internal and external users. For management, these reports provide a structured overview of operational results and financial stability, supporting strategic planning, budgeting, performance evaluation, and risk management. For external stakeholders, such as shareholders, banks, suppliers, and potential investors, financial statements are a key basis for assessing profitability, solvency, liquidity, and growth potential (Andrić et al., 2024). When financial reports are prepared in accordance with recognized accounting standards and present a true and fair view of the company's financial condition, they significantly reduce information asymmetry and strengthen market confidence.

The impact of financial reporting quality on business operations is multifaceted. First, high-quality financial reports improve access to capital. Investors and lenders are more willing to provide funds to companies that demonstrate transparency and accountability through accurate and comprehensive reporting. This can lead to lower costs of capital, improved credit ratings, and greater financial flexibility. Second, reliable financial information enhances internal decision-making processes. Managers rely on accurate data to allocate resources efficiently, evaluate investment projects, control costs, and identify areas requiring improvement. Inaccurate or manipulated financial information can distort managerial decisions, leading to inefficient resource allocation and long-term financial instability.

Furthermore, the quality of financial reporting significantly influences corporate reputation and long-term sustainability. Companies known for transparent and ethical reporting practices are more likely to build strong relationships with stakeholders and maintain a positive public image. Conversely, cases of financial misstatement, fraud, or lack of transparency can severely damage a company's credibility and result in legal consequences, financial losses, and even bankruptcy. Numerous historical corporate scandals have clearly demonstrated that poor financial reporting practices can undermine not only individual companies but also broader market stability. (Irwandi, Pamungkas, 2020)

In addition, high-quality financial reporting contributes to effective corporate governance. It supports oversight mechanisms, such as audits and regulatory supervision, and promotes accountability of management to shareholders (Hong, Hanh, 2022). By providing clear and accurate information, financial reports enable boards of directors and supervisory bodies to monitor performance and ensure that management actions align with the company's strategic objectives and stakeholders' interests.

The quality of financial reporting plays a crucial role in shaping business performance, financial stability, and long-term growth. It affects decision-making processes, access to capital, stakeholder trust, corporate reputation, and governance effectiveness. Therefore, ensuring high standards in financial reporting is not only a regulatory obligation but also a strategic necessity for companies striving to achieve sustainable success in today's dynamic business environment.

1. REGULATION OF FINANCIAL STATEMENTS QUALITY

The financial reporting framework represents the conceptual and regulatory foundation upon which high-quality financial statements are prepared and presented. Within the system of professional regulation, the framework defines the objectives, principles, qualitative characteristics, and elements of financial reporting. It ensures that financial statements are not prepared arbitrarily, but rather in accordance with clearly established rules and concepts that promote transparency, consistency, and comparability. A well-defined financial reporting framework is therefore essential for achieving and maintaining the quality of financial statements.

At the international level, one of the most influential frameworks is the Conceptual Framework for Financial Reporting issued by the International Accounting Standards Board. This framework underpins the development of International Financial Reporting Standards (IFRS) and provides guidance in situations where no specific standard applies. It establishes the objective of general-purpose financial reporting, which is to provide financial information about an entity that is useful to existing and potential investors, lenders, and other creditors in making decisions about providing resources to the entity. By clearly defining this objective, the framework ensures that financial statements are prepared with a focus on decision usefulness.

The conceptual framework identifies fundamental qualitative characteristics of useful financial information: relevance and faithful representation. Relevance means that information must be capable of influencing users' decisions by

helping them evaluate past, present, or future events. Faithful representation requires that financial information accurately reflects the economic substance of transactions, rather than merely their legal form (IFRS Foundation, 2018). This principle is particularly important in preventing creative accounting practices that may comply with formal requirements but distort economic reality. Enhancing qualitative characteristics: comparability, verifiability, timeliness, and understandability further strengthen the overall quality of financial reporting.

In addition to defining qualitative characteristics, the financial reporting framework establishes the elements of financial statements: assets, liabilities, equity, income, and expenses. Clear definitions of these elements are crucial for consistent recognition and measurement. For example, an asset is defined as a present economic resource controlled by the entity as a result of past events, while a liability represents a present obligation to transfer an economic resource. These definitions guide accountants in determining whether specific transactions should be recognized in the financial statements and how they should be measured. Without such definitions, financial reporting would lack coherence and comparability across entities.

Measurement bases represent another key component of the financial reporting framework. The framework recognizes different measurement approaches, including historical cost, current cost, fair value, and value in use. The selection of an appropriate measurement basis significantly affects the reported financial position and performance of a company. Professional regulation provides guidance on when and how each measurement basis should be applied in order to ensure reliability and relevance. For example, fair value measurement may provide more relevant information in certain circumstances, but it must be supported by reliable valuation techniques and adequate disclosures to maintain faithful representation.

The financial reporting framework also addresses presentation and disclosure requirements. Transparent presentation ensures that financial statements are structured in a way that facilitates understanding and analysis. Disclosure requirements provide additional explanations about accounting policies, estimates, risks, and uncertainties (IFRS Foundation, 2018). These disclosures reduce information asymmetry between management and external users and enable stakeholders to better assess the financial health and risk profile of the entity. Comprehensive disclosure is especially important in complex areas such as financial instruments, revenue recognition, and contingent liabilities.

In addition to professional regulation, the quality of financial reporting is also determined by legal and internal regulations. Legal regulation, enacted at the level of each national economy, more closely defines issues such as the content and form of financial statements, the frequency of financial reporting, entities required to prepare a full or abridged set of financial statements, entities subject to audit, and similar matters. At the final level, in terms of direct accounting regulation, the quality of financial statements is determined by internal regulations within each organization. Internal regulations are adopted by each organization and relate to the selection and application of accounting policies, such as the choice of depreciation methods, depreciation rates, asset valuation methods, and other issues that further specify professional and legal regulations.

2. LITERATURE REVIEW

According to Morris (1987) agency theory and signalling theory are two important theoretical frameworks used to explain the quality of financial reporting. Agency theory is a theory that examines the design of contracts aimed at resolving agency problems and reducing agency costs that arise from agency relationships, particularly when decision-making authority is delegated from principals to agents (Hendrastuti, Harahap, 2023). In modern companies, owners usually delegate decision-making responsibilities to managers. However, managers may sometimes act in their own interests rather than in the best interests of shareholders. This creates what is known as an agency problem. High-quality financial reporting helps reduce this problem by providing transparent, accurate, and reliable information about the company's financial performance and position. When financial reports are clear and trustworthy, shareholders can better monitor management's actions and make informed decisions. Therefore, agency theory suggests that better financial reporting quality reduces information asymmetry and conflicts of interest between managers and owners.

Signalling theory explains how companies use financial reporting to send signals to investors, creditors, and other stakeholders. Since external users do not have the same level of information as managers, companies with strong financial performance often use high-quality financial reports to signal their stability, profitability, and future growth potential. Transparent and reliable financial statements help build investor confidence and improve the company's reputation in the market. On the other hand, poor-quality reporting may create suspicion and reduce trust. Therefore, signalling theory assumes that efficient companies provide investors with more relevant, accurate, and higher-quality information (Al-Sartawi, Reyad, 2018)

The quality of financial reporting has a significant impact on an organization's performance across several dimensions (Muzira, 2019). First, it contributes to improved profitability, as accurate and reliable financial statements enable management to make better decisions regarding costs, pricing, and investments. As a result, organizations can optimize their operations and enhance overall profit levels. Second, high-quality financial reporting supports revenue growth. Transparent and credible financial information increases the trust of investors, creditors, and business partners, facilitating easier access to capital and enabling business expansion, which ultimately leads to higher sales revenues. Third, it enhances the efficiency of resource management. Precise and timely financial data allow organizations to plan and control the use of assets, inventories, and cash flows more effectively, improving operational efficiency. Finally,

quality financial reporting reduces risk and strengthens organizational stability. By minimizing information asymmetry and the likelihood of poor decision-making, and by ensuring compliance with regulations, it contributes to the long-term financial sustainability and stability of the organization.

Given the above, numerous authors have examined how the quality of financial reporting affects organizational performance. For example, Saković et al. (2024) analyzed the impact of the quality of financial reporting on biological assets and real estate on the business performance of organizations, measured by return on assets. The research was based on a sample of 186 observations over the period from 2020 to 2021. The results indicate that the quality of reporting on biological assets and real estate in agricultural enterprises has a significant positive effect on return on assets. In addition, firm growth and size are highlighted as key variables influencing business performance.

Alsmady (2022) examined the impact of quality of financial reporting, external audit, and earnings power on company performance. Using regression analysis, the author found that the quality of financial reporting has a positive effect on organizational performance, which was measured through several indicators, including profitability, market-to-book value, and market-based measures.

Rathnayake et al. (2021) investigated the relationship between the quality of financial reporting on one side and return on assets, return on equity, and market-to-book ratio as measures of organizational performance on the other. When the models include control variables, a positive and statistically significant relationship is observed between the quality of financial reporting and organizational performance.

Aruobogha et al. (2024) examined the impact of financial reporting quality on the business performance of publicly listed companies in Sub-Saharan Africa. The study covered a sample of 112 companies over the period from 2012 to 2022. The results also indicate the existence of a positive relationship between the quality of financial reporting and organizational performance when control variables are included. Among the significant control variables, the authors highlight firm size as particularly important.

Mittal (2024) demonstrates that financial reporting quality positively influences firm performance in emerging markets, enhancing both profitability and market valuation. Similarly, Sarioglu et al. (2025) find that integrated reporting practices contribute to higher financial performance metrics, including ROA and ROE, in both developed and emerging economies. Abu Hamour et al. (2024) emphasize that high-quality financial reporting improves earnings quality, which in turn supports more reliable performance measurement and decision-making.

The interplay between financial reporting quality and ESG (Environmental, Social, and Governance) disclosure has also been highlighted in recent research. Wu and Abeysekera (2023) show that ESG-focused firms exhibit higher quality reporting, which positively correlates with financial performance in China. ESG regulations similarly appear to enhance reporting quality without undermining firm efficiency (Palas et al., 2025). Moreover, Pascaru and Hategan (2024) provide a bibliometric analysis indicating that firms with robust audit and reporting systems consistently achieve superior operational outcomes.

Li et al. (2024) explore how CEO characteristics interact with reporting quality to affect investment efficiency in the U.S., suggesting that strong reporting practices reduce managerial discretion errors and enhance strategic decision-making. Global board reforms also have a measurable impact on reporting quality, as indicated by research on institutional changes worldwide (Chen et al., 2024). Finally, the systematic review of IFRS adoption confirms that standardized, high-quality reporting frameworks improve firm performance across various sectors and legal environments (Salah, 2020).

Taken together, this body of research highlights a clear and consistent pattern: high-quality financial reporting is a critical determinant of organizational performance, not only through traditional profitability and growth channels but also via enhanced transparency, resource efficiency, regulatory compliance, and the integration of ESG considerations (Mittal, 2024; Sarioglu et al., 2025; Wu & Abeysekera, 2023; Abu Hamour et al., 2024).

3. METHODOLOGY AND SAMPLE

The main objective of this paper is to examine the quality of financial statements as a factor of the strategic development of organizations. The sample consists of 180 companies from the manufacturing sector and the trade sector in the Republic of Serbia during the period 2022-2024. According to the rule of thumb, the minimum sample size is at least 10 times greater than the number of predictor variables (Seabrooke, 2025). In the study, four predictive variables were included, indicating that the sample size is adequate. These sectors were selected because they are the largest in terms of the number of companies and employees during the observed period, according to data from the Statistical Office of the Republic of Serbia (2026). Therefore, it is expected that these sectors make a significant contribution to economic development and are of interest to numerous stakeholders. Data from the financial statements were obtained from the publicly available website of the Business Registers Agency (2026). In order to achieve the stated objective, the following research hypotheses are set:

H1: The quality of financial reporting has a positive effect on the profitability of companies.
H2: The quality of financial reporting has a positive effect on the growth of companies.

There are different methodologies for measuring the quality of financial reporting, such as earnings management (Ilić et al., 2024; Debbianita, 2024), the financial reporting index (Goncalves, 2017), the internet financial reporting index

(Khan, Ismail, 2010). In this study, the quality of financial reporting was measured based on the financial reporting quality index for two categories of assets: property, plant and equipment, and inventories based on Goncalves (2017). Considering the nature of business operations in companies from the trade and manufacturing sectors, property and inventories represent significant items in the balance sheet, and the quality of reporting on them significantly affects business decision-making. The financial reporting quality index represents the ratio between actual (realized) and required (observed) disclosures in financial statements. The index ranges from 0 to 1, where values closer to 0, including 0 itself, indicate non-disclosure of information and thus low (poor) quality of financial reporting, while values closer to 1 indicate high-quality financial reporting. If all observed information is adequately disclosed in the reports, the index takes the value of 1, in which case the quality of reporting is considered extremely high (Goncalves, 2017). Property, plant and equipment, as well as inventories, represent significant categories within the total assets of manufacturing companies; therefore, it is assumed that the performance achieved by companies ultimately depends on the quality of reporting on these categories. International Accounting Standard 16 – Property, Plant and Equipment (hereinafter: IAS 16) and International Accounting Standard 2 – Inventories (hereinafter: IAS 2) provide detailed requirements regarding mandatory and voluntary disclosures for these asset categories. Companies are required to present all mandatory disclosures in their reports, specifically within the notes to the financial statements. The disclosure of all required information in accordance with professional regulations directly affects the quality of financial reporting by providing more complete and accurate information for business decision-making. It should be noted that non-disclosure of certain information does not necessarily mean that a particular situation does not exist within a company; it may also be the result of intentional or unintentional omission of information (Peštović, 2026). Given the extensive scope of disclosure requirements under IAS 16 and IAS 2, the following mandatory disclosures were analyzed for the purposes of this research:

1) According to IAS 16 requirements:
   - The measurement bases used for determining the gross carrying amount
   - The depreciation methods used
   - The useful lives or depreciation rates applied
   - The gross carrying amount and accumulated depreciation at the beginning and end of the period, including all adjustments to carrying value

2) According to IAS 2 requirements:
   - Accounting policies for measuring inventories
   - The total carrying amount of inventories by classification

In addition to the quality of financial reporting as the independent variable, the study also considers company size, company liquidity, and leverage. Company profitability is measured by return on assets, which represents the ratio between net income and total assets and indicates the company's earning power (Rodić et al., 2024). Company growth is observed through the growth of operating revenues across two time periods.

In order to test the proposed hypotheses, the following two regression models were specified:

$$Y1 = \beta0 + \beta1X1 + \beta2X2 + \beta3X3 + \beta4X4 + \varepsilon i$$

Where:
Y1 – profitability (return on assets)
X1 – quality of financial statements (based on index)
X2 – size
X3 – liquidity
X4 – debt ratio

$$Y2 = \beta0 + \beta1X1 + \beta2X2 + \beta3X3 + \beta4X4 + \varepsilon i$$

Where:
Y2 – growth
X1 – quality of financial statements (based on index)
X2 – size
X3 – liquidity
X4 – debt ratio

In the following table, the methodology for calculating the dependent and independent variables defined in the research models is presented.

Table 1: Methodology of variables

Label	Variables name	Methodology
Y_1	Profitability (ROA)	Net Result / Total Assets
Y_2	Growth	Operating Revenue$_t$ / Operating Revenue$_{t-1}$
X_1	Quality of financial statements	Completed Disclosures / Total Disclosures
X_2	Size	nLog of Total Assets
X_3	Liquidity	Current Assets / Current Liabilities
X_4	Debt ratio	Total Liabilities / Capital

Source: Authors' calculations

4. RESULTS AND DISCUSSIONS

The following table presents the descriptive statistics of dependent and independent variables.

Table 2: Descriptive statistics

Label	Variables	Average value	Minimum	Maximum
Y_1	Profitability (ROA)	0.0793	-0.0251	0.6625
Y_2	Growth	1.0379	0.0928	1.4510
X_1	Quality of financial statements	0.6190	0.3333	1.0000
X_2	Size	12.2163	8.0091	16.8908
X_3	Liquidity	3.2719	0.1839	25.0980
X_4	Debt ratio	0.4871	0.0277	3.5537

Source: Authors' calculations

Observing the results of the descriptive statistical analysis, it is noticeable that manufacturing companies in the sample achieved, on average, a positive profitability of 7.93% in the period 2022–2024, as well as a sales revenue growth of 3.79%. It is also evident that there are companies operating at a net loss, as well as companies that generated lower sales revenue compared to the previous year.

Regarding the quality of financial reporting, companies disclose on average about 61.90% of the observed disclosures. To the greatest extent, companies disclose information related to the valuation methods used for both property, plant and equipment, and inventories. This is followed by disclosures related to the depreciation methods applied and the depreciation rates of property, plant and equipment. The least frequently disclosed information relates to value adjustments during the period for property, plant and equipment, as well as information on inventory values by specific classifications (Table 3).

Table 3: Percentage of disclosure of certain information

Information	Percentage of disclosure of certain information
The measurement bases used for determining the gross carrying amount (IAS 16)	93,33%
The depreciation methods used (IAS 16)	91,67%
The period or depreciation rates applied (IAS 16)	91,67%
The gross carrying amount and accumulated depreciation at the beginning and end of the period, including all adjustments to carrying value (IAS 16)	48,89%
Accounting policies for measuring inventories (IAS 2)	91,67%
The total carrying amount of inventories by classification (IAS 2)	44,44%

Source: Authors' calculations

The results of the regression analysis are presented in Table 4 and Table 5. Prior to analyzing the regression results, model adequacy tests were conducted. The testing results indicate the absence of multicollinearity, as well as no presence of autocorrelation. Additionally, for the first model the Anova results (F=46.970, p=0.000) indicates that the model is significant. Furthermore, first model summary indicate that 51.9% of the variation in the dependent variable is explained by the independent variables (R=0.721; R square=0.519; Adjusted R square=0.508).

Table 4: Results of the Regression Analysis of the Impact of Financial Reporting Quality on Profitability

Model (ROA)	Beta	St. er.	t	Sig.
Cons	-0.261	0.029	-8.868	0.000
Quality of financial statements	0.370	0.031	11.763	**0.000**
Size	0.007	0.002	2.902	**0.004**
Liquidity	0.003	0.002	1.927	0.056
Debt ratio	0.078	0.018	4.421	**0.000**

Source: Authors' calculations

The results of the analysis of the first regression model indicate that the quality of financial reporting, size and debt have a significant impact on the profitability of manufacturing companies. All three indicators have a positive statistically significant impact on profitability. Companies with better financial report quality achieve better performance measured based on return on assets. These findings are according to the previous research (Saković et al, 2024; Alsmady, 2022) Larger companies have more resources that can be implemented into the accounting and therefore the quality of financial statements can provide better performances. Companies with additional borrowing directed toward business activities can achieve better profitability. On the other hand, if additional borrowing is used to service existing debt, such borrowing will not lead to an improvement in profitability (Jakšić, Mijić, 2013). According to the results the H_1 is accepted.

For the second model the Anova results (F=16.917, p=0.000) indicates that the model is significant. Furthermore, second model summary indicate that 28% of the variation in the dependent variable is explained by the independent variables (R=0.529; R square=0.280; Adjusted R square=0.263).

Table 5: Results of regression analysis of the impact of financial reporting quality on growth

Model (Growth)	Beta	St. er.	t	Sig.
Cons	0.636	0.065	9.772	0.000
Quality of financial statements	0.511	0.069	7.364	**0.000**
Size	0.006	0.005	1.169	0.244
Liquidity	-0.003	0.003	-.836	0.404
Debt ratio	0.078	0.039	1.983	**0.049**

Source: Authors' calculations

The results of the second regression model indicate that the quality of financial reporting and debt ratio have significant positive impact on growth. This suggests that companies with higher-quality financial reporting are more likely to achieve stronger growth, as transparent and reliable financial information improves decision-making, investor confidence, and access to external financing. At the same time, a higher debt ratio may contribute positively to growth when borrowed funds are effectively used to finance productive business activities, expansion, and investment opportunities. Leverage refers to the increased level of financing from external sources, which is sustainable in the long run only if the companies concerned achieve a higher return on total equity than the cost of using those external sources of capital (Vuković et al., 2022). Liquidity does not have significant impact on growth and these findings indicate that ensuring short-term liquidity will not lead to growth (Bashir et al., 2020). The non-significant effect of liquidity on company growth may suggest that short-term solvency alone is insufficient to generate long-term strategic expansion. Growth is more strongly influenced by investment capacity, market opportunities, and financing structure than by current liquidity positions. Therefore, the findings imply that both financial reporting quality and appropriate use of debt play an important role in supporting business growth and long-term development. According to the results the H_2 is accepted.

CONCLUSION

The quality of financial statements represents a key factor in modern business, as it provides reliable and relevant information for decision-making. Transparent and accurate reports increase the trust of investors, creditors, and other stakeholders. In this way, a company can more easily access sources of financing under more favorable conditions. High-quality financial reporting enables management to gain better insight into business performance and identify weaknesses. Timely and precise information facilitates planning and control of business activities. It also reduces the risk of making incorrect decisions based on inaccurate data. High-quality reports contribute to compliance with legal and regulatory requirements. This helps avoid potential penalties and reputational risks.

In order to ensure the quality of financial statements, it is necessary to adequately comply with the requirements of the entire accounting regulatory framework, including professional, legal, and internal regulations. Additionally,

accountants, as the preparers of financial statements, face an additional burden of meeting disclosure requirements within a relatively short period of time, while ensuring that the information presented is accurate and clear.

Research on the quality of financial reporting in the Republic of Serbia indicates that companies, on average, disclose less than two-thirds of the observed information in accordance with the requirements of IAS 16 and IAS 2. Additionally, two areas requiring improvement in reporting quality have been identified: information on value adjustments in accordance with IAS 16, and information on inventory values by classification in accordance with IAS 2. Regarding whether the quality of financial statements affects business performance, the results indicate a positive impact of reporting quality on profitability and the growth of companies. The quality of financial statements is not merely an accounting obligation, but an important strategic tool for sustainable growth and development of a company.

This study contributes to the existing literature by strengthening the theoretical understanding of the relationship between financial reporting quality and organizational performance through the application of agency theory and signalling theory. From the perspective of agency theory, the findings confirm that higher-quality financial reporting reduces information asymmetry between managers and owners, improves monitoring mechanisms, and supports more efficient managerial decision-making, which ultimately enhances profitability and growth. From the perspective of signalling theory, transparent and reliable financial statements serve as positive signals to investors, creditors, and other stakeholders, increasing trust, improving access to external financing, and supporting long-term business expansion.

Furthermore, the study extends prior research by demonstrating that disclosure quality related to specific balance sheet categories, such as property, plant and equipment and inventories, can serve as an important determinant of business performance. This suggests that financial reporting quality should not be observed only through aggregate financial indicators, but also through compliance with disclosure requirements at the micro-accounting level.

The novelty of this study lies in its micro-level analysis of financial reporting quality in the context of a developing market, specifically the Republic of Serbia. This approach enables a more detailed evaluation of how the quality of disclosures in economically significant balance sheet positions affects organizational profitability and growth. The limitations of this research are reflected in the narrow selection of financial reporting quality measurement related to IAS 16 and IAS 2. However, it should be taken into account that these two asset positions are the most significant items in the balance sheet of companies in the manufacturing and trade sectors. The results also provide significant insight for managers and other stakeholders regarding critical issues that need to be improved for reporting in accordance with the mentioned standards. Future research should include the disclosures of other standards in order to conduct a more comprehensive analysis of financial reporting quality and provide greater usefulness for stakeholders, as well as comparative analysis among the countries with similar level of economic development.

REFERENCES

Abu Hamour, A. M., Saleh, M. M. A., Abdo, K. K., Alzu'bi, A. K. A., Alnsour, E. A., & Jwaifel, A. M. Y. (2024). The effect of financial reporting quality on earnings quality of industrial companies. *Corporate & Business Strategy Review, 5*(2), 38–50. https://doi.org/10.22495/cbsrv5i2art4

Al-Sartawi, A., Reyad, S. (2018). Signaling theory and the determinants of online financial disclosure. *Journal of Economic and Administrative Science,* 34(12), 237-247. https://doi.org/10.1108/JEAS-10-2017-0103

Alsmady, A. (2022). Quality of financial reporting, external audit, earnings power and companies performance: The case of Gulf Corporate Council Countries. Research in Globalization. 5(2022), 100093. DOI: https://doi.org/10.1016/j.resglo.2022.100093

Andrić, M., Jakšić, D., Vuković, B., Peštović, K., Krsmanović, B., Spahić, N. (2024). Revizija teorija i praksa. Subotica, Ekonomski fakultet u Subotici.

Aruobogha, O., Jones, A., Ogheneovo, O. (2024). Financial Reporting Quality and the Performance of Firms in Sub-Sahara Africa: The Mediating Role of Firms Characteristics. International Journal of Public Policy and Administration Research. 11(1), 1-13.

Bashir, Z.; Arshad, M.U.; Asif, M.; Khalid, N. (2020). Driving factors of growth evidence in the food and textile sectors of Pakistan. *Financ. Internet Q. 16*, 11–19.

Business Registers Agency. (2026). Registers of Financial Statements. Available 10.2.2026. at https://www.apr.gov.rs/registri/finansijski-izvestaji.2069.html

Chen, R., Liu, F., & Zhao, C. (2024). Worldwide board reforms and financial reporting quality. *Research in International Business and Finance, 69*, 102239. https://doi.org/10.1016/j.ribaf.2024.102239

Debbianita, D., Kuang, T., Hoetama, M. (2024). Earnings management: a literature review. *Indonesian Journal of Accounting and Governance,* 8(1), 40-56.

Goncalves, R., Lopes, P., Craig, R. (2017). Value relevance of biological assets under IFRS.

Hendrastuti, R., Harahap, R. F. (2023). Agency theory: Review of the theory and current research. *Jurnal Akuntansi Aktual.* 10(1). 85-101 http://dx.doi.org/10.17977/ um004v10i12023p085

Hong N., Hanh, D. (2022). A Quality Financial Report: A Conceptual Analysis International Journal of Research in Vocational Studies (IJRVOCAS), 2(1), 26–32.

IFRS Foundation. (2018). Conceptual Framework for Financial Reporting. IFRS.

Ilic, T., Pestovic, K., Sakovic, D., Radjo, D. (2024). Evaluation of Earnings Management in Relation to the Quality of Financial Reporting: A Comparative Analysis of the Agriculture and Manufacturing Sectors, *Contemporary Agriculture*, 73(1-2), 119-128, http://doi.org/10.2478/contagri-2024-0015

International Accounting Standard 16 – Properties, equipment and plant (IAS 16) Available 10.2.2026. at https://www.srr-fbih.org/

International Accounting Standard 2 – Inventory (IAS 2) Available 10.2.2026. at https://www.srr-fbih.org/

Irwandi, S. A., Pamungkas, I. D. (2020). Determinants of financial reporting quality: Evidence from Indonesia. Journal of International Studies, 13(2), 25-33. DOI: https://doi.org /10.14254/2071-8330.2020/13-2/2

Jakšić, D., Mijić, K. (2013). Uticaj profitabilnosti na mogućnost dodatnog kreditnog zaduživanja učesnika na finansijskom tržištu. *Novi Ekonomist*. 13, 52-55.

Journal of International Accounting, Auditing and Taxation, 29, 118-126, DOI: https://doi.org/10.1016/j.intaccaudtax.2017.10.001

Li, Z., Athanasiadis, K., Fygkioris, M., & Koufopoulos, D. N. (2024, August). Financial reporting quality, CEO age, and investment efficiency: Evidence from the U.S. market. Paper presented at the *11th International Conference on Management Science and Applications (ICMSA)*, Istanbul, Turkey.

Mittal, S. (2024). Financial Reporting Quality and Firm Performance: Evidence from Emerging Markets. *Journal of Applied Optics*, *45*, 155–158. Retrieved from https://appliedopticsjournal.net/index.php/JAO/article/view/133

Morris, R. (1987). Signalling, Agency Theory and Accounting Policy Choice. *Accounting and Business Research.* 18(69). 47-56 http://doi.org/ 10.1080/00014788.1987.9729347

Muzira, D. R. (2019). A Quality Financial Report: Concept Paper. International Journal of Social Sciences & Educational Studies, 5(3), 167-177. DOI: https://doi.org/10.23918/ijsses.v5i3p167

Palas, R., Gafni, D., Solomon, D., & Baum, I. (2025). ESG ratings and financial reporting quality: Why social performance matters. *Finance Research Letters, 86*, 108613. https://doi.org/10.1016/j.frl.2025.108613

Pascaru, A., & Hategan, C. D. (2024). Financial reporting and audit quality: A bibliometric analysis. *Journal of Financial Studies, 9*(16). https://doi.org/10.55654/JFS.2024.9.16.12

Peštović, K. (2026). Objavljivanje informacija u beleškama uz finansijske izveštaje. Računovodstvo i poslovne finansije, 2, 12-19.

Rathnayake, R., Rajapakse, R., Lasantha, S. (2021). The Impact of Financial Reporting Quality on Firm Performance. Journal of Business and Technology. Special edition. 53-67. DOI: http://doi.org/10.4038/jbt.v5i0.53

Republički zavod za statistiku. (2026). *Poslovanje preduzeća u republici Srbiji prema oblicima svojine, 2023-2024.* Beograd, Repulički zavod za statistiku.

Rodić, J., Andrić, M., Vuković, B., Jakšić, D. (2024). Analiza finansijskih izveštaja. Subotica, Ekonomski fakultet u Subotici.

Saković, D., Peštović, K., Tica, T., Rađo, D. (2024). The impact of quality of biological assets and properties disclosures on agricultural company`s performance, *Custos e agronegocio. 20*(1), 91-109.

Salah, W. (2020). The international financial reporting standards and firm performance: A systematic review. *Applied Finance and Accounting, 6*(2). https://doi.org/10.11114/afa.v6i2.4851

Sarioglu, M., Ozsoz, E., Simic, V., & Kara, K. (2025). Integrated Reporting Quality as a Determinant of Financial Performance: Evidence from Emerging and Developed Markets. Management Science Advances, 2(1), 239-259. https://doi.org/10.31181/msa21202524

Seabrooke, J. (2025). Powering Nutrition Research: Practical Strategies for Sample Size in Multiple Regression. Nutrients, 17(16), 2668; https://doi.org/10.3390/nu17162668

Vuković, B., Peštović, K., Mirović, V., Jakšić, D., Milutinović, S. (2022). The Analysis of Company Growth Determinants Based on Financial Statements of the European Companies. *Sustainability.* 14(2). 770. 1-17. https://doi.org/10.3390/su14020770

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THE IMPACT OF AI IMPLEMENTATION ON EMPLOYEES' ATTITUDES, BEHAVIORS, AND PSYCHOLOGICAL STATES

Abstract: In modern business conditions characterized by constant change and a high level of competitiveness, organizations are moving towards the necessity of implementing artificial intelligence (AI), which represents the key factor of transformation in traditional business models in order to improve efficiency and to retain and strengthen their competitive market position. The research subject of this paper is to examine the effects of AI implementation on employees' attitudes, behaviors, and psychological state. The primary aim of this paper is to identify theoretical frameworks, underpinning empirical studies in this field, as well as variables and relations between them, as key empirical results. For this purpose, a review of theoretical and empirical studies was conducted, examining the effect of AI on employees' attitudes (job satisfaction, job security, turnover intention and employee engagement), behavior (employee performance) and psychological state (job stress and burnout). Results of completed review of available literature indicate that the implementation of AI in organizations has a significant influence on attitudes, behavior and psychological state of employees, primarily through positive effects on engagement, work-life balance, creativity, innovation, and career development. However, its impact on job stress and burnout is indirect and mediated by work-related factors such as job security, workload, and task design. Consequently, AI may reduce stress when it enhances efficiency and facilitates tasks, but it may also increase stress if it intensifies expectations or job complexity. Overall, the psychological effects of AI depend largely on how it is implemented and managed within the organization. According to these findings, the authors have planned that in the next research phase, they will develop a conceptual framework, which will unite identified variables and their relations, with a focus on the realization of empirical analysis on a certain sample in Serbia, as a way of researching concrete effects of artificial intelligence implementation on the domestic business environment. The limitations of this paper are a relatively small number of existing research studies regarding this topic (especially within the context of Serbia), as well as the lack of empirical research that simultaneously encompasses all relevant variables.

Keywords: AI, employee attitudes, psychological state, employee behavior, Serbia

INTRODUCTION

Artificial intelligence (AI) has evolved into a central element of contemporary business operations, transitioning from a prospective concept to an established organizational reality. Rapid digital transformation, driven by the accelerated development of advanced technologies, has significantly reshaped organizational functioning and decision-making processes As Kraus et al. (2022) highlight, digital transformation is no longer simply a technological option but a critical requirement for organizations seeking to adapt to the growing demands and expectations of a globalized market. In such conditions, organizations are required to continuously adapt in order to remain competitive, while AI increasingly takes a central role in enabling efficiency through automation of routine tasks and advanced data analysis.

Organizations today function as interconnected systems, combining human skills and technological tools. Despite technological advancements, employees continue to represent the primary source of organizational value creation and a key determinant of sustainable competitive advantage. However, the implementation of AI introduces substantial changes in the way employees perform their tasks, interact with technology, and perceive their roles within the organization. The effects of AI implementation largely depend on employees' perceptions of this technology. While some employees recognize AI as a tool that facilitates work and enhances performance, others may perceive it as a threat, leading to resistance, fear, or reduced motivation. Understanding these perceptions is crucial, as they influence attitudes, behaviors, and well-being. Consequently, organizations must align technological progress with the protection of employee well-being.

Although there has been a growing number of studies examining the impact of AI on employees, the existing literature still lacks comprehensive empirical research that simultaneously analyzes multiple individual outcomes in the context of AI implementation. This gap is particularly evident in the Serbian business environment, where empirical evidence remains limited and the mechanisms through which organizational factors, such as job security, workload, and job design—shape these relationships are insufficiently explored. Accordingly, the research problem of this paper lies in the need for a comprehensive analysis of the effects of AI implementation on individual employee outcomes within organizations.

This study examines AI's influence on employees' attitudes (job satisfaction, job security, turnover intention, and engagement), behaviors (performance), and psychological states (stress and burnout). The objective is to identify key theoretical frameworks, variables, and relationships highlighted in previous research. In addition, prior studies often investigate these factors in isolation, which constrains a holistic view of how AI impacts employees. The following research questions guide the study: (1) which theoretical frameworks are most commonly used in studying AI's impact on employees; (2) how AI affects employees' attitudes; (3) how AI implementation influences work behavior and performance; and (4) how AI impacts psychological functioning. The paper is structured in three sections: the first outlines the theoretical background and key AI concepts; the second presents the methodology, summarizing the literature review approach; and the third combines results and discussion, interpreting findings and highlighting their implications.

1. THEORETICAL BACKGROUND

Artificial intelligence (AI) is primarily perceived as a technological innovation; however, its adoption significantly affects employees' psychological functioning and organizational dynamics. This chapter aims to systematize existing theoretical knowledge on AI, discussing its conceptual definition, historical evolution, and its dual role as both a technological and psychological phenomenon within organizations. AI was formally introduced by John McCarthy in 1955 during the preparations for the Dartmouth Summer Research Project, where it was defined as "the science and engineering of making intelligent machines" (McCarthy et al., 1955). While the formal conceptualization dates to the 1950s, the idea of machines capable of thinking emerged much earlier, reflecting humanity's long-standing curiosity about artificial cognition.

The Dartmouth project represented a turning point that transformed AI from an abstract idea into a scientific reality (McCorduck et al., 1977). Foundational contributions include Alan Turing's Turing Test, which evaluates a machine's ability to demonstrate intelligent behavior comparable to humans, and Claude Shannon's demonstration of how logical operations could be implemented in digital systems (Hajdarović, 2024). Advances in neural networks and deep learning have accelerated AI development, enabling systems to learn from data, recognize patterns, and improve performance over time (LeCun, Bengio & Hinton, 2015). Kaplan and Haenlein (2019) define AI as the ability of a technological system to gather information from its environment, interpret it, and derive actionable insights that support goal achievement while adapting to changes in the surrounding context. Practical milestones, such as IBM's Deep Blue defeating the world chess champion, illustrate AI's potential for solving highly complex problems.

The historical trajectory of AI alternates between periods of rapid progress, often called "AI springs," and periods of stagnation, or "AI winters," which occurred due to limited computational resources, high costs, and unrealistic expectations (Moloi & Marwala, 2021; Galanos, 2023). The evolution of AI is intertwined with advances in computing and the growth of the internet, as progress in one field often stimulated breakthroughs in another. Despite remarkable technological progress, contemporary AI adoption raises challenges related to ethics, transparency, and employee acceptance.

In organizational contexts, AI has transformed structures, decision-making processes, team organization, and overall efficiency (Wisskirchen et al., 2017). It represents an interdisciplinary field, integrating knowledge from computer science, mathematics, psychology, and philosophy. Modern applications include automation of routine tasks, advanced data analysis, flexible work arrangements such as the gig economy, and autonomous systems. More specifically, AI can

be applied through deep learning, where machines continuously learn from data and adjust based on errors; robotization, where production robots take over tasks previously performed by humans with higher precision and lower costs; dematerialization, which automates the collection and processing of information, reducing reliance on traditional administrative work; gig economy platforms, enabling flexible, short-term task engagement and collaboration with multiple clients; and autonomous driving, where sensor-equipped vehicles independently navigate and directly impact professions dependent on transportation. These applications demonstrate AI's dual role as both an organizational resource and a potential job demand.

The dual nature of AI is particularly evident in its impact on employees. When implemented positively, AI reduces workload, automates routine tasks, and allows employees to focus on creative and complex assignments, enhancing engagement and performance. Conversely, when perceived as intrusive or burdensome, AI can increase stress, workload, and pressure, potentially lowering self-confidence and contributing to burnout. Accordingly, employees may respond defensively when AI is perceived as a threat, or proactively when it is seen as a supportive resource.

Table 1: Positive and Negative Impacts of Artificial Intelligence

Positive Effects of AI	Negative Effects of AI
Creation of new jobs related to AI and digital technologies	Job loss due to automated tasks (tasks being taken over by AI)
Opportunities for further education, skill development, and upskilling,	Reduced demand for certain skills
Reduction of manual work through automation	Higherdependency on technology
Higher salaries for highly skilled employees	Lower salaries for low-skilled employees (increasing social inequality)
Decrease in physical workload	Ethically questionable use of AI systems

Source: Authors adapted from Păvăloaia & Necula (2023)

Conservation of Resources (COR) theory explains that individuals are motivated to protect existing resources and acquire new ones, with resource losses having a greater psychological impact than equivalent gains (Halbesleben et al., 2014; Hobfoll et al., 2018). From this perspective, AI can act as a resource that supports skill development and goal attainment, or as a stressor that challenges employees' adaptive capacities.

From a Resource-Based View (RBV), organizations consist of valuable resources that, when rare, difficult to imitate, and non-substitutable, can generate sustained competitive advantage (Barney, 1991; Lubis, 2022). AI meets these criteria by facilitating process improvements, automating complex tasks, and supporting decision-making in ways that competitors cannot easily replicate. By integrating AI technologies into organizational workflows, companies can enhance efficiency, improve strategic decision-making, and maintain a competitive edge, while simultaneously influencing employee well-being. From this perspective, AI strengthens organizational capacities while also shaping employee performance, a key factor in sustaining competitive advantage.

In conclusion, AI's dual character as both a potential resource and a job demand underscores its significance in contemporary organizations. Its deployment directly shapes employees' attitudes, behaviors, and psychological states, affecting engagement, performance, and overall well-being. This expanded theoretical framework, enriched by historical, technological, and psychological perspectives as well as the practical applications of deep learning, robotization, dematerialization, gig economy engagement, and autonomous driving, provides a robust foundation for empirical investigations into AI's impact on individual employee outcomes and highlights the necessity of aligning technological innovation with human-centered organizational practices.

2. METHODOLOGY

The empirical insights presented in this paper are based on a literature review of recent studies examining the effects of artificial intelligence (AI) on employee attitudes, behaviors, and psychological states. In selecting relevant studies, particular attention was paid to research addressing key constructs such as employee attitudes—defined as psychological tendencies reflected in the evaluation of various aspects of work, positively or negatively, shaping how employees think, feel, and respond in the workplace (Eagly & Chaiken, 1993; Robbins & Judge, 2019)—and employee behaviors, encompassing all actions, procedures, and reactions directed toward task performance, colleagues, or the organization (Robbins & Judge, 2019).

Additionally, studies were chosen for their examination of specific outcomes frequently highlighted in the literature, including job satisfaction, job security, turnover intentions, and employee engagement (Tett & Meyer, 1993; Robbins & Judge, 2019). Academic databases were searched using keywords such as "artificial intelligence," "employee engagement," "job satisfaction," "job performance," "burnout," and "work stress." Studies were selected based on their relevance, methodological rigor, and contribution to understanding AI's impact on employees across various industries

and geographic contexts. The review focuses on synthesizing key findings, highlighting consistent patterns, and identifying potential gaps in current research.

3. RESULTS AND DISCUSSION

Job satisfaction, defined as a positive emotional state resulting from the evaluation of one's experiences at work (Locke, 1969, as cited in Thangaswamy & Thiyagaraj, 2017), together with engagement and job security, represents key indicators of how AI affects employees. The literature shows that AI implementation can have both positive and negative effects: while AI contributes to higher job satisfaction, engagement, and productivity through automation and better work–life balance (AlSulimani, Qazi & Senathirajah, 2025; Judijanto et al., 2025; Gayathiri & Prabu, 2025), it can also increase stress, job insecurity, and burnout among employees (Ali, Hussain, Hassan & Anwer, 2024; Hassan et al., 2024).

The impact of AI on employees' turnover intentions is similarly mixed: perceived organizational support and engagement mediate the relationship between AI exposure and employees' decisions to stay or leave, whereas insecurity and anxiety can increase tendencies toward "quiet quitting" and turnover intentions (Haritha & Lohani, 2024; Salama et al., 2025; Erdogan et al., 2025; Zulifiqar et al., 2025). Employee engagement is confirmed as a crucial factor for retention and job performance, with autonomy, work–life balance, digital leadership, and job satisfaction further strengthening engagement (Bošković, 2021; Sadiqin & Hwihanus, 2025).

Employee performance, a multidimensional construct encompassing productivity, efficiency, and contributions to organizational outcomes (Musa et al., 2025), is also affected by AI. Empirical studies consistently indicate that AI adoption enhances performance, often mediated by engagement and job satisfaction. Prentice, Wong & Lin (2023) found that AI in service sectors improves work engagement, which subsequently enhances task performance and perceived job security. Džafic (2024) highlighted that technological awareness, innovativeness, and emotional intelligence positively influence performance, while perceived risk limits AI adoption and generates resistance. Kardini (2024) and Usman, Suryadi & Sari (2025) confirmed that AI implementation positively affects performance, with job satisfaction and perceived job security acting as mediators, although engagement does not always serve as a mediating factor.

However, AI's impact on employees' psychological states is complex. Job stress, burnout, and well-being are significantly influenced by AI, especially when it is perceived as threatening or overwhelming. Work stress emerges from demanding tasks, poor organizational conditions, and inadequate work environments, reducing commitment and promoting employee detachment (Lee & Shin, 2010; Dilekçi, Kaya & Çiçek, 2025). Kim & Lee (2024) found that AI adoption indirectly increases burnout through heightened job stress, a finding mirrored by Jin, Jiang & Liao (2024), who reported that awareness of smart technologies (STARA: Smart Technology, AI, Robotics, and Algorithms) negatively impacts emotional well-being via stress.

The literature also highlights AI's dual effects on well-being. Berber, Gašić & Vučenović (2025) observed that AI can enhance overall well-being, particularly for highly educated and managerial employees who benefit from greater control over technology. Conversely, Figueroa & Garcia (2025) demonstrated that AI-induced technostress mediates its effect on burnout, while Zhang, Guo, Yuan & Ji (2025) showed that technostress can either hinder or foster innovative behavior, depending on whether it is perceived as a barrier or a challenge. Fan et al. (2026) further emphasized that training and technical competence are essential to mitigate technostress and promote employee well-being.

In sum, AI exerts multidimensional effects on employees. It can enhance engagement, job satisfaction, performance, and retention when supported by adequate organizational resources and strategies. At the same time, it can elevate stress, burnout, and turnover intentions if introduced without sufficient support, training, or clear communication. These findings underscore the necessity for organizations to implement AI thoughtfully, ensuring that technological adoption is accompanied by proactive measures to maintain employee well-being, engagement, and sustainable performance.

CONCLUSION

Based on the review of theoretical and empirical research, it is evident that the implementation of artificial intelligence (AI) within organizations has multifaceted and complex effects on employees' attitudes, behaviors, and psychological states. When applied appropriately reducing employees' workload on routine tasks and providing support AI can foster positive outcomes, including higher job satisfaction, engagement, and performance. At the same time, AI's impact on stress, job security, and turnover intentions is ambivalent, largely depending on how the technology is implemented and perceived by employees.

The theoretical contribution of this study lies in the systematic review and synthesis of relevant research on AI's impact on key employee attitudes and their connection to behavior and performance. Organizations are required to act responsibly and thoughtfully when integrating AI into their business models. Technological infrastructure alone is insufficient; organizations must also provide employee training, transparent communication, continuous support, and preparation for change. These measures act preventively, mitigating potential negative outcomes such as job insecurity, stress, and burnout. Properly leveraged, AI should empower employees, supporting both their professional and personal development, rather than serving as a source of pressure, uncertainty, or resistance.

This study is limited by the relatively small number of empirical investigations on this topic, particularly in the context of Serbia, and by the lack of research simultaneously addressing all relevant variables. Accordingly, the authors' future research will focus on developing a conceptual framework and conducting an empirical analysis on an appropriate sample in Serbia, which will provide a more precise understanding of AI's impact within the domestic business environment. The planned methodology involves distributing questionnaires to employees across various industries and business segments. Data obtained will be analyzed using the SmartPLS software, employing the PLS-SEM (Partial Least Squares Structural Equation Modeling) method, which allows for a rigorous examination of the relationships between AI implementation and employees' attitudes, behaviors, and psychological states.

The implementation of AI in modern business contexts is a critical prerequisite for maintaining and enhancing competitive advantage. Organizations that successfully integrate AI into their processes can achieve significant benefits, including cost reduction, operational efficiency, and agility in responding to environmental changes. When a balance is achieved between technological advancement and employee well-being—using AI as a supportive tool rather than a replacement, organizations can maximize the benefits of AI while safeguarding employee satisfaction, engagement, and overall performance.

REFERENCES

Ali, T., Hussain, I., Hassan, S., & Anwer, S. (2024). Examine how the rise of AI and automation affects job security, stress levels, and mental health in the workplace. *Bulletin of Business and Economics (BBE), 13*(2), 1180–1186.

AlSulimani, T. S., Qazi, S., & Senathirajah, A. R. B. S. (2025). Determinants and Outcomes of AI Adoption in Human Resource Information Systems: A Smart PLS-SEM Approach in Achieving Digital Transformation. *Journal of Cultural Analysis and Social Change*, 2524–2537.

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management, 17*(1), 99–120.

Berber, N., Gašić, D., & Vučenović, D. (2025). Relation between attitudes towards artificial intelligence and employee well-being in Serbia. In *International Scientific Conference on Economics, Management and Information Technologies* (Vol. 2, No. 1, pp. 93–99).

Bošković, A. (2021). Autonomija i angažovanost zaposlenih u digitalnoj eri: Moderatorska uloga rada na daljinu. *Ekonomski horizonti, 23*(3), 241–257.

Dilekçi, Ü., Kaya, A., & Çiçek, İ. (2025). Occupational stress, burnout, and change fatigue as predictors of quiet quitting among teachers. *Acta Psychologica, 254*, 104812.

Džafić, S. (2024). *Uloga emocionalne i vještačke inteligencije u unapređenju radnih performansi* (Doctoral dissertation, [S. Džafić]).

Eagly, A. H., & Chaiken, S. (1993). *The psychology of attitudes.* Harcourt Brace Jovanovich College Publishers.

Fan, M., Soomro, S., Soomro, S., Sohu, J. M., Shah, S. B., & Shaikh, S. N. (2026). The human side of AI adoption: exploring technostress, training and employee well-being in manufacturing SMEs. *Journal of Manufacturing Technology Management, 37*(2), 273–294.

Figueroa, A., & Garcia, A. (2025, September). The Dual Impact of AI on Burnout and Technostress in Manufacturing Workplaces. In *European Conference on Innovation and Entrepreneurship* (pp. 892–897). Academic Conferences International Limited.

Galanos, V. (2023). To have done with the metaphor of summers and winters: Can AI and internet history cure hype? *SSRN Electronic Journal.*

Gayathiri, G., & Prabu, G. (2025). Exploring the role of artificial intelligence-powered HR practices in shaping employee engagement and retention strategies. *Journal of Information Systems Engineering and Management, 10*(3), Article 7772. https://doi.org/10.52783/jisem.v10i3.7772

Halbesleben, J. R., Neveu, J. P., Paustian-Underdahl, S. C., & Westman, M. (2014). Getting to the "COR": Understanding the role of resources in conservation of resources theory. *Journal of Management, 40*(5), 1334–1364.

Hajdarović, M. (2024). Povijesni pregled razvoja umjetne inteligencije. *Poučavanje povijesti, III*(1), 69–71.

Haritha, P., & Lohani, R. (2024). Impact of AI technology disruption on turnover intention of employees in digital marketing. *International Research Journal on Advanced Engineering and Management, 2*, 389–400. https://doi.org/10.47392/IRJAEM.2024.0055

Ibrahim Hassan, A. H., Baquero, A., Salama, W. M., & Ahmed Khairy, H. (2024). Engaging hotel employees in the era of artificial intelligence: The interplay of artificial intelligence awareness, job insecurity, and technical self-efficacy.

Hobfoll, S. E., Halbesleben, J., Neveu, J. P., & Westman, M. (2018). Conservation of resources in the organizational context: The reality of resources and their consequences. *Annual Review of Organizational Psychology and Organizational Behavior, 5*, 103–128.

Jin, G., Jiang, J., & Liao, H. (2024). The work affective well-being under the impact of AI. *Scientific Reports, 14*(1), 25483.

Judijanto, L., Zaman, D., Louisther, H., Ghurabillah, G., & Hasibuan, R. (2025). The Impact of Artificial Intelligence and Robotic Process Automation on Accounting Performance and Employee Satisfaction in Financial Services in Indonesia. *The Es Accounting And Finance, 3*(02), 94–104.

Kaplan, A., & Haenlein, M. (2019). Siri, Siri, in my hand: Who's the fairest in the land? On the interpretations, illustrations, and implications of artificial intelligence. *Business Horizons, 62*(1), 15–25.

Kim, B. J., & Lee, J. (2024). The mental health implications of artificial intelligence adoption: the crucial role of self-efficacy. *Humanities and Social Sciences Communications, 11*(1), 1561.

Kardini, N. L. (2024). The Effect of Artificial Intelligence (AI) Implementation and Intelligence on Job Performance: The Mediating Role of Job Satisfaction. *Proceedings of the Multidisciplinary Research Community, 1*(1), 279–285.

Kraus, S., Durst, S., Ferreira, J. J., Veiga, P., Kailer, N., & Weinmann, A. (2022). Digital transformation in business and management research: An overview of the current status quo. International Journal of Information Management, 63, 102466. https://doi.org/10.1016/j.ijinfomgt.2021.102466

LeCun, Y., Bengio, Y., & Hinton, G. (2015). Deep learning. *Nature, 521*, 436–444.

Lee, Y., & Shin, S. (2010). Job stress evaluation using response surface data mining. *International Journal of Industrial Ergonomics, 40*, 379–385.

Lubis, N. W. (2022). Resource based view (RBV) in improving company strategic capacity. *Research Horizon, 2*(6), 587–596.

McCarthy, J., Minsky, M., Rochester, N., & Shannon, C. (1955). A proposal for the Dartmouth summer research project on artificial intelligence.

McCorduck, P., Minsky, M., Selfridge, O. G., & Simon, H. A. (1977). History of artificial intelligence. In *Proceedings of IJCAI* (pp. 951–954).

Moloi, T., & Marwala, T. (2021). A high-level overview of artificial intelligence: Historical overview and emerging developments. *Future of Business and Finance.*

Musa, S. J., Success, B. E., Ibrahim, K. M., Kadams, M. A., & Success, D. U. (2025). Impact of artificial intelligence (AI) on performance of listed deposit money banks in Nigeria. *MRS Journal of Accounting and Business Management, 2*(9), 1–11.

Păvăloaia, V.-D., & Necula, S.-C. (2023). Artificial Intelligence as a Disruptive Technology—A Systematic Literature Review. *Electronics, 12*(5), 1102. https://doi.org/10.3390/electronics12051102

Prentice, C., Wong, I. A., & Lin, Z. C. (2023). Artificial intelligence as a boundary-crossing object for employee engagement and performance. *Journal of Retailing and Consumer Services, 73*, 103376.

Robbins, S. P., & Judge, T. A. (2019). *Organizational Behavior* (18th ed.). Pearson.

Salama, W. M., Khairy, H. A., Mansour, A. A., Alrefae, W. M., Afify, S. M., & Shehadat, A. T. A. (2025). How AI awareness drives employee intention to leave in hotels: The mediating roles of job burnout and psychological contract breach. *Geo Journal of Tourism and Geosites, 60*, 1206–1220.

Sadiqin, A., & Hwihanus, H. (2025). THE EFFECT OF ARTIFICIAL INTELLIGENCE, WORK-LIFE BALANCE, DIGITAL LEADERSHIP, AND JOB SATISFACTION ON EMPLOYEE ENGAGEMENT AND EMPLOYEE PERFORMANCE IN THE HYBRID WORK ERA AT PT XYZ. *SIBATIK JOURNAL: Jurnal Ilmiah Bidang Sosial, Ekonomi, Budaya, Teknologi, Dan Pendidikan, 4*(11), 3673–3684.

Thangaswamy, A., & Thiyagaraj, D. (2017). Theoretical concept of job satisfaction – A study. *International Journal of Research-Granthaalayah, 5*(6), 464–470.

Tett, R. P., & Meyer, J. P. (1993). Job satisfaction, organizational commitment, turnover intention, and turnover: path analyses based on meta-analytic findings. *Personnel Psychology, 46*(2), 259–293. https://doi.org/10.1111/j.1744-6570.1993.tb00874.x

Usman, O., Suryadi, S., & Sari, R. N. (2025). THE EFFECT OF AI INTEGRATION IN HR PRACTICES ON EMPLOYEE PERFORMANCE: MEDIATING ROLES OF ENGAGEMENT AND PERCEIVED JOB SECURITY. *Bina Bangsa International Journal of Business and Management, 5*(2), 529–541.

Uygungil-Erdogan, S., Şahin, Y., Sökmen-Alaca, A. İ., Oktaysoy, O., Altıntaş, M., & Topçuoğlu, V. (2025). Assessing the effect of artificial intelligence anxiety on turnover intention: the mediating role of quiet quitting in Turkish small and medium enterprises. *Behavioral Sciences, 15*(3), 249.

Wisskirchen, G., Biacabe, B. T., Bormann, U., Muntz, A., Niehaus, G., Soler, G. J., & von Brauchitsch, B. (2017). Artificial intelligence and robotics and their impact on the workplace. *IBA Global Employment Institute, 11*(5), 49–67.

Zhang, S., Guo, P., Yuan, Y., & Ji, Y. (2025). Anxiety or engaged? Research on the impact of technostress on employees' innovative behavior in the era of artificial intelligence. *Acta Psychologica, 259*, 105442.

Zulifiqar, H., Fatima, L., Akhtar, M. S., & Akhtar, M. N. (2025). ARTIFICIAL INTELLIGENCE IN HR: REDUCING TURNOVER INTENTIONS WITH AI-DRIVEN EMPLOYEE ENGAGEMENT SOLUTIONS. *International Research Journal of Social Sciences and Humanities, 4*(1), 85–111.

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THE ROLE OF THE CIRCULAR ECONOMY IN STRENGTHENING THE SUSTAINABILITY OF THE BUSINESS ENVIRONMENT UNDER CONDITIONS OF GLOBAL CRISES

Abstract: The contemporary business environment is increasingly characterized by challenges arising from global economic, environmental, and social crises, which highlight the need for sustainable business models and more efficient resource management. In this context, the concept of the circular economy has gained increasing recognition as an important instrument for strengthening the sustainability and resilience of business systems. The aim of this paper is to examine the role of the circular economy in enhancing the sustainability of the business environment in the context of global crises through the analysis of relevant scientific literature. The paper represents a review study based on the systematization and analysis of findings from previous research addressing the implementation of circular economy principles across different economic sectors. Key findings from previous studies are analyzed and presented in tabular form in order to identify major trends, benefits, and challenges related to the application of circular business models. The results of the analysis indicate that the implementation of circular economy principles contributes to more efficient resource use, reduction of environmental impacts, and strengthening of the long-term sustainability of the business environment, which is particularly important in conditions of global instability.

Keywords: circular economy, sustainability, business environment, global crises, literature review

1. INTRADUCTION

In recent decades, the global business environment has been increasingly shaped by various forms of instability, including economic crises, environmental degradation, climate change, and geopolitical tensions. These challenges have significantly influenced the way organizations operate, forcing them to reconsider traditional linear models of production and consumption based on the “take-make-dispose” logic (Geissdoerfer et al., 2017). The growing pressure to ensure long-term sustainability and resilience has led to the emergence of alternative development paradigms, among which the circular economy (CE) has gained particular prominence.

The circular economy represents a systemic approach aimed at minimizing waste and maximizing the efficient use of resources through strategies such as reuse, recycling, remanufacturing, and sustainable product design (Kirchherr et al., 2017). Unlike the traditional linear model, CE promotes closed-loop systems in which materials and products are kept in use for as long as possible, thereby reducing environmental impact and improving economic efficiency. In the context of global crises, this model becomes especially relevant, as it enables organizations to reduce dependency on scarce resources and increase their adaptability to external shocks (Ellen MacArthur Foundation, 2015).

The relevance of the circular economy has been further emphasized by recent global disruptions, such as the COVID-19 pandemic, supply chain breakdowns, and energy crises, which have exposed the vulnerabilities of conventional business models (Ivanov & Dolgui, 2021). In such conditions, companies are increasingly recognizing the importance of integrating sustainability into their strategic decision-making processes. The adoption of circular economy principles not only contributes to environmental protection but also enhances organizational resilience, innovation capacity, and competitive advantage (Bocken et al., 2016).

In addition, recent research highlights the importance of integrating digital technologies and supply chain management practices into circular economy models. For example, studies show that digitalization of supply chains can significantly support the implementation of circular economy principles by improving data integration, resource tracking, and decision-making processes (Cvrkušić et al., 2025) . This indicates that the transition toward circular business models is not only an environmental necessity but also a strategic and technological challenge for modern organizations.

Previous research indicates that the implementation of circular business models can lead to multiple benefits, including cost reduction, improved resource productivity, and the creation of new market opportunities (Murray et al., 2017). At the same time, the transition toward circularity is associated with numerous challenges, such as technological limitations, regulatory barriers, and the need for changes in organizational culture and stakeholder engagement (Korhonen et al., 2018). Therefore, understanding the role of the circular economy in strengthening the sustainability of the business environment requires a comprehensive analysis of both its advantages and limitations.

In line with these considerations, this paper aims to provide a systematic overview of existing research on the application of circular economy principles and their contribution to sustainable business development in the context of global crises. By synthesizing findings from relevant scientific studies, the paper seeks to identify key trends, benefits, and challenges associated with the implementation of circular economy models, thereby contributing to a better understanding of their strategic importance for modern organizations.

2. THEORETICAL FRAMEWORK OF THE CIRCULAR ECONOMY

The concept of the circular economy has evolved as a response to the limitations of the traditional linear economic model, which is based on intensive resource exploitation and waste generation. The circular economy is grounded in the principles of reducing, reusing, and recycling materials, as well as extending product life cycles and promoting sustainable consumption patterns (Kirchherr et al., 2017). In contrast to the linear model, which leads to resource depletion and environmental degradation, the circular economy emphasizes the creation of closed-loop systems that minimize waste and maintain the value of products and materials for as long as possible (Murray et al., 2017). In recent years, this concept has gained increasing attention in both academic and policy contexts, particularly within the framework of sustainable development and green transition strategies (European Commission, 2020).

At its core, the circular economy aims to create a regenerative system in which resource input and waste, emissions, and energy leakage are minimized. This is achieved through closing material loops and optimizing resource efficiency across the entire value chain (Geissdoerfer et al., 2017). The concept is closely linked to sustainable development, as it integrates environmental, economic, and social dimensions of business performance. In this context, the circular economy contributes to achieving key sustainability goals, including climate change mitigation, resource conservation, and the promotion of responsible production and consumption (Korhonen et al., 2018). Recent studies further highlight the importance of developing appropriate performance indicators to measure circular economy outcomes and assess their contribution to sustainability (Scarpellini et al., 2020).

Several authors emphasize that the circular economy is not only an environmental concept but also a strategic approach that enables companies to achieve competitive advantage. By adopting circular business models, organizations can improve operational efficiency, reduce costs, and enhance their market positioning (Bocken et al., 2016). Furthermore, circular strategies enable companies to create additional value through innovative offerings, such as product-service systems, sharing platforms, and remanufacturing activities. These approaches not only generate new revenue streams but also strengthen relationships with customers and other stakeholders. In this regard, circular business model innovation has been identified as a key driver of sustainable competitive advantage in contemporary organizations (Centobelli et al., 2020).

In addition, the circular economy plays a crucial role in improving organizational resilience, particularly in the context of global crises. By reducing dependence on virgin resources and enhancing the use of secondary materials, companies can better withstand supply chain disruptions and market volatility (Ivanov & Dolgui, 2021). This aspect has become particularly important in light of recent global disruptions, including the COVID-19 pandemic and energy crises, which have highlighted the vulnerability of traditional supply chains. Consequently, circular economy practices are increasingly viewed as a mechanism for strengthening business continuity and long-term sustainability.

The circular economy is also strongly connected with digital transformation processes. The use of advanced technologies, such as big data analytics, the Internet of Things (IoT), artificial intelligence, and blockchain, enables more efficient tracking of resources and supports the implementation of circular strategies (Cvrkušić et al., 2025). Recent research indicates that Industry 4.0 technologies significantly facilitate the transition toward circular economy models by improving data integration, transparency, and decision-making processes (Awan et al., 2021; Dantas et al., 2021). Digital technologies thus act as key enablers of circular practices and contribute to the development of smart and sustainable business ecosystems (Ranta et al., 2021).

Despite its numerous advantages, the transition toward a circular economy is associated with several challenges. These include high initial investment costs, lack of technological capabilities, insufficient regulatory support, and resistance to organizational change (Korhonen et al., 2018). Additionally, successful implementation requires collaboration among various stakeholders, including governments, businesses, and consumers, as well as the development of appropriate institutional frameworks. Institutional pressures and resource availability have also been identified as important factors influencing the adoption of circular economy practices and related technologies (Bag et al., 2021).

Therefore, the circular economy should be understood as a comprehensive and dynamic concept that requires systemic changes in production and consumption patterns. Its successful implementation depends on the alignment of economic, technological, and social factors, as well as the ability of organizations to integrate sustainability into their strategic decision-making processes. In this sense, the circular economy represents not only an environmental imperative but also a strategic opportunity for achieving long-term competitiveness and resilience in an increasingly uncertain global environment.

3. CIRCULAR ECONOMY AND BUSINESS SUSTAINABILITY IN TIMES OF GLOBAL CRISES

Global crises, including economic downturns, environmental disruptions, climate change, and health emergencies, have exposed the fragility of traditional business models based on linear resource consumption. In such conditions, sustainability and resilience become key determinants of long-term business success. The circular economy offers a viable solution for addressing these challenges by promoting resource efficiency, reducing waste, and minimizing dependence on external inputs (Ellen MacArthur Foundation, 2015). In recent years, this concept has gained particular importance within global policy frameworks aimed at achieving sustainable development and increasing economic resilience (European Commission, 2020).

One of the main contributions of the circular economy in times of crisis is its ability to enhance organizational resilience. By adopting circular practices, companies can reduce supply chain risks, diversify resource sources, and improve their capacity to respond to external shocks (Ivanov & Dolgui, 2021). This is particularly important in the context of global supply chain disruptions, where reliance on limited resources can pose significant risks. Recent studies further indicate that the integration of circular economy principles with digital technologies enables better monitoring of supply chains, improves transparency, and facilitates faster and more effective decision-making in uncertain environments (Awan et al., 2021; Ranta et al., 2021).

Furthermore, the circular economy contributes to environmental sustainability by reducing waste generation and minimizing negative ecological impacts. This is aligned with global sustainability goals and regulatory frameworks, which increasingly emphasize the importance of responsible resource management and environmental protection (Korhonen et al., 2018). In addition, empirical research suggests that circular economy practices can significantly improve environmental performance indicators and support the transition toward low-carbon and resource-efficient economies (Scarpellini et al., 2020).

At the same time, the implementation of circular economy principles can generate substantial economic benefits, including cost savings, increased operational efficiency, and the creation of new business opportunities. Circular strategies such as product life extension, recycling, and remanufacturing allow companies to reduce production costs and create additional value (Centobelli et al., 2020). Moreover, the integration of circular economy and Industry 4.0

technologies has been identified as a key driver of sustainable innovation and competitiveness in modern business environments (Dantas et al., 2021).

In addition to economic and environmental benefits, the circular economy also contributes to the social dimension of sustainability. By promoting responsible production and consumption patterns, circular practices can enhance stakeholder engagement, improve corporate reputation, and support the development of more inclusive and sustainable business ecosystems. This multidimensional impact makes the circular economy a comprehensive approach to addressing complex global challenges.

However, despite its numerous advantages, the transition toward a circular economy is associated with several challenges. These include high initial investment costs, lack of technological capabilities, insufficient regulatory support, and resistance to organizational change (Korhonen et al., 2018). Furthermore, institutional pressures and resource constraints can significantly influence the adoption of circular economy practices, particularly in developing and transition economies (Bag et al., 2021). Therefore, successful implementation requires coordinated efforts among governments, businesses, and other stakeholders, as well as the development of supportive policy frameworks and financial incentives.

In this context, the circular economy should be understood as a strategic and systemic response to global crises, enabling organizations to enhance their resilience, sustainability, and long-term competitiveness. Its successful implementation depends on the integration of technological, organizational, and institutional factors, as well as the ability of companies to adapt to rapidly changing environmental conditions.

4. REVIEW OF PREVIOUS RESEARCH

In order to provide a comprehensive overview of existing knowledge, this section presents key findings from previous studies on the relationship between circular economy practices and business sustainability.

Table 1: Overview of selected studies on circular economy and business sustainability

Authors	Year	Focus of research	Key findings
Geissdoerfer et al.	2017.	CE as sustainability paradigm	CE integrates environmental and economic goals
Bocken et al.	2016.	Circular business models	CE supports innovation and competitive advantage
Kirchherr et al.	2017.	Conceptualization of CE	CE defined through multiple dimensions and practices
Korhonen et al.	2018.	Limitations of CE	Identifies structural and systemic challenges
Murray et al.	2017.	CE and business ethics	CE contributes to sustainable value creation
Ivanov & Dolgui	2021.	Supply chain resilience	Digitalization enhances resilience in crises
Cvrkušić et al.	2025.	Digital supply chains & CE	Digital tools support CE implementation

Source: Authors' compilation

The analysis of previous studies indicates that the circular economy has a significant positive impact on various aspects of business sustainability. Most studies highlight improvements in resource efficiency, environmental performance, and innovation capabilities, confirming that circular practices can serve as a key driver of sustainable business transformation. In particular, the findings suggest that the adoption of circular economy principles enables organizations to reduce operational costs, optimize resource utilization, and improve their overall environmental performance.

In addition, the reviewed literature emphasizes the strategic importance of circular economy practices in achieving long-term competitiveness. Studies focusing on circular business models indicate that companies that integrate circular principles into their core strategies are better positioned to respond to changing market conditions and stakeholder expectations. This is particularly relevant in the context of global crises, where flexibility, adaptability, and efficient resource management play a crucial role in ensuring business continuity.

Another important insight derived from previous research is the growing role of digital technologies in supporting the implementation of circular economy principles. The integration of digital tools into supply chain management systems enables greater transparency, improved resource tracking, and more effective decision-making processes. As highlighted by recent studies, digitalization acts as a catalyst for the transition toward circular business models, particularly in complex and dynamic business environments.

Furthermore, the literature points to the importance of institutional and organizational factors in facilitating or hindering the adoption of circular economy practices. Regulatory frameworks, government policies, and stakeholder pressures significantly influence the extent to which companies are willing and able to implement circular strategies. At the organizational level, factors such as leadership commitment, innovation capacity, and availability of resources play a critical role in determining the success of circular initiatives.

Despite the positive effects identified in the literature, several studies also highlight the limitations and challenges associated with the circular economy. These include technological constraints, high implementation costs, and the need for systemic changes in production and consumption patterns. Additionally, there is a lack of standardized metrics for measuring circular economy performance, which makes it difficult to assess and compare the effectiveness of different circular strategies across industries.

Overall, the review of previous research suggests that the circular economy represents a promising approach for enhancing business sustainability, but its successful implementation requires a holistic and coordinated approach. Future research should focus on developing more comprehensive measurement frameworks, exploring sector-specific applications, and analyzing the long-term impacts of circular economy practices on business performance and resilience.

5. CONCLUSION

The findings of this review suggest that the circular economy represents a key strategic approach for enhancing the sustainability of the business environment, particularly in the context of global crises. By enabling more efficient resource use, reducing waste, and minimizing environmental impact, circular practices contribute to long-term economic and environmental sustainability. In this sense, the circular economy not only addresses current ecological challenges but also provides a foundation for more resilient and adaptive business systems.

At the same time, the integration of digital technologies plays an increasingly important role in facilitating the transition toward circular business models. The combination of circular economy principles and digital transformation creates new opportunities for improving business processes, optimizing resource flows, and increasing organizational resilience. Digital tools enable greater transparency, real-time monitoring, and data-driven decision-making, which are essential for managing complex and dynamic business environments, especially under conditions of global instability.
However, the transition toward circularity is not without challenges. Companies must overcome technological, financial, and organizational barriers, as well as align their strategies with regulatory requirements and stakeholder expectations. The lack of standardized performance measurement systems and insufficient institutional support further complicate the implementation of circular economy practices. Therefore, a holistic and coordinated approach is necessary in order to fully realize the potential of the circular economy.

From a managerial perspective, the findings highlight the importance of integrating circular economy principles into strategic planning and decision-making processes. Managers should focus on developing innovative business models, investing in digital technologies, and fostering collaboration across the value chain in order to successfully implement circular practices. Additionally, policymakers play a crucial role in creating supportive regulatory frameworks and incentives that encourage the adoption of circular economy strategies.

This study contributes to the existing literature by providing a comprehensive overview of the role of the circular economy in strengthening the sustainability of the business environment in times of global crises. However, it is important to acknowledge certain limitations. As a review paper, the study is based on secondary data and existing research, which may limit the generalizability of the findings. Future research should focus on empirical analysis of circular economy implementation across different sectors and regions, as well as on the development of standardized metrics for assessing circular economy performance.
In conclusion, the circular economy represents not only an environmental necessity but also a strategic opportunity for achieving sustainable growth, enhancing resilience, and ensuring long-term competitiveness in an increasingly uncertain global environment.

REFERENCES

Awan, U., Sroufe, R., & Shahbaz, M. (2021). Industry 4.0 and the circular economy: A literature review and future research directions. *Business Strategy and the Environment*, 30(4), 2038–2060.

Bag, S., Pretorius, J. H. C., Gupta, S., & Dwivedi, Y. K. (2021). Role of institutional pressures and resources in the adoption of big data analytics powered artificial intelligence and circular economy capabilities. *Technological Forecasting and Social Change*, 163, 120420.

Bocken, N. M. P., de Pauw, I., Bakker, C., & van der Grinten, B. (2016). Product design and business model strategies for a circular economy. *Journal of Industrial and Production Engineering*, 33(5), 308–320.

Centobelli, P., Cerchione, R., & Chiaroni, D. (2020). Designing business models in circular economy: A systematic literature review and research agenda. *Business Strategy and the Environment*, 29(4), 1734–1749.

Cvrkušić, D., Aleksić, M., & Bjekić, R. (2025). *Digitalization of the supply chain in support of the circular economy*. Strategic Management, 203–208.

Dantas, T. E. T., et al. (2021). Circular economy and Industry 4.0 towards sustainable development. *Sustainable Production and Consumption*, 26, 213–227.

European Commission. (2020). *A new circular economy action plan for a cleaner and more competitive Europe*. Brussels.

Ellen MacArthur Foundation. (2015). *Towards the circular economy: Economic and business rationale for an accelerated transition*.

Geissdoerfer, M., Savaget, P., Bocken, N. M. P., & Hultink, E. J. (2017). The circular economy – A new sustainability paradigm? *Journal of Cleaner Production*, 143, 757–768.

Ivanov, D., & Dolgui, A. (2021). A digital supply chain twin for managing the disruption risks and resilience in the era of Industry 4.0. *Production Planning & Control*, 32(9), 775–788.

Kirchherr, J., Reike, D., & Hekkert, M. (2017). Conceptualizing the circular economy. *Resources, Conservation and Recycling*, 127, 221–232.

Korhonen, J., Honkasalo, A., & Seppälä, J. (2018). Circular economy: The concept and its limitations. *Ecological Economics*, 143, 37–46.

Murray, A., Skene, K., & Haynes, K. (2017). The circular economy: An interdisciplinary exploration of the concept and application. *Journal of Business Ethics*, 140(3), 369–380.

Ranta, V., Aarikka-Stenroos, L., & Väisänen, J. M. (2021). Digital technologies catalyzing circular economy business models. *Business Strategy and the Environment*, 30(1), 133–150.

Scarpellini, S., et al. (2020). Circular economy performance indicators. *Resources, Conservation and Recycling*, 160, 104813.

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CORPORATE ENTREPRENEURSHIP ASSESSMENT INSTRUMENT: INSIGHTS FROM FOUR REGIONS

Abstract: The main aim of this study is to investigate similarities and differences in assessing the key corporate entrepreneurship factors among top and middle managers in four innovation regions. The sample consisted of 240 managers from the City of Zagreb, the City of Novi Sad, the Province of Vojvodina, and the City of Banja Luka. Research instrument was Corporate Entrepreneurship Assessment Instrument [CEAI] (Kuratko, 2014). All five factors have been analyzed i.e. Management Support, Work Discretion, Rewards, Time availability, and Organizational Boundaries. The written permission has been obtained by authors. The CEAI has been translated into Serbian language (Kontic, 2011), and used as a tool to assess various aspects of corporate entrepreneurship over the last 15 years. In this study Serbian version of the questionnaire has been translated into Croatian and Bosnian languages i.e. ijekavian dialect. The mixed method has been used. Content analysis has been used to process qualitative data. Quantitative data processed by the Correspondence Analysis. The results have been presented by five key factors. The managers from the City of Banja Luka and the City of Zagreb gave higher grades for Management Support factor then managers from the Province of Vojvodina as whole. The results of Work Discretion factor showed similar results. Recoding has been necessary for questions in Work Discretion and Time Availability. Rewards have been similar assessed as the Management Support factor from managers of selected regions. The managers from the City of Zagreb gave the highest grades for Organizational Boundaries factor then managers from the City of Banja Luka, as well as managers from the Province of Vojvodina. Scatter plots for all five factors from CEAI questionnaire have been presented.

Keywords: corporate entrepreneurship, CEAI, regional innovations, Correspondence analysis, strategic management

1. INTRODUCTION

In contemporary business environment, companies that engage in corporate entrepreneurship tend to be more profitable and resilient to crisis than others (Janicijevic, 2025); (Kontic L. Z., 2022); (Janicijevic N. a., 2023); (Kontic L. T., 2025). The most cited studies are those that used CEAI (Kuratko, 2014). It can be applied through various means to

benefit many companies looking for innovation and growth based on corporate entrepreneurship. Since it has been studied from different fields, various definitions of the CE phenomenon have appeared in the relevant literature (Simba, 2019).
The recent literature review and future research agenda has been provided by (Urbano, 2022). Over the last 15 years, corporate entrepreneurship have been well explored in Serbian context (Kontic, 2011); (Kontic L. D., 2017); (Kontic L. a., 2017); (Kontic L. T., 2023).
This study seeks to determinate similarities and/or differences among top and middle managers in assessing the key corporate entrepreneurship factors explored in CEAI questionnaire. Concrete, the research question is: are there differences in assessing key factors by managers from four regions? From Serbia, the authors selected the City of Novi Sad, and the Province of Vojvodina; from Croatia the City of Zagreb, and the City of Banja Luka from Bosnia and Herzegovina. The Province of Vojvodina is a emerging innovator + (Hollanders, 2023). The City of Zagreb is a Strong Innovator - performing above the EU average (Hollanders, Regional Innovation Scoreboard - Regional profiles Croatia , 2023). The City of Banja Luka is a key center for research and innovation in Bosnia and Herzegovina, and classified as Emerging innovator (Hugo Hollanders, European Innovation Scoreboard 2023 Country profile Bosnia and Herzegovina, 2023). In selection process of the companies, three main criteria have been used: innovation performances, financial performance and companies' reputation, and access to top and middle level managers. Sample is representative for investigate corporate entrepreneurship in observed four regions.
In the field of corporate entrepreneurship and strategic management, this is the first study that explored data collected by CEAI and processed by the Correspondence analysis. Correspondence Analysis emerges as a powerful tool for exploring the relationships between categorical variables and revealing hidden patterns within the data. It is widely used to extract meaningful insights from complex datasets in various scientific fields.
The study contributes from theoretical and practical perspectives. Regional collaboration is one of essential component to stimulate innovation in the Western Balkan countries. The innovations generate sustainable growth, improve economics resilient, and improve crisis and strategic management in the companies.
The paper is organized as follows. Next section is devoted to methodology, followed by the presentation and discussion of the research study results. Finally, conclusions are drawn from this empirical study.

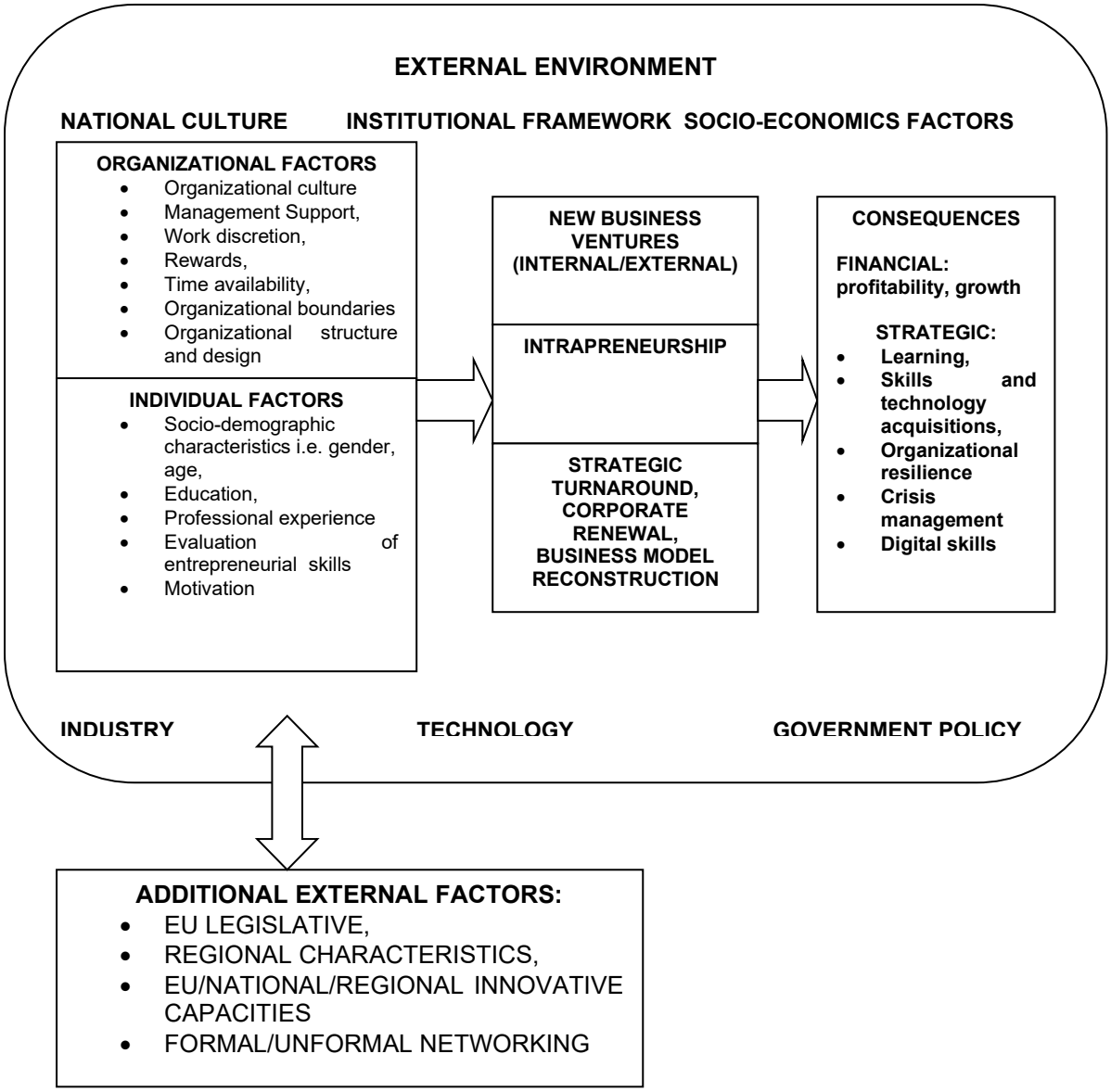
2. REVIEW OF PAST RESEARCH

The corporate entrepreneurship is a complex construct that appears in numerous forms (Urbano, 2022). A systematic literature review revealed a conceptual model of the corporate entrepreneurship which the authors' of this study adopted for purpose of their own research (*See Picture 1*).
External environment influences all companies in one national economy. Various factors have different effects, positive, neutral or negative on the company. The key factors are as follows:

- Socio-economic environment,
- Institutional framework,
- National culture,
- Industry,
- Technology
- Government Policy

Additional factors may include European Union (EU) legislative, innovation capacities at EU, state or regional level, regional characteristics, and formal and/or unformal networking.
At organizational (micro-level) level of analysis main factors can be as followed:

- Entrepreneurial culture,
- Management Support,
- Work discretion,
- Reinforcement/Rewards,
- Organizational boundaries, and
- Time availability, and
- Organizational structure and design.



Picture 1: CE Model
Source: Adapted from Urbano, 2022

Entrepreneurial culture accelerates individual creativity, risk-taking, and organizational learning, and has numerous positive effects on companies (Shiferaw, 2023) (Arabeche, 2022) (Al Koliby, 2024) (Usman, 2024) (Al-Dhaafri, 2022) (Shwedeh, 2024 June). Management support, work discretion, rewards, organizational boundaries and time availability are the key corporate entrepreneurship factors that measured by CEAI (Kuratko, 2014). The results of the previous study revealed that Time availability is related to organizational culture in Serbian context (Janicijevic N. a., 2025).
The review of the past studies that used CEAI in specific context such as the transitional, emerging or developing countries more or less similar to Serbian environment is presented in the Table 1.

Table 1: Validation of CEAI in specific environment in period 2011-2026

Countries/Study	Methods	Main results	Validation of CEAI
South Africa / (van Wyk, 2011)	Confirmatory analysis of 333 responses from managers	The results indicated an eight-factor 34-item questionnaire. Additional factors were: Innovative initiatives, Financial support, and Sufficient time.	Work discretion α = 0.84, Management support and risk-taking α = 0.82, Rewards/ reinforcement α = 0.75, Organizational boundaries α = 0.81 and Inadequate time α = 0.67.
Serbia / Kontic (2011)	Quantitative analysis data from four organizations (167 managers)	Pilot testing revealed possible implementation for investigating CE in Serbian context.	Whole CEAI α=0.927 Time availability α=0.465 was very low
Serbia / Kontic et al. (2017)	Longitudinal study	Employees' attitudes toward the CE key factors have been depended on their age, education, professional experience, and management level	There is a need for some modification in the version translated into Serbian.
Romania / Agapie (2018)	Quantitative analysis data from technology-based companies (175 respondents)	Romania entrepreneurial culture based on ten relevant factors.	CEAI can be used in Romanian context, without Time availability
Case study / (Bisht, 2023)	Single case study	A company need to work in domain of Rewards, and Organizational boundaries	CEAI can be used for assessment CE
Brazil / (de Araujo Castro, 2020)	Quantitative study 548 managers	Statistical analyses showed that organizational factors and entrepreneurial characteristics haven't been interrelated.	Cronbach's Alpha was achieved in all constructs, with the exception of the Time availability α = 0.481, lower than 0.6.
Thai / (Satwong, 2025)	The impact of CEAI key factors on economic, environmental, and social performance outcomes.	Results indicate that CE, particularly reward and reinforcement mechanisms, significantly impact performances. The research highlights the importance of fostering an internal entrepreneurial climate.	CEAI can be use in Thai content.

Source: Markov, 2012.
(Style: SM-SourceTable)

Individual factors that affect corporate entrepreneurship may include the following:

- Socio-demographic characteristics of employees such as gender or age
- Education,
- Professional Experience,
- Motivation.

Moreover, it is important to evaluate entrepreneurial skills of all managers and employees. Self-evaluation questionnaires and standardized questionnaires have been used. Important issue is the employees' intrinsic or extrinsic motivation factors.

Based on the systematic review on the literature, there are three main perspectives of the corporate entrepreneurship (Urbano, 2022). The first view is an internal corporate entrepreneurship, also named intrapreneurship, which includes innovations within companies' boundaries. The second perspective embodies the joint venture in entrepreneurial activities and innovations. Third perspective includes corporate turnaround, corporate revival, renewal, and business process reconstruction.

The consequences or the answer on the following question: Why the managers invest in corporate entrepreneurship activities? is a main component of the CE model. Financial results are important in the terms of profitability and companies' growth. The more important results are strategic results measured by improved learning capacities, adopted new technologies with new technological skills, acquisition of digital skills, and crisis management competencies to build companies that are resilient to all kind of crisis.

3. METHODOLOGY

The sample consisted of 240 top and middle-managers from four regions: The City of Novi Sad, The Province of Vojvodina (besides the City of Novi Sad), The City of Zagreb, and The City of Banja Luka. The regions have been selected by three European Commission Regional Innovation Scoreboard (Hollanders, Regional Innovation Scoreboard - Regional profiles Croatia , 2023) (Hollanders, Regional Innovation Scoreboard, 2023) (Hugo Hollanders, European Innovation Scoreboard 2023 Country profile Bosnia and Herzegovina, 2023). The three main criteria have been used in companies' choices. The first criterion was innovation performances of the company. The second one was financial performances and reputation of company. The third criterion was availability of managers who want to participate in the survey. The authors' personal and professional contacts have been used to obtain relevant data.
The main aim of this study is to investigate regional similarities and differences among top and middle managers in assessing the key corporate entrepreneurship factors.
The hypotheses of the study are following:
H_0: There are differences in assessing the key corporate entrepreneurship factors by managers in four selected regions.
H_1: There are differences in assessing the factor Management Support by managers in four selected regions.
H_2: There are differences in assessing the factor Work Discretion by managers in four selected regions.
H_3: There are differences in assessing the factor Rewards by managers in four selected regions.
H_4: There are differences in assessing the factor Time Availability by managers in four selected regions.
H_5: There are differences in assessing the factor Organizational Boundaries by managers in four selected regions.
The research instrument was Corporate Entrepreneurship Assessments Instrument [CEAI], which consisted of 48 questions. All procedures performed in this study were in accordance with the ethical standards of University of MB, University of Belgrade, University of Osijek, and the Helsinki Declaration.
Data have been processed by the correspondence analysis. Origin of the technique can be found in the early 20. century (Hirschfeld, 1935 October). Forty years later, academics have revived the Correspondence analysis (Benzecri, 1977) (Bourdieu, 1979) (Greenacre M. , 1984) (Hill, 1974). Same happed at the begging of 21. century, to processed numerous qualitative data (Greenacre M. , 2017). The behavioral and social science studies embody questionnaires that have numerous categorical questions i.e. CEAI. Therefore, the correspondence analysis is adequate choice for processing data. A visual result of the Correspondence analysis is a scatterplot (Greenacre M. , 2017).

4. RESULTS AND DISCUSSION

The results of this study will be presented by the similarities of the key corporate entrepreneurship factors. First, the profiles of the key CE factors will be presented (*See Table 2, Table 3 and Table 4*).

Table 2: Profiles of Key Management Support and Rewards (in %)

Factor	Management Support (MS)					Rewards (RW)				
Region	Grades					Grades				
	1	2	3	4	5	1	2	3	4	5
City of Banja Luka (B&H)	1.58	6.68	30.76	48.51	12.48	5.56	8.06	23.33	47.48	15.28
City of Zagreb (HR)	4.23	16.9	33.1	37.32	8.45	10.31	13.93	23.68	39.00	13.09
City of Novi Sad (NS)	26.99	21.84	26.87	21.23	3.07	28.08	15.77	26.54	20.00	9.62
Province of Vojvodina (VV)	20.93	27.06	32.77	15.43	3.81	26.00	16.00	25.33	19.33	13.33

Source: Authors' calculation

Table 3: Profiles of Work Discretion and Time Availability (in %)

Factor	Work Discretion (WD)					Time Availability (TA)				
Region	Grades					Grades				
	1	2	3	4	5	1	2	3	4	5
City of Banja Luka (B&H)	1.83	10.5	26.83	45.83	15.0	8.8	32.8	21.87	32.8	3.73
City of Zagreb (HR)	3.67	14.67	28.0	43.17	10.5	12.53	27.3	27.3	27.86	5.01
City of Novi Sad (NS)	8.67	19.67	27.17	31.85	12.65	11.67	32.3	24.12	26.07	5.84
Province of Vojvodina (VV)	8.43	20.48	22.89	30.92	17.27	16.67	32.67	20.67	19.33	10.67

Source: Authors' calculation

Table 4: Profile of Organizational Boundaries (in %)

Factor / Region	Grades				
	1	**2**	**3**	**4**	**5**
City of Banja Luka (B&H)	1.2	12.2	22.49	51.44	12.68
City of Zagreb (HR)	5.0	10.0	16.43	47.14	21.43
City of Novi Sad (NS)	8.58	7.92	17.16	53.47	12.87
Province of Vojvodina (VV)	8.05	13.22	18.39	42.53	17.82

Source: Authors' calculation

Based on the Chi-square test, data from regions were asymmetric for all factors of the CEAI. Managers from the City of Zagreb and the City of Banja Luka gave grade 4 more often than managers from The Province of Vojvodina, as whole. Insights from Management support and Rewards factors are the following:

- *High difference between City of Banja Luka and the Province of Vojvodina as whole*
- *High difference between the City of Zagreb, on the one side and the Province of Vojvodina and City of Banja Luka, on other side.*
- *Moderate difference between City of Banja Luka, and the City of Zagreb,*
- *Moderate difference between the City of Novi Sad and rest of the Province of Vojvodina*

Work discretion (WD) and Time availability (TA) factor have questions that require inverted codification (For WD it is Q 29; for TA questions Q 36, 39, and 40 from CEAI).
Total inertia enables identification of the principal components composed of these profiles and calculation of variability which is described by each component. The Principal components method can be used for identification similarities and differences between profiles. Detailed analysis identified two principal components by the aforementioned key factors (*See Table 5*).

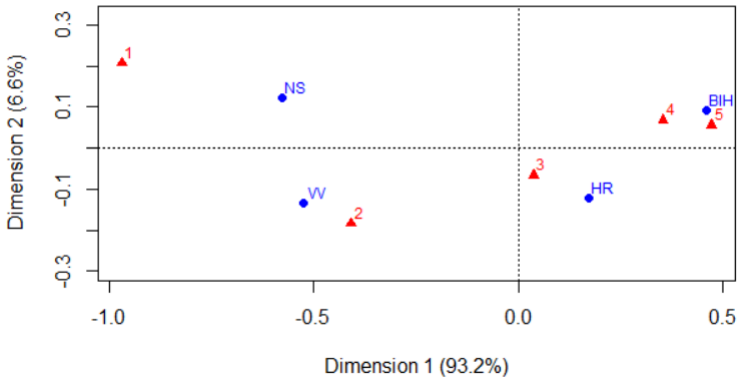
Table 5: Principal components of CEAI factors

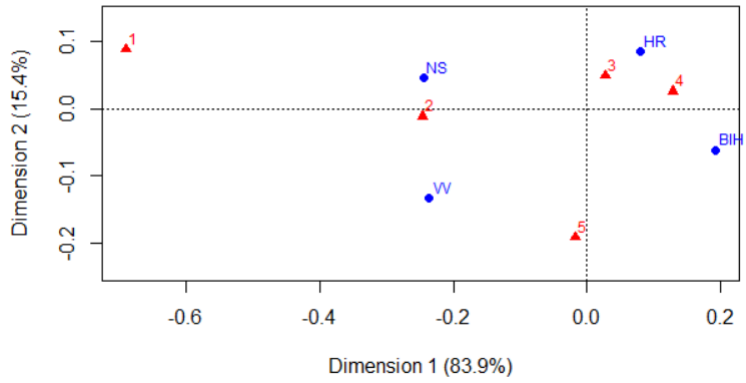
Region	MS		RW		WD		TA		OB	
	1	2	1	2	1	2	1	2	1	2
B&H	1.0556	0.793	1.0711	0.9942	1.0556	0.793	1.0711	0.9942	1.442766	-0.2281
HR	0.3947	-1.066	0.3778	-1.4114	0.3947	-1.066	0.3778	-1.4114	-0.45083	1.1638
NS	-1.3246	1.0565	-1.3245	0.4378	-1.3246	1.0565	-1.3245	0.4378	0.896171	1.5188
VV	-1.2052	-1.1681	-1.1791	0.2329	-1.2052	-1.1681	-1.1791	0.2329	-0.81717	0.3836

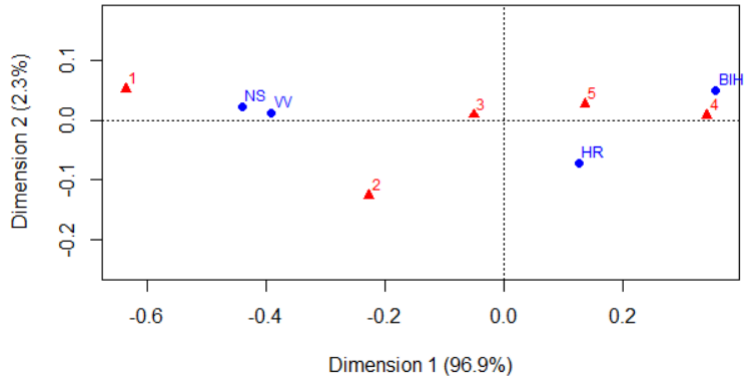
Source: Authors' calculation

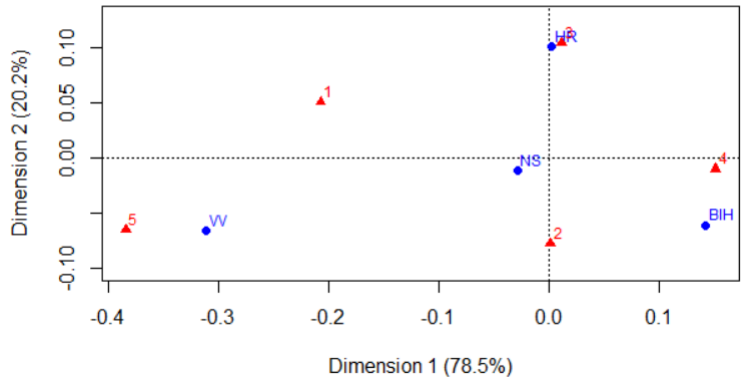
From Table 5 it can be concluded significantly minor differences in assessment WD, and TA than MS. The first component explains 93.15% of total inertia of the Management Support factor. Although, for the factor Rewards, the first component explained 96.87% of total inertia i.e. dispersion of grades between regions.
The first component explains 87.5% of total inertia of the Work Discretion factor. Although, for the factor Time availability, the first component explained 78.53% of total inertia i.e. dispersion of grades between regions.
Moreover, it can be concluded significantly less differences in assessment OB than MS. Total inertias of OB was very low 0.03661765. Detailed analysis identified two principal components. The first component explains 61.15% of total inertia of the Organizational Boundaries factor. The second component explained 29.79% of total inertia i.e. dispersion of grades between regions.
Picture 2: presents scatter plots of CEAI factors in the following order:

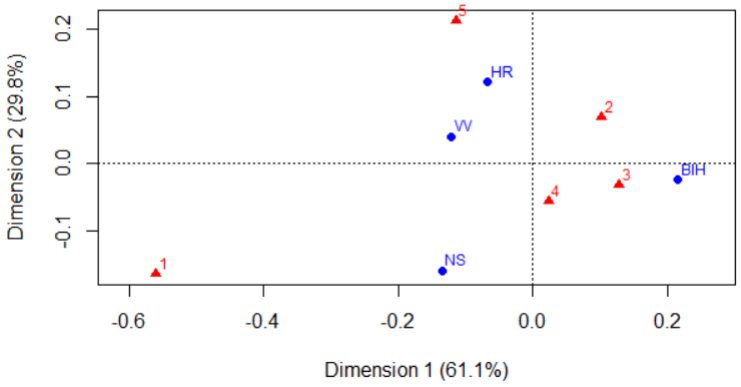
1. Management Support,
2. Rewards,
3. Work Discretion,
4. Time Availability, and
5. Organizational boundaries.


Dimension 2 (6.6%)
0.3
0.1
-0.1
-0.3
-1.0
-0.5
0.0
0.5
Dimension 1 (93.2%)
1
NS
BIH
4
5
3
HR
VV
2


Dimension 2 (15.4%)
0.1
0.0
-0.1
-0.2
1
NS
2
HR
3
4
BIH
VV
5
-0.6
-0.4
-0.2
0.0
0.2
Dimension 1 (83.9%)


Dimension 2 (2.3%)
0.1
0.0
-0.1
-0.2
1
NS
VV
3
5
BIH
4
HR
2
-0.6
-0.4
-0.2
0.0
0.2
Dimension 1 (96.9%)


Dimension 2 (20.2%)
0.10
0.05
0.00
-0.10
HR
1
NS
4
5
VV
BIH
2
-0.4
-0.3
-0.2
-0.1
0.0
0.1
Dimension 1 (78.5%)



Picture 2: Scatterplots for a) MS, b) RW, c) WD, d) TA, and e) OB
Source: Authors' calculation

The best insights can be getting from the Scatter plots, as visual presentation of the Correspondence Analysis. It emerges as a powerful tool for exploring the relationships between categorical variables and revealing hidden patterns within the data. It is widely used to extract meaningful insights from complex datasets.
Based on the picture 2, the first graph illustrated that managers from the City of Zagreb (HR), and the City of Banja Luka (B&H) gave similar grades for Management Support battery of questions. These grades have been higher than grades came from the Province of Vojvodina.The second graph is very similar. The third graph illustrates similarities between managers from the City of Zagreb and City of Banja Luka, on one side, and the Province of Vojvodina on another. The managers from Vojvodina, as whole gave more often extreme grades than other two regions. The fourth graph is similar.
From the graph 5, it can be concluded that managers from the City of Banja Luka had opposite opinions than the rest of the sample regarding the assessment of the Organizational Boundaries factor. Top and middle managers from the City of Zagreb gave more often grade 5 than other managers.

4. CONCLUSION

A particularly important field of research on corporate entrepreneurship includes innovations and regional collaboration to gain and maintain competitive advantage. The five factor questionnaire developed by Kuratko et al., (2014) entitled CEAI (Kuratko, 2014). Over the last 15 years numerous studies conducted by authors using CEAI.
This study confirmed that Correspondence Analysis can be a powerful tool for exploring the relationships between categorical variables and revealing hidden patterns within the data from four regions at different economic development. The results revealed similarities between the managers from the City of Zagreb and the City of Banja Luka in assessing four of five corporate entrepreneurship factors. The results from Organizational Boundaries suggested that managers from the City of Zagreb gave higher ratings then managers from other selected regions.
The limitations of the study regard linguistic and cultural issues when a research instrument created in one national culture had been used in another cultures. Future study will include more companies from selected regions.

REFERENCES

Agapie, A. P. (2018). Adapting a corporate entrepreneurship assessment instrument for Romania. *South African Journal of Business Management 49 (1)* , 1-7.

Al Koliby, I. M.-S.-H. (2024). Unveiling the linkages between entrepreneurial culture, innovation capability, digital marketing capability and sustainable competitive performance of manufacturing SMEs: evidence from emerging countries. . *The Bottom Line 37 (4)* , 473-500.

Al-Dhaafri, H. &. (2022). Role of leadership, strategic planning and entrepreneurial organizational culture towards achieving organizational excellence: evidence from public sector using SEM. *Measuring Business Excellence 26 (3)* , 378-396.

Arabeche, Z. S. (2022). Entrepreneurial orientation, organizational culture and business performance in SMEs: Evidence from emerging economy. *Sustainability 14 (9)* , 5160.

Badoju, G. A. (2023). *Corporate Entrepreneurship and Entrepreneurial Behavior of Employees: Antecedents and Triple Bottom Line Consequences .* (doctoral dissertation): Universitat Jaume I Spain.

Benzecri, J. P. (1977). Historie et prehistorie de l'analyse des donnes. Parties V L'analyse des correspondences. *Les cahiers de l'analyse des donnees 2 (1)* , 9-40.

Bisht, A. (2023). Firm readiness for Corporate Entrepreneurship. *International Journal of Science and Research 12 (4)* , 296-297.

Bourdieu, P. (1979). *Dinstinction: A social Critique of the Judgement of Taste.* Routledge.

de Araujo Castro, A. G. (2020). *Designing and testing an assessment model of the antecedents of corporate entrepreneurship in public and private companies.* Brasil: Pontifícia Universidade Católica de Minas Gerais - PUC Minas.

Fisher, R. (1940). An examination of the different possible solutions of a problem in incomplete blocks. *Annals of Eugenics 10 (1)* , 52-75.

Greenacre, M. (2017). *Correspondence Analysis in practice 3rd ed.* Chapman and Hall/CRC.

Greenacre, M. (1984). *Theory and Applications of Correspondence Analysis.* Academic Press.

Hill, M. (1974). Correspondence analysis: a neglected multivariate method. *Applied Statistics 23* , 340-354.

Hirschfeld, H. (1935 October). A connection between correlation and contigency. In *Mathematical proceedings of the Cambridge Philosophical Society vol. 31 no 4* (pp. 520-524). Cambridge: Cambridge University Press.

Hirschfield, H. (1935). A connection between correlation and contingency. *Proc.Camb.Phil.Soc. 31* , 520-524.

Hollanders, H. (2023). *Regional Innovation Scoreboard - Regional profiles Croatia .* Brussel: European Commission .

Hollanders, H. (2023). *Regional Innovation Scoreboard.* Brussels: European Commission.

Hugo Hollanders, N. E.-S.

Hugo Hollanders, N. E.-S. (2023). *European Innovation Scoreboard 2023 Country profile Bosnia and Herzegovina.* Brussel: European Commission.

Janicijevic, N. a. (2025). Corporate entrepreneurship in a collectivist culture: The role of time availability. *International Journal of Emerging Markets 20 (5)* , 1801-1818.

Janicijevic, N. a. (2023). The mechanism and the direction of organizational culture's impact on corporate entrepreneurship. *TEME* , 337-354.

Kontic, L. a. (2017). Corporate entrepreneurship in Serbian public sector. In M. S. Radovic Markovic, *Entrepreneurship: Types, Current Trends and Future Perspectives* (pp. 14-26). Belgrade: Faculty of Business Economics and Entrepreneurship.

Kontic, L. D. (2017, October 15). Testing corporate entrepreneurship assessment instrument in transition environment. *DIEM: Dubrovnik International Economic Meeting Vol. 3, No. 5* , pp. 67-78.

Kontic, L. (2011). Istraživanje korporativnog preduzetništva u izabranim srpskim organizacijama. In N. a. Janicijevic, *Novi metodi menadžmenta i marketinga u podizanju konkurentnosti srpske privrede* (pp. 103-116). Beograd: Ekonomski fakultet Univerziteta u Beogradu.

Kontic, L. T. (2023). Corporate entrepreneurship identity in the core of turnaround strategy: The case of Serbia. *Economic and Social Development: Book of Proceeding* (pp. 166-174). Belgrade: ESD, and University MB.

Kontic, L. T. (2025). The state of entrepreneurship in Serbia: Insights from enterprises' surveys. *Economic and Social Development in Bipolar and Multipolar Envirnment* (p. 424). Belgrade: ESD, and University MB.

Kontic, L. Z. (2022). Economic recovery thought corporate entrepreneurship strategy: The case of Serbia. *Review of Socio-Economic Perspectives 7 (2)* , 1-9.

Kuratko, D. H. (2014). Diagnosing a firm's internal environment for corporate entrepreneurship. *Business Horizons, Vol. 57, No.1* , 37-47.

Satwong, P. (2025). Cultivating sustainability: the impact of corporate entrepreneurship on Thai business. *Asian Interdisciplinary and Sustainability Review 14 (2)* , 11.

Shiferaw, R. M. (2023). Entrepreneurial leadership. learning organization and organizational culture relationship: A systematic literature review. *Journal of Innovation and Entrepreneurship 12 (1)* , 38.

Shwedeh, F. &. (2024 June). Utilization of Augmented Reality in Enhancing Innovation and Entrepreneurship in the UAE. In *International Scientific Conference Management and Engineering* (pp. 243-252). Cham: Springer Nature Switzerland.

Simba, A. a. (2019). Advancing entrepreneurial leadership as apractice in MSME management and development. *Journal of Small Business Management 57 (sup2)* , 397-416.

Urbano, D. T. (2022). Corporate entrepreneurship: a systematic literature review and future research agenda. *Small Business Economics 59 (4)* , 1541-1565.

Usman, F. K.-M. (2024). Entrepreneurial innovations and trends: A global review: Examining emerging trends, challenges, and opportunities in the field of entrepreneurship, with a focus on how technology and globalization are shaping new business ventures. *International Journal of Science and Research Archive 11 (1)* , 552-569.

van Wyk, R. &. (2011). An eight-factor solution for the Corporate Entrepreneurship Assessment Instrument. *African Journal of Business Management 5 (8)* , 3047-3055.

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THE ROLE OF HUMAN RESOURCE MANAGEMENT IN SERBIAN ORGANIZATIONS BASED ON EMPIRICAL EVIDENCE OF CRANET RESEARCH FROM 2026

Abstract: One of the impacts of the global instability and contemporary business environment is that managing organizations' most valuable assets, human capital is becoming a vital task of all organizations. Human resource management (HRM) must find adequate answers to the global and local, internal and external challenges organizations are facing with in order to achieve its main goal, to attract, motivate, and retain competent and committed employees. New challenges related to global political and economic instability, digitalization, artificial intelligence, new generations at the labour market and many others, require from organizations to focus more on human resources and develop specific HRM strategies to manage their employees adequately. It is important to determine the actual state of HRM practice and the role of HR department in contemporary organizations. The main aim of this paper is to analyse the main indicators of HRM function in organizations in Serbia, to determine its actual state and the level of development. The paper is based on literature review and empirical research results. The data are gathered through the newest round of global Cranet research from 2026. The preliminary analysis includes the main indicators of HRM, such as: the existence of HRM department, the existence of written business and HR strategies, the involvement of HR manager in the development of business strategy and the primary role of HR department and line manager in the main decisions regarding employee compensation, staffing, training and retention. The obtained results give worthwhile insight into the importance and development of human resource management activities in Serbia in 2026.
Keywords: human resource management, development, Serbia, Cranet

1. INTRODUCTION

Human resource management (HRM) as a management concept and activity includes wide range of activities with the aim of managing organizational most valuable resources, the employees. HRM needs to answer to all challenges that are arising in the internal and external business environment to achieve its goal, to attract, motivate, and retain employees. The main HRM activities are HR planning, staffing, training and development, career management, compensation, safety on work, etc. Due to the changes in the business environment HRM is becoming more and more important in contemporary business. New challenges related to global political and economic instability, digitalization, artificial intelligence, new generations at the labour market and many others, require from organizations to focus more on human resources and develop specific HRM strategies to manage their employees adequately. This is why due to the changes in the business environment HRM is becoming more and more important in contemporary business. In order to develop

sucessful HRM strategy and activities it is important to determine the actual state of HRM practice and the role of HR department in contemporary organizations.

The evolution of the HRM usually is presented through several phases. The first phase is the "administrative" function, which was characterised by a paternalistic approach to employees. On the other side, the "contemporary" phase of HRM is known for the strategic business partner role. It is important to emphasize that the evolution of HRM is different considering the business environment and economic development of countries. In the majority of market economies HRM is more developed, it has a strategically important role, while in former planned economies the state and its administration had had the largest influence on business till 1990. HRM in Eastern and Central Europe, as a former communist bloc, has experienced many changes since 1990 and which are still ongoing" (Poór et al., 2011; Kohont et al., 2015; Slavić & Berber, 2016).

The main aim of this paper is to analyse the main indicators of HRM function in organizations in Serbia, to determine its actual state and the level of development. The paper is based on literature review and empirical research results. The data are gathered through the newest round of global Cranet research from 2026. The preliminary analysis includes the main indicators of HRM, such as: the existence of HRM department, the existence of written business and HR strategies, the involvement of HR manager in the development of business strategy and the primary role of HR department and line manager in the main decisions regarding employee compensation, staffing, training and retention.

The paper consists of four parts. In the first part the authors presented some of the main developmental issues on HRM in Serbia. The second part of the research presents the methodology. Results and discussion are given in the third part, while conclusions are presented in the fourth part.

2. THEORETICAL BACKGROUND

When exploring a development of HRM, it is important to point out at least three different perspectives: *business function*, which focuses attention on the question of how strategic the HRM function is, or could or should be, in organizations, *occupation/profession*, which asks the question of when specific and rounded up tasks started to be performed by a special occupation often placed by organizations in a special personnel department, and *division of responsibility and authority*, which examines the question of the distribution of authority and influence between all of the various stakeholders (Kohont et al., 2015). Beside these three perspectives, in the research of the evolution of the HRM in one country or a region it is important to take into account the economic, cultural and historic factors that were in place in different countries. Those factors determine the entire business environment of one country/region (Slavić & Berber, 2016).

The power of the HR function is defined in relation to its strategic significance within the firm (Gooderham et al., 2015). According to them, this comprises three mechanisms: whether the HR function has achieved board membership; whether the HR function has a substantial degree of involvement in the development of the firm strategy; and whether line managers are involved in its evaluation.

Describing the characteristics of HRM practice in Serbia it is important to underline that the national culture of Serbia is making the adaptation of western management techniques difficult. Based on Hofstede's (1980) dimensions Serbia is a country with high power distance (76), uncertainty avoidance (88) and explicitly individualistic (27) and feminine (27) values. According to Janićijević (2003) the dimension of national culture affects the organizational culture, as well, and results in authoritative leadership style, the high importance of informal relations – networking, and high bureaucracy. This is while the Anglo-Saxon management techniques could not be used directly, but only after studious adaptation.

The evolution of real human resource management practice in Serbia has begun after 2000. After the political and economic changes in 2000 the intense process of organizational transformation and restructuring of Serbian companies pointed to the importance of HRM. The development of HRM practice was mainly linked to the activities of foreign multinational companies, which brought to Serbia not only their production or services, but modern management and HRM practices, too. The CRANET research from 2008 about the HRM function in Serbia showed that, despite the favourable institutional and academic surroundings, HRM practice has not yet achieved its desired level. The majority of Serbian companies did not have legitimate HR departments, or, if they do, they had only administrative roles (Svetlik et al, 2010).
Table 1 presents main characteristics of the HRM in Serbia in previous periods. It is obvious that the HRM practices were influenced by the Socialist model of development and political and economic situation in Serbia.

Table 1. The periods of the *HRM development in Serbia from 1945 to 2008*

Time period	Phase	Main characteristics
1945–1960	Administrative-ideological period	Personnel policy consisted of employment, payment, and the assurance of employees 'social standard. It was determined by the state and implemented through legislation. Personnel function had to recruit employees for key positions who were not only professionally but also politically suitable. The director of personnel had to be politically credible without any special training in the field. There were no trained personnel professionals and Communist Party representatives continued to make key personnel decisions.
1960–1970	Initiation	Economic reforms failed and former Yugoslavia faced with economic crisis followed by high rates of inflation and increasing foreign debts. In the late 1950 the first courses for personnel managers were organised, and in the 1960s courses were also offered at a post-secondary level. Personnel function remained administrative, and personnel policy stayed firmly within the hands of the state. The personnel function became visible although not professionalized. The main players in the field were managers, who received some training and were still more or less influenced politically, self-management bodies such as boards for personnel and social issues, and Communist Party representatives.
1970–1980	Pioneering	Questions concerning salaries, the social standard, and workers' rights were increasingly dealt with by enterprises' work councils and their committees. At a macro level, personnel policy was formally defined in so-called social agreements which were adopted by 'self-managed communities of interest' organised on a local, regional and state level as a kind of association of stakeholders interested in a well-functioning employment system. Personnel function remained administrative, the education and expertise of personnel officers was relatively low, and their role in decision making about personnel matters was unimportant. Personnel function was most often organized in one department together with the legal function and led by lawyers. The first undergraduate PM programme was established at the University of Belgrade.
1980–2000	Personnel management (PM)	During the 1990s Serbia faced with civil wars, extreme hyperinflation, the loss of former markets, UN economic sanctions on foreign trade and FDI, the maintenance of social ownership, NATO air strikes, spontaneous and tycoon privatization, a strengthening of the informal sector, and considerable economic crisis. This situation was reflected in the role and position of the personnel function within companies which remained rather unchanged. In many companies executives could not understand how the HR function could make the vision of growing human asset a reality. HR professional associations still did not exist, the number of relevant HR articles and books was still small, there was no relevant HR journal, the market for HR services was still undeveloped, and HR had yet to be recognized as a profession.
2000–2008	PM/HRM	The role of HRM function was very weak, but a growing number of companies were introducing HRM departments. The majority of these recently established HRM departments had limited functions – mostly performing administrative tasks, without real strategic involvement. The lack of competences of HRM professionals was the result of inappropriate university-level education of future HRM experts. The integration of HRM with the business strategy is low, managers do not regard HRM department as a strategic partner and do not view HRM as a vital factor of the company's success.

Source: Kohont et al., 2015; Bogićević Milikić et al., 2008; Slavić et al., 2012; Štangl Šušnjar & Leković, 2009.

Concerning the HRM practice after 2008 it is important to stress the research results of Slavić, Šušnjar, Poór (2012). Based on Cranet 2008-10 research results from Serbia and Hungary they underline that there are signs for convergence and divergence in the HRM practice. The *convergence* is manifested in the similarities of significance of HRM expressed by labour cost/operating cost ratio, the existence of corporate and HRM strategy and the stage of involvement of HRM in the business strategy development process. The *divergence* is present in the form of place of the HRM manager at the Board of Directors and in the recruitment source of a senior HR manger, as the signs of significance of HRM, as well as in all analysed indicators of the key players and main decision makers in HRM fields. Štangl Šušnjar and Leković (2009) claim that the majority of HRM responsibilities (staffing, compensation) are formally in the line managers' authority, but the main responsibility for these HRM issues is, indeed, in the hands of top managers.

The study of Bogićević Milikić et al. (2012) revealed some signs of positive change in Serbian HRM, too, because it found that the HRM function was organized within the separate department, with the HR manager who possess university degree in subject areas other than Law. Also, HR departments are included in making major policy decisions regarding HR issues, written policy in some HR areas, such as pay and benefits, recruitment and selection and training and development exist in organizations, more HR staff has university degree instead of clerical staff, etc.

According to the data from Serbian Cranet research from 2008 and 2015 it can be stated that HRM got more strategic role. In 2015 HR managers were usually in the top management boards and they were consulted from the outset during strategy formulation process. There was an increase of those organizations that possess written organizational mission, business and HR strategies, too. Regarding authority questions, it is important to emphasize that in Serbian organizations line manager were still the most responsible for HR decisions. HR department (alone or in consultations) was mostly engaged in decision making in staffing, training, and industrial relations. With average results on absenteeism and employees' turnover, Serbian organizations spent less money on training and compensation than other European countries (Slavić & Berber, 2016). The HR staff ratio index has improved, the human resources form a higher proportion of the companies' total costs, and therefore the role of the HR department in assuring efficiency, productivity, and profitability has emerged. The long-term orientation is proved by the increased ratio of labour costs spent on training and development (Poór et al., 2016).

The Cranet research from 2021 pointed to the following characteristics of HRM practice in Serbia: the majority of companies possess HR departments, the person with responsibility for HR issues has a seat on the board or equivalent committee and almost all companies have a written mission and business strategy (Berber, 2022). Almost ¾ of organizations possess a written HR strategy, and also a training and staffing strategy (67% and 68.9% respectively). About half of the companies have CSR statement and a diversity statement as a written document. Line managers in cooperation with HR managers (and vice versa) are mainly responsible for all HR activities, from pay and benefits to workforce reduction or expansion. The HR department has the most important role in decision-making about industrial relations (33% of companies claimed this response). The majority of organizations in the sample from Serbia evaluate the performance of their HR departments. About half of the organizations use e-HRM and HR analytics (Berber et al, 2022).

3. METHODOLOGY

The methodology used in the research is based on the Cranet methodology, the world's largest international network for comparative research on human resource management (Berber et al., 2017). The Cranet is a multi-country, multi-time-point survey of HRM policies and practices, that lasts over the past 30 years by a collaborative network of researchers from more than 40 countries worldwide (Parry et al., 2021, 274). The research aims to provide high-quality data for academic, public, and private sectors, as well as for students of HRM, and to create new knowledge about HRM practices in different countries of the world. The questionnaire was divided into six parts/sections: HRM activities in an organization, staffing, employee development, compensation and benefits, industrial relations and communication, and organizational details. Answers to questionnaires were provided by executive managers or HR managers in organizations with more than 50 employees (Berber et al., 2018). Also, the single-respondent methodology is used, when only one response is given for the entire company HRM practices, usually by HR managers or other managers on higher positions. For the purpose of this paper, the authors used the data on HRM activities in organizations (section I in the Cranet questionnaire).

3.1. Sample overview

The Serbian sample of the research from 2026 consists of 92 organizations. The sample overview shows that about 15% of them are from wholesale and retail trade sector, about 13% are from telecommunications, IT and other information services, about 12 % are from the manufacture of food, beverages, textiles, wood and paper, coke and refined petroleum, and related products, about 10 % are from other manufacturing, about 6,5% are from financial services and from education, while the others are from other sectors.

The majority of analysed organizations are from private sector (76%), while 20,7% comes from public sector. The 3,3% of the sample is made up of organizations with mixed ownership.

The HR practice of a company may depend on the market what it serves. The majority of the organizations (46%) serves national market, 41% of them target the global market, while 13% of the analysed organizations focus on the local market.

4. RESULTS

According to the results of the analysis, 89,1% of all responding organizations has an HR department, and 70,3% of companies claimed that the person with responsibility for HR issues have a seat on the Board or equivalent committee.

Figure 1 shows the responses of organization regarding the existence of several written documents and strategies related to HRM.

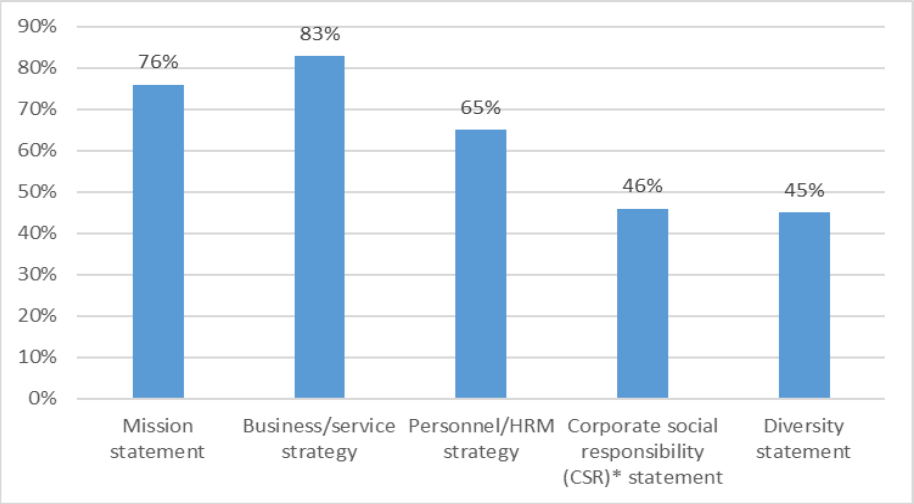


Figure 1. Percentage of organizations that possess certain written documents related to HRM
Source: Authors.

It is seen that almost all companies have written business strategy and mission statement. In case of HR strategy, 65% of organization possess a written HR strategy. In case of ethics, which was investigated by the CSR and diversity statements, the results shows that less than half of the companies have CSR and diversity statement as a written document.

Figure 2 shows at what phase the person responsible for personnel/HR issues is involved in the development of organization's business/service strategy.

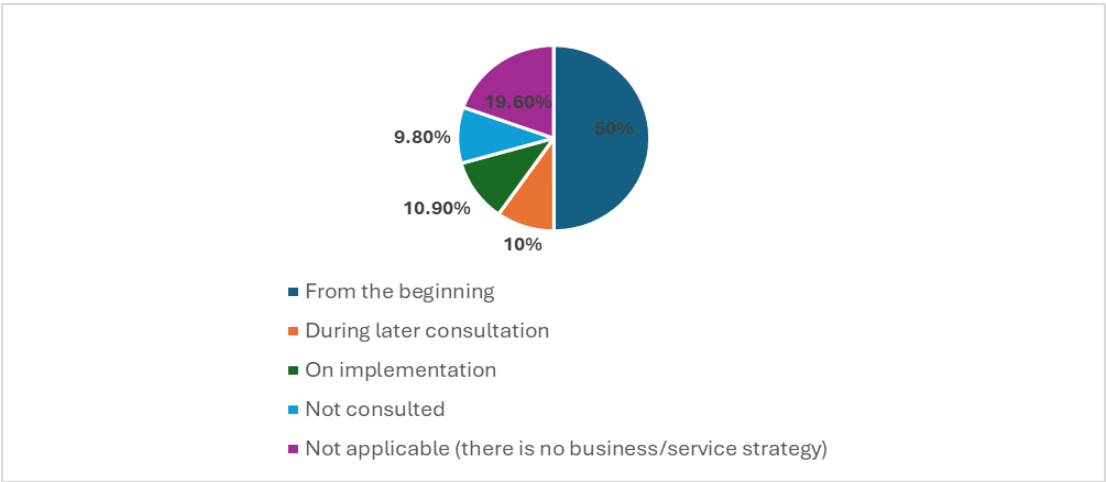


Figure 2. The involvement of the person responsible for personnel/HR issues in the development of organization's business/service strategy
Source: Authors.

The obtained data show that in the half of analysed organizations the person responsible for HR issues in involved to the business strategy development from the beginning. In these organizations HR has a real strategic role, it may be seen as a business partner.

Figure 3 shows the responsibility for different HR issues in a company.

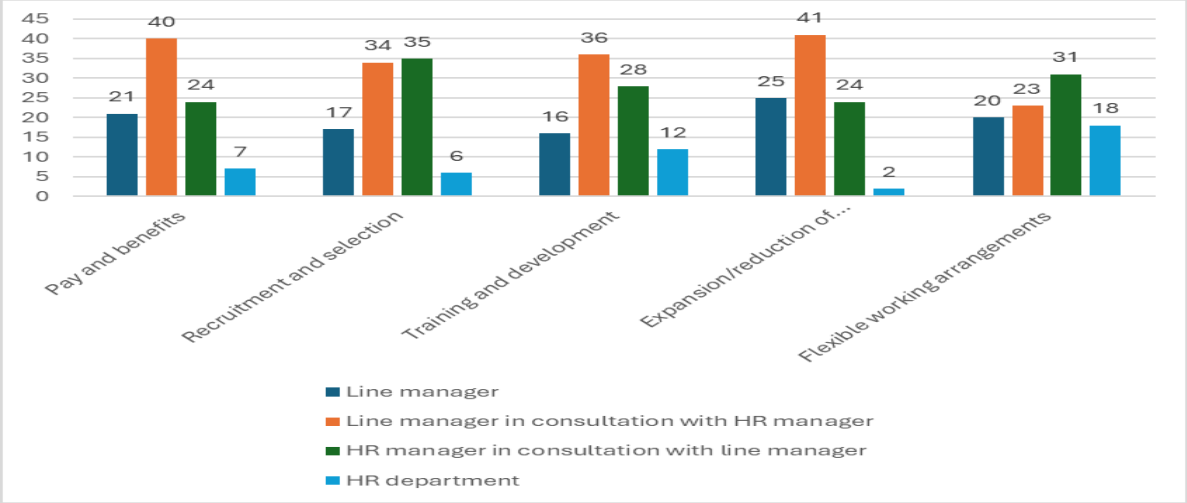


Figure 3. The main responsibility towards decision making on HRM issues in a company
Source: Authors.

The data show that in the majority of HR related issues the line manager makes the decision in consultation with HR manager. In case of recruitment and selection the line manager and HR manager make the decision together. On the other hand, in case of flexible working arrangements HR manager is the main decision-maker in consultation with line manager.

The last figure presents the extent of the evaluation of performances of HR department in organizations.

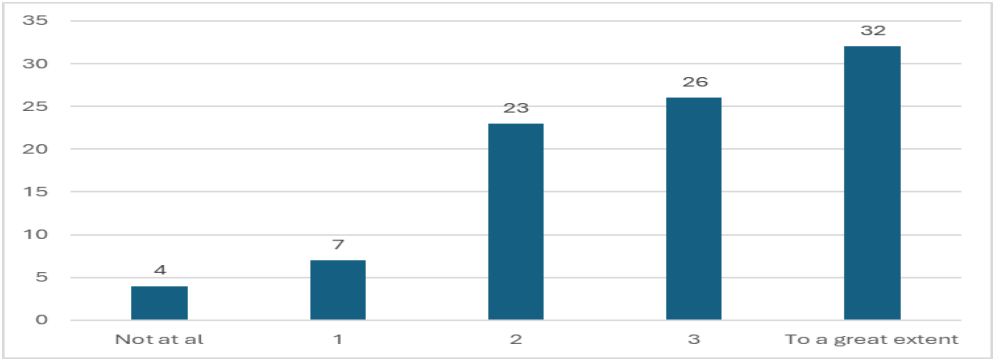


Figure 4. The extent of the evaluation of performances of HR department in organizations
Source: Authors.

From figure 4 we can conclude that the majority of organizations in the sample from Serbia evaluate performance of their HR departments. Most of them are doing that to a very great extent (35%), and to a great extent (28%). One quarter of the organizations perform this kind of evaluation on the average level, while only 12% of organizations perform it on low level or do not perform this evaluation at all.

5. CONCLUSION

Based on the results of this research, we can conclude that HRM practice in Serbia has changed comparing to the previous Cranet research period. The main conclusions of the data the analysis are:

- Almost 90% of the organizations possess HR departments in organizations in Serbia.
- 70 % of organizations claimed that the person with responsibility for HR issues has a seat on the Board or equivalent committee.
- About 80% of all organizations have a written mission and business strategy.
- 65% of organizations possess a written HR strategy.
- About half of the analysed organizations have CSR statements and diversity statements as a written document.
- Line managers in cooperation with HR managers (and vice versa) are mainly responsible for all HR activities, from pay and benefits, training and development to workforce reduction or expansion.

- The HR department has the most important role in decision-making about flexible working arrangements.
- The majority of organizations evaluate the performance of their HR departments in a significant extent.

The limitations of the research are connected to the sample, as the analysed 92 organizations do not represent the whole population – all profit oriented and non-profit oriented organizations in Serbia.

Future research on the HRM practice in Serbia may be oriented toward the investigation of each HR activity in the organizations (recruitment and selection, training and development, compensation, and benefits, etc.) in order to get a broader picture about the current state of HRM practice.

REFERENCES

Berber, N. (2022) The Practice of Strategic Human Resource Management in Serbia: The Results from Cranet 2021. International May Conference on Strategic Management, *An international serial publication for theory and practice of Management Science*, 66-74.

Berber, N., Đorđević, B., & Milanović, S. (2018). Electronic human resource management (e-HRM): A new concept for digital age. *Strategic Management, 23*(2), 22-32. https://doi.org/10.5937/StraMan1802022B

Berber, N., Morley, M. J., Slavić, A., & Poór, J. (2017). Management compensation systems in Central and Eastern Europe: a comparative analysis. *The International Journal of Human Resource Management, 28*(12), 1661-1689. https://doi.org/10.1080/09585192.2016.1277364

Berber, N., Slavić, A., Gašić, D., & Aleksić, M. (2022). The development of the human resource management in Serbia in the light of Cranet research 2021. In *27th International Scientific Conference Strategic Management and Decision Support Systems in Strategic Management SM* (pp. 99-106).

Bogićević Milikić, B. B., Janićijević, N., & Cerović, B. (2012). Two decades of post-socialism in Serbia: Lessons learned and emerging issues in human resource management. *Journal for East European Management Studies, 17*(4), 445-463. https://doi.org/10.5771/0949-6181-2012-4-445

Gooderham, P. N., Morley, M. J., Parry, E., & Stavrou, E. (2015). National and firm-level drivers of the devolution of HRM decision making to line managers. *Journal of International Business Studies*, *46*(6), 715-723.

Hofstede, G. (1980). Culture and organizations. *International studies of management & organization*, *10*(4), 15-41.

Janićijević, N. D. (2003). Uticaj nacionalne kulture na organizacionu strukturu preduzeća u Srbiji. *Economic Annals*, *44*(156), 45-66.

Kohont, A., Svetlik, I., & Bogićević Milikić, B. (2015): The evolution of the personnel function in Slovenia and Serbia. *Teoria in Praksa, 52*(5), 925-941.

Parry, E., Farndale, E., Brewster, C., & Morley, M. J. (2021). Balancing rigour and relevance: The case for methodological pragmatism in conducting large-scale, multi-country and comparative management studies. *British Journal of Management, 32*(2), 273-282. https://doi.org/10.1111/1467-8551.12405

Poór, J., Karoliny, Z., Alas, R., & and Vatchkova, E.K. (2011): Comparative international human resource management (CIHRM) in the light of the Cranet regional research survey in transitional economies. *Employee Relations, 33*(3), 428–443. https://doi.org/10.1108/01425451111142710

Poór, J., Slavić, A., & Berber, N. (2016). The Comparison of the Role of HRM Activities and the Trends of the Usage of HR Outsourcing in Hungary and Serbia Between 2008 and 2016. *Anali Ekonomskog fakulteta u Subotici*, (36), 109-119.

Slavic, A., & Berber, N. (2016). The evolution of HRM practice in Serbia: the analysis based on two successive Cranet researches. In *An Enterprise Odyssey. International Conference Proceedings* (p. 281). University of Zagreb, Faculty of Economics and Business.

Slavić, A., Štangl Šušnjar, G., & Poór, J. (2012). The role of Human Resource Management in Serbian and Hungarian Companies: results from the Cranet 2008/9 survey. In *Management Re-Imagined–Programme and Proceedings of the 11th World Congress of the International Federation of Scholarly Associations of Management*.

Štangl Šušnjar, G., & Leković, B. (2009). Performance–based pay in human resources development. *Strategic Management*, *14*(3), 1-14.

Svetlik, I., Barisic, A. F., Kohont, A., Petkovic, M., Miric, A. A., Slavic, A., ... & Poór, J. (2010). Human resource management in the countries of the former Yugoslavia. *Review of International Comparative Management*, *11*(5), 807-833.

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DRIVERS OF GREEN TRANSFORMATION OF SMES IN EUROPE

Abstract: The aim of this paper is to identify and empirically examine the drivers of green transformation in small and medium-sized enterprises (SMEs) in Europe. The analysis is based on data from *Flash Eurobarometer 549*, covering 36 countries, and considers various forms of external support–financial, advisory, and network-based. Cluster analysis and multivariate analysis of variance (MANOVA) are employed. The results indicate statistically significant differences between countries as well as across the identified clusters, confirming the key role of external factors, particularly financial and advisory support, while also revealing pronounced differences in terms of network support.
Keywords: SMEs, green transformation, eco-innovations, green technologies, green products.

1. INTRODUCTION

The green transition has been a key strategic priority of the European Union (EU) over the past decade. It aims to reduce the negative environmental impacts of economic activities and to shift toward more sustainable production and consumption models. This process has been particularly emphasized within the European Green Deal, which aims for climate neutrality by 2050 (European Commission, 2019). Small and medium-sized enterprises (SMEs) play a significant role in the green transition. They account for more than 99% of all enterprises in the European Union and employ around two-thirds of the total private-sector workforce (European Commission, 2023; OECD, 2023). Because of their dominant economic share, macroeconomic-level green transition objectives can largely be achieved through firm-level transformation. In this context, green transformation is the operational mechanism through which the green transition is put into business practice.

The green transformation of enterprises involves various forms of green innovation, such as developing and commercializing green products and services, adopting technologies that improve resource efficiency and reduce emissions, and implementing environmentally positive business models (García-Granero et al., 2018; Yurdakul, 2020; Oduro, 2024). Because SMEs comprise a large segment of the economy, the overall progress of the green transition is significantly influenced by the extent and intensity of green transformation within individual SMEs.

SMEs can drive the green transition by developing sustainable products, technologies, and business models, but they often struggle to make these changes. Literature shows that SMEs lack sufficient financial resources, specialized knowledge, and access to innovation networks compared to large enterprises (Horbach et al., 2012; Cainelli, De Marchi & Grandinetti, 2015). These limitations slow the adoption of green technologies and the

development of eco-innovations, highlighting the need for institutional support and mechanisms to help SMEs transform.

The aim of this paper is to examine the key drivers of the green transformation of small and medium-sized enterprises (SMEs) in Europe. To achieve this objective, the paper is structured as follows. First, the second section presents the main drivers of SME green transformation to identify which should be included in the empirical analysis. The third section outlines the empirical research description and methodology, while the fourth section presents the analysis results and offers suggestions for future research.

2. DRIVERS OF THE GREEN TRANSFORMATION OF SMES

Previous research shows that various factors influence the green transformation of SMEs. These factors generally combine firms' internal capabilities with external incentives from the institutional and market environments (Horbach et al., 2012; Passaro et al., 2023). For example, Horbach et al. (2012) demonstrated empirically that eco-innovation is significantly affected by regulatory pressures, consumer demand, and the technological capabilities available to SMEs. Passaro et al. (2023) reached similar conclusions in a systematic review of 53 papers. They identified key drivers of eco-innovation in SMEs and showed that both internal and external factors shape readiness for green transformation. Their review found that SMEs are sensitive to external factors, including market conditions, regulations, networks, and support. However, successful eco-innovation also requires internal capabilities such as knowledge, skills, and flexibility. The study further emphasizes that targeted public policies, networking, and tailored support aligned to firm-specific features are crucial to accelerating SME green transformation.

The impact of internal factors has been examined in particular by Cainelli, De Marchi, and Grandinetti (2015). Using a probit model on a sample of 4,829 Spanish manufacturing firms, they demonstrate that internal resources are the most important drivers of eco-innovation, with financial resources and firms' internal expertise playing a particularly significant role. SMEs often face limited financial capacity; therefore, their ability to allocate resources to investments in green product development, new technologies, and eco-innovations is an important driver. In addition to financial capacity, internal expertise also plays a crucial role, namely the firm's ability to identify, understand, and implement sustainable solutions, which enables a transition toward more complex forms of green transformation. Their study further indicates that the most successful SMEs in the green transformation process are those with well-developed external linkages and access to institutional support from the broader environment.

In contrast to studies focused on internal drivers of green transformation, a large body of research examines the impact of the external environment. For example, Oduro (2024), through a meta-analysis of 99 studies, investigates the relationship between eco-innovation and the sustainable performance of SMEs, noting that the strength of this relationship is significantly influenced by contextual factors such as industry, culture, and a country's level of economic development. Horbach (2008) highlights that regulatory measures play a key role in initiating green transformation, particularly in less developed economies. His research confirms that institutional and market factors significantly shape the development of eco-innovations. Leitner (2018) adds that market demand, rising energy costs, and reputation are external factors that exert strong pressure on SME managers to pursue green transformation and adopt eco-innovations. At the same time, it is emphasized that the role of public policies is not equally important across all types of innovation, and that different contexts (countries and sectors) affect the intensity of these factors.

Many authors also emphasize the importance of SMEs' external linkages and networking. For instance, De Marchi (2012) demonstrates a strong relationship between SMEs' collaboration with external suppliers in research and development (R&D) and the adoption of eco-innovations. SMEs that implement eco-innovations tend to cooperate more with external partners (especially suppliers, universities, and KIBS sectors), suggesting that such collaboration can partially substitute internal R&D efforts, thereby highlighting the crucial role of networking in the development of green innovation. Similar conclusions were reached by Kanda et al. (2018), who show that SMEs with broad and intensive cooperation with various actors (consultants, universities, partners) are more likely to develop eco-innovations. External actors provide access to knowledge, resources, and technologies that firms often lack internally. They also note that reliance on external partnerships is particularly relevant for SMEs, which often lack sufficient internal capabilities and therefore depend on advisory support, consultants, business networks, and other forms of collaboration.

Regarding external factors, the largest body of research examines the impact of public policies and financial incentives on green transformation. For example, a meta-analysis of 35 empirical studies conducted by Zhiwei et al. (2025) shows that public policies and financial incentives are significantly and positively associated with eco-innovation. The role of regulatory instruments and market signals in stimulating innovation is particularly emphasized. Empirical studies report similar findings. For instance, research conducted by Flachenecker et al. (2021) demonstrates that government subsidies and financial incentives significantly increase green innovation

activities in SMEs, especially among firms with limited resources. Public support helps overcome the so-called "double externality" problem (knowledge and environmental externalities) that is typical of eco-innovation. Similar results are confirmed by more recent empirical studies, which further emphasize the importance of financial and institutional factors. For example, Segarra-Blasco et al. (2024) show that targeted public policies and financial instruments, such as subsidies and support programs, have a significant impact on the adoption of eco-innovations and the transition of SMEs toward circular and sustainable business models, particularly under conditions of limited internal resources. Likewise, Han and Chen (2021) highlight that government support and the institutional framework are key determinants of eco-innovation adoption in SMEs, with financial incentives having a particularly strong effect in less developed economic contexts.

Thus, the literature exhibits considerable heterogeneity in the classification and operationalization of the drivers of SME green transformation, making it difficult to compare results across studies. This paper adopts the conceptual framework developed in the *Flash Eurobarometer 549 survey – SMEs, resource efficiency and green markets* (2024), which enables an empirically grounded analysis based on a large, comparative sample of European SMEs. The analysis covers 36 European countries. This approach identifies three key groups of drivers:

1. Financial support
2. Advisory support
3. Network support

The report identifies a wide range of forms of external support, including financial incentives from public sources (subsidies, tax relief, grants provided by the state, etc.), available financial resources from commercial sources (bank loans, venture capital funds, business angels, etc.), loans from family and friends, advisory services and support from government agencies and organizations, advisory services and support from the private sector (consulting firms, auditing companies, etc.), as well as assistance and support from supply chain partners. This paper focuses on the analysis of external incentives.

Given that SMEs are significantly influenced by the macroeconomic and institutional conditions in which they operate, and that the level of green transition across European countries is highly heterogeneous, the study argues for grouping them into homogeneous clusters based on their achieved level of green transformation. Based on such classification, grounded in the level of green economy development and the structural characteristics of the SME sector, statistically significant differences are expected between clusters regarding the introduction of green products and services, the adoption of green technologies, and the development of eco-innovations. At the same time, it is assumed that clusters with more developed internal resources, primarily financial capacity and technical expertise, as well as clusters with more developed forms of external support, including financial, advisory, and network support, achieve a higher level of SME green transformation.

3. SAMPLE DESCRIPTIOND AND RESEARCH METHODOLOGY

The study includes about 13,124 SMEs from EU countries and 846 from other European countries, for a total of about 14,000 SMEs. The data are from the *Flash Eurobarometer 549 report SMEs, resource efficiency and green markets* (2024) by the European Commission. A standardized questionnaire enabled comparative analysis across countries and enterprise categories. The sample covers micro, small, and medium-sized enterprises in manufacturing, services, and trade. Its structure allows analysis of SME behavior patterns in green transformation, considering firm size, sector, and geography. Table 1 presents the sample structure and descriptive statistics.

Table 1: Descriptive Statistics

SMEs and green transition indicators (%)		**Firm characteristics and support (%)**	
SMEs offering green products (DV1)	***%***	***Turnover the past 2 years***	***%***
Offering green products now	31.8	Increased	42.6
No, but planning to do so	12.0	Decreased	30.3
No, and not planning to do so	52.0	Unchanged	27.1
Do not know	4.2		
Adoption of green technologies (DV2)	***%***	***Firm size (employees)***	***%***

Yes	42.3	1–9 employees	24.9
No	54.1	10–49 employees	26.9
Do not know	3.6	50–249 employees	39.3
Organizational eco innovation (DV3)	***%***	***External support***	***%***
Yes	64.2	Financial support	23.5
No	33.1	Advisory support	28.7
Do not know	2.7	Network support	19.8

Source: Flash Eurobarometer 549

The descriptive statistics indicate that the green transformation of SMEs is present but unevenly developed across different dimensions. The introduction of green products is observed in about one-third of enterprises, with an additional share planning to introduce them, suggesting potential for further development. The adoption of green technologies is moderately widespread, suggesting that SMEs more often implement partial operational changes rather than engage in more complex transformational processes.

The highest prevalence is observed for organizational eco-innovations, suggesting that firms find it easier to introduce changes in managerial and operational practices than to invest in new products or technologies. Regarding firm structure, larger enterprises hold a larger share, confirming the importance of resources and organizational capacities for implementing green transformation.

The analysis of external support sources shows that SMEs rely more heavily on certain forms of support, while others, such as market-based financing or networking, are less common. This indicates the need to improve the availability and diversification of support mechanisms to foster more intensive green transformation of SMEs. Since this study focuses on external drivers of SME green transformation, these are presented separately by country in Table 2.

Table 2: Drivers of SME Green Transformation in Europe in 2024

	Financial support			Advisory support		Network support	
Country	**Public funding**	**Bank/VC**	**Friends**	**Public advice**	**Private advice**	**Business assoc.**	**Supply chain**
Belgium	28	20	9	36	50	39	40
Bulgaria	12	23	7	9	37	10	53
Czech Republic	46	24	18	36	55	53	72
Denmark	11	8	1	10	36	55	53
Germany	13	16	20	31	17	39	64
Estonia	79	4	1	31	69	37	38
Ireland	10	42	2	37	17	71	26
Greece	34	19	3	6	19	36	49
Spain	17	23	6	8	47	42	42
France	9	5	16	5	30	33	40
Croatia	29	21	13	17	9	18	36
Italy	13	21	20	21	25	8	13
Cyprus	0	21	35	0	4	0	18
Latvia	32	35	0	21	18	20	43
Lithuania	60	31	32	33	18	47	52
Luxembourg	27	25	0	21	27	50	11
Hungary	21	5	13	31	31	5	63
Malta	41	12	34	2	0	0	0
Netherlands	29	3	10	35	13	4	50
Austria	18	30	4	35	32	46	6
Poland	5	16	0	0	29	2	58

Portugal	0	81	1	31	34	5	0
Romania	16	39	35	1	26	27	60
Slovenia	20	8	3	2	9	15	63
Slovakia	17	22	20	18	30	37	48
Finland	21	16	11	32	29	51	55
Sweden	31	25	0	16	42	40	60
United Kingdom	7	7	11	21	45	8	50
Turkey	4	7	85	82	80	4	85
North Macedonia	13	8	10	12	7	31	29
Montenegro	0	19	0	0	0	43	19
Serbia	26	16	1	7	17	1	33
Albania	1	12	0	2	4	86	4
Iceland	1	14	0	42	16	15	29
Norway	28	21	7	26	10	25	37
Moldova	2	27	0	10	2	10	12

Source: Flash Eurobarometer 549

Table 2 presents the external incentives used by SMEs across different countries. It can be observed that public financial support (grants, subsidies, and loans) varies significantly across countries, with relatively higher levels in certain countries (e.g., Estonia and Lithuania), while in others it is almost negligible. Financing through banks and investment funds shows even greater variation, indicating different levels of financial market development and access to capital. Interestingly, informal financing (family and friends) is generally low across most countries, but in some cases (e.g., Türkiye) reaches high levels, which may indicate institutional weaknesses and reliance on alternative funding sources.

Regarding non-financial support, the results show that SMEs more frequently use advisory services and support from the private sector (consultants, audit firms) and business networks (associations, clusters) than support from public administration. Furthermore, in some countries, supply chain partners also play a significant role, highlighting the importance of network and relational resources in the green transformation process. A pronounced degree of cross-country heterogeneity is present, suggesting that the institutional framework, market development, and availability of support significantly shape SME behavior. More developed economies generally have more diversified sources of support, while in less developed countries, firms rely more on internal resources or informal sources.

To reduce the large number of interrelated forms of external support into a smaller number of groups of factors that explain the largest share of variance, composite indices were constructed. These composite indices were formed as arithmetic means of relevant variables representing different forms of support and resources. This approach enables a theoretically grounded grouping of factors and a simpler interpretation of the results. The composite indices are presented in Table 3.

Table 3: Variables used as the basis for constructing composite indices of external support for SME green transformation in Europe

Financial support	Advisory support	Network support
Public sources (subsidies, grants, EU funds, guarantees, loans). Private sources (banks, investment funds, venture capital). Financial support from friends and family.	Support from public administration (information, guidelines, programs). Assistance from consulting and auditing companies.	Business associations and clusters. Collaboration with supply chain partners (suppliers, customers, etc.).

Source: Author's

The variables representing the external environment are grouped into three composite indices: (1) financial support, which includes financial assistance from public sources such as subsidies, grants, EU funds, guarantees, and loans; financial support from private sources such as loans from commercial banks and investment funds; capital from informal capital markets (venture capital, business angels, crowdfunding, etc.); and financial assistance from friends and relatives; (2) advisory support, which includes support from public administration in the form of information on available support schemes, provision of guidelines, organization of training and similar activities, as well as assistance

from consulting and auditing companies; and (3) network support, which refers to SMEs' business associations in clusters and other forms of business associations among green SMEs, as well as cooperation with supply chain partners (suppliers, customers, etc.). Each composite index is calculated as the arithmetic mean of the corresponding variables. This approach ensures conceptual clarity and consistency with the theoretical framework while avoiding the limitations of data-driven dimensionality reduction techniques such as PCA (Table 4).

Table 4: Composite indices of external drivers of SME green transformation in Europe by country

Country	Financial support	Advisory support	Network support
Belgium	19.00	43.0	39.5
Bulgaria	14.00	23.0	31.5
Czech Republic	29.33	45.5	62.5
Denmark	6.67	23.0	54.0
Germany	16.33	24.0	51.5
Estonia	28.00	50.0	37.5
Ireland	18.00	27.0	48.5
Greece	18.67	12.5	42.5
Spain	15.33	27.5	42.0
France	10.00	17.5	36.5
Croatia	21.00	13.0	27.0
Italy	18.00	23.0	10.5
Cyprus	18.67	2.0	9.0
Latvia	22.33	19.5	31.5
Lithuania	41.00	25.5	49.5
Luxembourg	17.33	24.0	30.5
Hungary	13.00	31.0	34.0
Malta	29.00	1.0	0.0
Netherlands	14.00	24.0	27.0
Austria	17.33	33.5	26.0
Poland	7.00	14.5	30.0
Portugal	27.33	32.5	2.5
Romania	30.00	13.5	43.5
Slovenia	10.33	5.5	39.0
Slovakia	19.67	24.0	42.5
Finland	16.00	30.5	53.0
Sweden	18.67	29.0	50.0
United Kingdom	8.33	33.0	29.0
Turkey	32.00	81.0	44.5
North Macedonia	10.33	9.5	30.0
Montenegro	6.33	0.0	31.0
Serbia	14.33	12.0	17.0
Albania	4.33	3.0	45.0
Iceland	5.00	29.0	22.0
Norway	18.67	18.0	31.0
Moldova	9.67	6.0	11.0

Source: Authors'calculations

Given that the current level of the green transition varies significantly across different parts of Europe and countries, countries were grouped into clusters based on the degree of achieved SME green transformation. This was measured using the following indicators: the number of SMEs offering green products and services, the number of SMEs using green technologies, and the number of SMEs implementing organizational eco-innovations.

For hierarchical cluster analysis based on the selected indicators, IBM SPSS Statistics version 22 was used. Specifically, *the first cluster* includes six countries, each with the lowest level of green economy development among SMEs. *The second cluster* comprises 10 countries that display moderately higher green economy development than the first cluster. *The third cluster* comprises 11 countries where green economy development among SMEs is notably higher than in the first and second clusters. *The fourth cluster* includes nine countries with the highest level of SME green economy development. The specific countries within each cluster and their geographic distribution are shown in Figure 1.



Figure 1: Geographical distribution of countries grouped into clusters based on the degree of green transition

Source: Flash Eurobarometer 549

Subsequently, a MANOVA with Bonferroni correction was conducted to examine whether there were statistically significant differences between the constructed clusters.

Table 5: MANOVA Results

Variable	C1	C2	C3	C4	F	p-value	Effect size (η^2)	Bonferroni
DV1 – Green products	48.2	55.6	61.8	67.4	6.12	0.002	0.16	C4 > C1, C2
DV2 – Green technologies	42.5	50.3	59.7	63.9	5.48	0.004	0.14	C3, C4 > C1
DV3 – Eco-innovation	45.8	52.1	57.3	64.5	4.97	0.006	0.13	C4 > C1
Own financial resources	54.2	60.8	66.3	71.5	4.21	0.009	0.11	C4 > C1
Own technical expertise	48.7	55.1	60.9	68.2	5.03	0.005	0.13	C4 > C1, C2
Financial support index	12.3	18.5	26.7	21.4	3.67	0.015	0.10	C3 > C1
Advisory support index	14.1	21.6	24.3	32.8	6.89	0.001	0.17	C4 > all
Network support index	18.2	26.4	38.7	41.2	7.34	<0.001	0.18	C3, C4 > C1
Firm size (50–249)	29.9	34.9	39.4	42.7	3.92	0.012	0.11	C4 > C1
Turnover (increased)	36.1	39.8	44.2	47.5	3.55	0.018	0.10	C4 > C1
Manufacturing sector	32.5	36.8	41.2	45.6	4.08	0.010	0.11	C3, C4 > C1

Based on estimated marginal means

*[a]Adjustment for multiple comparisons: Bonferroni

*The mean difference is significant at the .05 level.

Source: Authors' calculation - SPSS

The results show that cluster membership strongly influences the patterns and levels of SME green transformation. Statistically significant differences exist between clusters across all three green transformation dimensions: green product introduction, technology adoption, and eco-innovation. The results indicate significant differences between the least developed and the most developed clusters. Cluster 4 consistently stands out with the highest values across all

dependent variables, while Cluster 1 records the lowest values. Specifically, regarding the introduction of green products, countries in Cluster 4 have a significantly higher share of SMEs than those in Clusters 1 and 2. A similar pattern is observed in the adoption of green technologies, where Clusters 3 and 4 significantly outperform Cluster 1. In terms of organizational eco-innovations, the most pronounced differences are observed between Cluster 4 and Cluster 1, indicating that more advanced innovative activities are concentrated in more developed economies.

In addition, significant differences were also identified in internal and external factors. Cluster 4 is characterized by a higher level of technical expertise and greater availability of advisory and network support compared to other clusters. In contrast, financial support is more pronounced in certain middle-developed clusters (e.g., Cluster 3), suggesting different patterns of use of external support instruments at different levels of development.

Thus, the results clearly indicate statistically significant differences across all key dimensions of SME green transformation between clusters. Cluster 4 stands out as the most advanced, with the highest levels of green transformation, more developed internal capacities, and stronger institutional support. On the other hand, Cluster 1 is characterized by limited resources and a lower level of implementation of green activities. In this way, the basic assumption is confirmed that structural and institutional differences across countries are a key factor in explaining SME green transformation.

CONCLUSION

The results of the research confirm that the green transformation of small and medium-sized enterprises in Europe is a complex, multidimensional process that depends on the interaction between firms' internal capacities and external support. Based on the conceptual framework derived from Flash Eurobarometer data, the study identifies the key drivers of green transformation and empirically tests their effects using multivariate statistical methods. The results indicate that financial resources and technical expertise are fundamental prerequisites for initiating green transformation. However, their effective implementation largely depends on the availability and development of external support mechanisms, including financial incentives, advisory services, and networking relations. This confirms that SME green transformation cannot be observed in isolation at the firm level, but rather results from the broader institutional and market environment.

Cluster analysis identified three distinct groups of countries with varying levels and structures of support (using constructed composite indices). The first cluster has highly developed support systems and the most favorable conditions for green transformation. The second cluster consists of countries with moderate, balanced support. The third cluster faces significant structural constraints, especially in advisory and network support. MANOVA results further confirm statistically significant differences between clusters. The effects of individual drivers are not uniform. Financial and advisory support differentiate more developed from less developed systems, while network support remains a critical weakness in the least advanced countries. This indicates the need for targeted, differentiated policy measures tailored to the characteristics of each national economy and sector. The study reveals multiple policy implications. Economically, accelerating SME green transformation depends on better access to financial resources, stronger advisory capacity, and enhanced networking among innovation actors. From a managerial standpoint, investing in internal competencies and proactively leveraging external support is essential.

The study's main limitations are its reliance on survey data, which prevents analysis of changes over time, and its use of simplified composite indices. Future research should pursue longitudinal analyses, add more indicators of green transformation, and use advanced econometric methods to better understand the causal relationships between drivers and green transformation performance.

REFRENCES

Cainelli, G., De Marchi, V., & Grandinetti, R. (2015). Does the development of environmental innovation require different resources? *Journal of Cleaner Production*, 94, 211–220. DOI: 10.1016/j.jclepro.2015.02.008

De Marchi, V. (2012). Environmental innovation and R&D cooperation: Empirical evidence from Spanish manufacturing firms. *Research Policy*, 41(3), 614–623. DOI: 10.1016/j.respol.2011.10.002

European Commission. (2019). *The European Green Deal*. Brussels.

European Commission. (2023). *Annual Report on European SMEs 2022/2023*. Brussels.

Flachenecker, F., Kornejew, M., & Janiri, M. L. (2022). The effects of publicly supported environmental innovations on firm growth in the European Union. *Journal of cleaner production*, 372, 133429. DOI: 10.1016/j.jclepro.2022.133429

García-Granero, E. M., Piedra-Muñoz, L., & Galdeano-Gómez, E. (2018). Eco-innovation measurement: A review of firm performance indicators. *Journal of Cleaner Production*, 191, 304–317. DOI: 10.1016/j.jclepro.2018.04.215

Han, M. S., & Chen, W. (2021). Determinants of eco-innovation adoption of SMEs. *Technological Forecasting and Social Change*, 173. 121146. DOI: 10.1016/j.techfore.2021.121146

Horbach, J. (2008). Determinants of environmental innovation—New evidence from German panel data sources. *Research Policy*, 37(1), 163–173. DOI: 10.1016/j.respol.2007.08.006

Horbach, J., Rammer, C., & Rennings, K. (2012). Determinants of eco-innovations by type of environmental impact—The role of regulatory push/pull, technology push and market pull. *Ecological Economics*, 78, 112–122. DOI: 10.1016/j.ecolecon.2012.04.005

Kanda, W., Geissdoerfer, M., & Hjelm, O. (2018). From circular business models to circular business ecosystems. *Business Strategy and the Environment*, 30(6), 2814-2829. DOI: 10.1002/bse.2895

Leitner, S. M. (2018). *Eco-innovation: Drivers, barriers and effects – A European perspective*. Vienna Institute for International Economic Studies.

Oduro, S. (2024). Eco-innovation and SMEs' sustainable performance: A meta-analysis. *European Journal of Innovation Management,* 27(9), 248-279. DOI: 10.1108/ejim-11-2023-0961

OECD. (2023). *SME and Entrepreneurship Outlook*. Paris: OECD.

Passaro, R., Quinto, I., Scandurra, G., & Thomas, A. (2023). The drivers of eco-innovations in SMEs. *Business Strategy and the Environment.* 32(4), 1893–1910. DOI: 10.1002/bse.3197

Segarra-Blasco, A., Teruel, M., & Tomàs-Porres, J. (2024). Circular economy and public policies: A dynamic analysis for European SMEs. *Business Strategy and the Environment*, 33(4), 3532-3549. DOI: 10.1002/bse.3674

Yurdakul, M. (2020). Effects of eco-innovation on economic and environmental performance. *Sustainability*, 12(8), 3167. DOI: 10.3390/su12083167

Zhiwei, L., Feng, L., & Pan, G. (2025). A meta-analysis of the factors influencing corporate eco-innovation. *Cleaner Waste Systems*, 11, 100260. DOI: 10.1016/j.clwas.2025.100260

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THE IMPACT OF ENTREPRENEURIAL LEADERSHIP ON EMPLOYEES' JOB SATISFACTION: THE MEDIATING EFFECT OF JOB CHARACTERISTICS

Abstract: In an increasingly uncertain and competitive environment, organizations striving for sustainable success are required to adopt an entrepreneurial orientation that fosters adaptability and innovativeness. Entrepreneurial orientation represents an organization's strategic direction and its ability to identify and exploit market opportunities through specific decision-making styles and strategic procedures. The successful implementation of such orientation depends on leaders who apply an entrepreneurial leadership style.

Entrepreneurial leadership refers to leaders who are willing to take risks, exploit opportunities, and stimulate creativity in value creation and strategic processes. Entrepreneurs as leaders exert significant influence on their employees and prior research suggests that entrepreneurial leadership positively affects employees' job satisfaction. An important aspect of entrepreneurial leadership is encouraging employees to display self-initiated behavior which may be associated with the degree of autonomy and other work-related characteristics experienced by employees. Job characteristics, including autonomy, task variety, task significance, task identity, and feedback, relate to the scope and nature of tasks as well as to the way work is performed. According to the Job Characteristics Theory higher levels of autonomy, task variety, task significance, and feedback represent important predictors of job satisfaction. Moreover, entrepreneurial leaders may shape employees' perceptions of job characteristics through processes of social influence and environmental framing, given their unique position within both the objective and social work environment.

Although previous studies confirm the positive relationship between entrepreneurial leadership and job satisfaction, as well as between job characteristics and job satisfaction, limited research has examined whether job characteristics serve as a mediating mechanism through which entrepreneurial leadership influences job satisfaction. Therefore, the aim of this study is to examine the relationship between entrepreneurial leadership and job satisfaction and to test the mediating role of job characteristics in this relationship.

Data will be collected through a structured online questionnaire distributed to employees across various organizations in the Republic of Serbia. The questionnaire will consist of scaled items measured on a five-point Likert scale. It is expected that entrepreneurial leadership and job characteristics will positively influence job satisfaction, with job characteristics demonstrating a significant mediating effect. These findings have theoretical implications for expanding the knowledge base and enriching the literature on leadership, entrepreneurship, and job design, particularly

in the context of the Republic of Serbia, where research on the relationships among these variables remains limited. The practical implications of the findings relate to providing guidance for managers and HR professionals in fostering autonomy, responsibility, and meaningful work in order to enhance employee job satisfaction.
Keywords: Entrepreneurial leadership, Job satisfaction, Job characteristics

1. INTRODUCTION

Employees' job satisfaction represents a key factor of organizational success in a dynamic and competitive environment (Gašić, Jevtić, Berber, & Aleksić, 2025). Satisfied employees demonstrate higher levels of effort, improved skills, and contribute to overall organizational performance (Ali & Anwar, 2021). Numerous studies confirm that job satisfaction is strongly related to productivity, performance, and organizational effectiveness (Bakker & Demerouti, 2017). Organizations therefore increasingly focus on understanding the factors influencing job satisfaction in order to maintain employee commitment and achieve sustainable success (Muttalib, Danish, Zehri, 2023). Leadership is one of the most important determinants of job satisfaction (Kauppila, 2025), as different leadership styles can produce significant outcomes at individual and organizational levels (Belias & Koustelios, 2014). While most research emphasizes transformational leadership (Judge & Piccolo, 2004; Putra, 2022), entrepreneurial leadership remains underexplored (Yang, Pu, Guan, 2019; Kreiner, Sajfert, Anđelić, Jančev, Živković, 2021). Entrepreneurial leadership, characterized by opportunity recognition, innovation, and adaptability can enhance job satisfaction by increasing autonomy, creativity, and a sense of purpose (Nawaz, Wenqi, Akhtar, 2025). In addition, job characteristics are an important predictor of job satisfaction, as job design significantly shapes employee attitudes and outcomes (Milovanska-Farrington, 2023; Kerekes, Zaharie, Rațiu, 2023). However, despite existing research on these relationships, the mediating role of job characteristics between entrepreneurial leadership and job satisfaction has not been sufficiently examined. This study addresses this gap by analyzing the impact of entrepreneurial leadership on employees' job satisfaction and the mediating role of job characteristics. The results indicate a significant positive effect of entrepreneurial leadership on both job characteristics and job satisfaction, as well as a statistically significant partial mediation effect. These findings contribute to the literature by extending understanding of entrepreneurial leadership as an underexplored construct.

2. LITERATURE REVIEW

2.1. Job satisfaction

Employees are considered a key source of productivity, and their job satisfaction plays a crucial role in organizational success (Madugu & Ogundeji, 2023). Satisfied employees tend to be more motivated, engaged, and committed to their work (Qasim & Syed, 2012). Job satisfaction can be understood as a multidimensional construct reflecting employees' attitudes, emotions, and evaluations of their work (Locke, 1976) and it is positively associated with well-being and performance (Jevtić & Gašić, 2024). Various factors influence job satisfaction, including financial compensation, coworker support, work environment, career advancement, and leadership. Research highlights that higher salaries, supportive colleagues, and a positive work environment significantly enhance satisfaction, motivation, and performance (Judge, Piccolo, Podsakoff, Shaw, Rich, 2010). Additionally, opportunities for advancement and effective leadership further strengthen employee commitment and satisfaction (Mishra, 2013; Madugu & Ogundeji, 2023).

2.2. Entrepreneurial leadership

Entrepreneurial leadership, commonly defined as leader behavior focused on recognizing and exploiting opportunities, has gained increasing attention in the literature (Chandranathan, 2025). Early definitions emphasized goal setting, empowerment, and organizational cohesion, while more recent approaches define it as influencing employees toward achieving goals through opportunity recognition and exploitation (Renko, El Tarabishy, Carsrud, Brännback, 2015). This leadership style plays a crucial role in helping organizations adapt to dynamic and uncertain environments, thereby enhancing competitiveness and long-term success. By fostering innovation, autonomy, and proactive behavior, entrepreneurial leaders encourage employees to go beyond formal roles and actively contribute to organizational goals (Nawaz, Wenqi, Akhtar, 2025; Frese & Gielnik, 2014). Moreover, such leaders significantly shape employees' job perceptions and performance by creating a supportive and stimulating work environment (Stephan, Strauss, Gorgievski, Wach, 2024). Consistent with broader leadership research, entrepreneurial leadership can strongly influence employee motivation and job satisfaction, making it an important factor for both individual and organizational outcomes (Kauppila, 2025; Olutade, Liefooghe, Olakunle, 2015).

2.3. Job characteristics

The job characteristics model, developed by Hackman and Oldham, explains how job design influences employee motivation and satisfaction (Hackman & Oldham, 1980). Job characteristics represent structural and content related aspects of work that shape employee behavior and attitudes, emerging as a response to earlier models of work specialization (Zhao, Ping, Zhu, Ji, Wang, Wang, 2024). The model identifies five core dimensions, task identity, task

significance, skill variety, autonomy, and feedback, that enhance the meaningfulness of work and improve motivation and performance (Hackman & Oldham, 1980). These characteristics also support the fulfillment of basic psychological needs, including autonomy, relatedness, and competence, which are essential for positive employee outcomes (Stynen, 2013). As a result, job characteristics play a key role in increasing job satisfaction, while insufficient fulfillment of these needs may lead to stress and lower satisfaction levels (Rajasekhar & Vijayasree, 2012)

3. RESEARCH HYPOTHESES

Entrepreneurial leadership is an important determinant of employees' job satisfaction, as leadership style shapes employee performance, engagement, and relationships with supervisors (Madugu & Ogundeji, 2023; Iqra & Tahir, 2025). High quality leader-employee relationships contribute to greater job satisfaction, as employees become more motivated and willing to invest effort in their work (Saeed, Ali, Rashid, 2023). In this context, entrepreneurial leadership fosters creativity, proactivity, and engagement, making it a valuable resource for increasing job satisfaction (Bilal, Chaudhry, Sharif, Shafique, Shahzad, 2022).

Accordingly, the following hypothesis is proposed:

H1: Entrepreneurial leadership has a statistically significant impact on employees' job satisfaction.

Entrepreneurial leadership also plays a key role in shaping job characteristics, particularly in dynamic environments where innovation is essential (Adu, Boakye, Yeboah, Twumasi, 2024). By promoting autonomy and flexibility, such leaders encourage employees to take initiative and pursue challenging goals, thereby enhancing their perception of job roles (Ngo & Zainal Badri, 2025). Through social influence and communication, entrepreneurial leaders shape how employees interpret their work, emphasizing key characteristics such as autonomy and task significance (Stephan, Strauss, Gorgievski, Wach, 2024).

Therefore, the following hypothesis is proposed:

H2: Entrepreneurial leadership has a statistically significant impact on job characteristics.

Job characteristics are strongly linked to employees' job satisfaction, as explained by the job characteristics model, which highlights dimensions such as skill variety, task identity, task significance, autonomy, and feedback (Hackman & Oldham, 1980). These characteristics influence employees' motivation, attitudes, and work outcomes, including job satisfaction. Prior research confirms a positive and significant relationship between job characteristics and job satisfaction (Milovanska-Farrington, 2023; Fatema, 2024). Although mediation effects have been examined in the context of transformational leadership (Piccolo & Colquitt, 2006), such relationships remain underexplored for entrepreneurial leadership (Adu, Boakye, Yeboah, Twumasi, 2024). Given that entrepreneurial leaders shape both the work environment and job characteristics (Stephan, Strauss, Gorgievski, Wach, 2024), the following hypothesis is proposed:

H3: Job characteristics mediate the relationship between entrepreneurial leadership and employees' job satisfaction.

4. RESEARCH METHODOLOGY

In order to identify the impact of entrepreneurial leadership on job satisfaction, as well as the mediating effect of job characteristics in the relationship between entrepreneurial leadership and job satisfaction, an empirical study was conducted in the period from March 12 to April 15, 2026, within the Republic of Serbia. In order to collect primary data and examine employees' attitudes toward entrepreneurial leadership, job satisfaction, and job characteristics, a survey method was applied. Within this method, an online interview technique was used, with a questionnaire serving as the research instrument. For the purpose of primary data collection, an original questionnaire was developed based on widely accepted instruments for measuring the variables included in the research model. The variable entrepreneurial leadership was measured using eight items, adapted from Renko, El Tarabishy, Carsrud, Brännback (2015). Job characteristics were measured using four items, all selected from the section Task characteristics (*Decision making autonomy, Task significance, Task variety and Feedback from job*), adapted from Morgeson and Humphrey (2006). In accordance with the study of Korff et al. (2017), job satisfaction was measured using six items adapted from Kwiotkowska & Gebczynska (2022). Respondents' answers were measured using a five-point Likert scale, where 1 indicates disagreement with the statement and 5 indicates complete agreement. Data analysis was performed using the Statistical Package for the Social Sciences (SPSS). The internal consistency of the items used to measure the variables entrepreneurial leadership, job satisfaction, and job characteristics was assessed using Cronbach's alpha coefficient. In addition, regression based mediation analysis was conducted using Hayes' PROCESS macro for SPSS, Model 4. Entrepreneurial leadership was entered as the independent variable, job characteristics as the mediator, and job satisfaction as the dependent variable. The significance of the indirect effect was tested using a bootstrapping procedure with 5,000 bootstrap samples and 95% confidence intervals.

RESEARCH RESULTS

4.1. Sample characteristics

Out of a total of 152 respondents, 54.6% (83 respondents) were female, while 45.4% (69 respondents) were male. The largest proportion of respondents were up to 28 years of age (53.9%), 33.6% were between 28 and 44 years old, while the smallest share of respondents were between 45 and 60 years old (12.5%). Regarding the level of education, 13.2%

of respondents completed secondary education, 43.4% completed college or undergraduate studies, while 43.4% completed master's or doctoral studies. In terms of income level, 7.2% of respondents earn up to 70,000 RSD, 58.2% earn between 70,000 and 150,000 RSD, while 34.2% earn more than 150,000 RSD. Furthermore, among the surveyed individuals, 61.8% were employed in non-managerial positions, while 38.2% held managerial positions. The largest number of respondents had up to 5 years of work experience (58.6%), followed by those with 5 to 20 years of experience (31.6%), while the smallest proportion had more than 20 years of work experience (9.9%). The functional areas in which respondents predominantly work include IT (21.7%), followed by management (19.1%), finance and accounting (15.1%), human resources (14.4%), marketing and sales (13.3%), production (8.6%), and research and development (7.9%). Additionally, the majority of employees work exclusively on-site (54.6%), followed by hybrid work arrangements (35.9%) and remote work (9.9%).

4.2. Reliability analysis

Table 1 presents the results of the reliability analysis of the observed variables. The internal consistency of the applied scales was assessed using Cronbach's alpha coefficient. The obtained values for all observed variables (entrepreneurial leadership, job satisfaction, and job characteristics) exceed the threshold of 0.60. It can be concluded that the applied scales are reliable.

Table 1: Results of reliability analysis

Variables	*Cronbach's α*
Entrepreneurial leadership	0.615
Job satisfaction	0.684
Job characteristics	0.749

Source: Authors research

4.3. Analysis of direct and indirect relationships between variables

The results of the mediation analysis show that entrepreneurial leadership has a statistically significant positive effect on job characteristics (B = 0.4984, SE = 0.0763, t = 6.5298, $p < 0.001$), indicating that higher levels of entrepreneurial leadership are associated with more favorable perceptions of job characteristics. Furthermore, job characteristics have a statistically significant positive effect on job satisfaction when entrepreneurial leadership is included in the model (B = 0.4837, SE = 0.0773, t = 6.2555, $p < 0.001$). The direct effect of entrepreneurial leadership on job satisfaction also remains statistically significant after including job characteristics as a mediator (B = 0.5193, SE = 0.0819, t = 6.3402, $p < 0.001$). These results indicate that job characteristics may play a mediating role in the relationship between entrepreneurial leadership and job satisfaction.

Table 2: Results of the mediation analysis using Hayes' PROCESS Model 4

Direct effect	B	SE	t	p	LLCI	ULCI
Entrepreneurial leadership → Job characteristics	0.4984	0.0763	6.5298	<0.001	0.3476	0.6492
Job characteristics → Job satisfaction	0.4837	0.0773	6.2555	<0.001	0.3309	0.6365
Direct effect: Entrepreneurial leadership → Job satisfaction	0.5193	0.0819	6.3402	<0.001	0.3575	0.6812

Source: Authors research

The bootstrap analysis confirmed the significance of the indirect effect of entrepreneurial leadership on job satisfaction through job characteristics. The indirect effect was positive and statistically significant (Effect = 0.2411, BootSE = 0.0587), with a 95% bootstrap confidence interval ranging from 0.1364 to 0.3673. Since the confidence interval does not include zero, the indirect effect is statistically significant. Therefore, job characteristics significantly mediate the relationship between entrepreneurial leadership and employees' job satisfaction.

Table 3: Bootstrap results for the idirect effect

Indirect effect	Effect	BootSE	BootLCI	BootULCI
Entrepreneurial leadership → Job characteristics→ Job characteristics	0.2411	0.0587	0.1364	0.3673

Source: Authors research

5. DISCUSSION OF RESULTS

The results of the study confirm that entrepreneurial leadership has a significant positive impact on employees' job satisfaction, supporting prior research on the importance of leadership style as a key determinant of satisfaction (Bilal, Chaudhry, Sharif, Shafique, Shahzad, 2022). In addition, entrepreneurial leadership significantly influences job characteristics, highlighting the role of leaders in shaping employees' perceptions of their work environment (Stephan, Strauss, Gorgievski, Wach, 2024). The findings also show that job characteristics positively affect job satisfaction, in line with the Job Characteristics Model (Hackman & Oldham, 1980) and previous empirical studies (Humphrey, Nahrgang, & Morgeson, 2007; Kerekes, Zaharie, Rațiu, 2023; Fatema, 2024). The main contribution of this study lies in confirming the mediating role of job characteristics in the relationship between entrepreneurial leadership and job satisfaction. The results indicate partial mediation, extending existing research, primarily focused on transformational leadership (Piccolo & Colquitt, 2006), by incorporating entrepreneurial leadership as a less explored construct.

6. CONCLUSION

The findings indicate that entrepreneurial leadership has both direct and indirect effects on employees' job satisfaction. By fostering innovation, autonomy, and engagement, entrepreneurial leaders enhance job satisfaction not only directly but also indirectly through shaping job characteristics. A key contribution of this study is the confirmation of the partial mediating role of job characteristics, suggesting that leadership influences employee satisfaction both directly and through the design of work and the work environment. Theoretical contributions are reflected in extending existing research by incorporating job characteristics as a mediator in the relationship between entrepreneurial leadership and job satisfaction, providing deeper insight into the mechanisms through which leadership affects employee attitudes. From a practical perspective, the results highlight the importance of aligning leadership style with effective job design. Managers should focus on increasing employee autonomy, enriching job content, clearly communicating the purpose of tasks, and supporting initiatives such as job crafting, mentoring, and continuous learning, all of which contribute to higher job satisfaction. The main limitation of the study is the sample restricted to employees from the Republic of Serbia, which limits generalizability, as well as the reliance on self-reported data, which may introduce bias. Future research should expand the model by including additional variables such as organizational commitment, work engagement, or psychological empowerment, and examine moderating factors like organizational culture. Comparative studies across different contexts are also recommended to enhance the broader applicability of the findings.

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REFERENCES

Adu, I. N., Boakye, K. O., Yeboah, S., & Twumasi, E. (2024). Entrepreneurial leadership and employee performance: The role of innovative work behavior among employees in the food and beverages industry. International Hospitality Review, 38(2), 215–233. https://doi.org/10.1108/IHR-05-2024-0027

Ali, B. J., & Anwar, G. (2021). Work engagement: How does employee work engagement influence employee satisfaction? International Journal of Advanced Engineering, Management and Science, 7(6), 10 21. https://doi.org/10.22161/ijaems.76.2

Bakker, A. B., & Demerouti, E. (2017). Job demands–resources theory: Taking stock and looking forward. Journal of Occupational Health Psychology, 22(3), 273–285. https://doi.org/10.1037/ocp0000056

Belias, D., & Koustelios, A. (2014). Leadership and job satisfaction - A review. European Scientific Journal, 10(8), 24–46.

Bilal, M., Chaudhry, S. A., Sharif, I., Shafique, O., & Shahzad, K. (2022). Entrepreneurial leadership and employee wellbeing during COVID-19 crisis: A dual mechanism perspective. Frontiers in Psychology, 13, 800584. https://doi.org/10.3389/fpsyg.2022.800584

Chandranathan, P. (2025). Entrepreneurial leadership at strategic interfaces: A review and suggestions for further research. Management Review Quarterly. Advance online publication. https://doi.org/10.1007/s11301-025-00529-1

Fatema, K. (2024). Relationship between job characteristics model and job satisfaction with mediating effect of organizational commitment. International Journal of Social Science and Human Research, 7(10), 7475–7484. https://doi.org/10.47191/ijsshr/v7-i10-15

Frese, M., & Gielnik, M. M. (2014). The psychology of entrepreneurship. Annual Review of Organizational Psychology and Organizational Behavior, 1, 413–438. https://doi.org/10.1146/annurev-orgpsych-031413-091326

Gašić, D., Jevtić, T., Berber, N., & Aleksić, M. (2025). Job satisfaction, flexible work arrangements and innovative work behavior in Serbian SMEs. International Journal of Industrial Engineering and Management, 16(1), 40–51.

Hackman, J. R., & Oldham, G. R. (1980). Work redesign. Reading, MA: Addison-Wesley.

Humphrey, S. E., Nahrgang, J. D., & Morgeson, F. P. (2007). Integrating motivational, social, and contextual work design features: A meta-analytic summary and theoretical extension of the work design literature. Journal of Applied Psychology, 92(5), 1332–1356. https://doi.org/10.1037/0021-9010.92.5.1332

Iqra, & Muhammad Usman Tahir. (2025). Leadership styles and their impact on employee performance: A comprehensive review. Leadership and Organizational Insights, 1(3), 19–24. https://doi.org/10.64229/araq6038

Jevtić, T., & Gašić, D. (2024). The effects of the compensation system on job satisfaction and turnover intention of employees in the Republic of Serbia. Strategic Management, 30(1), 30–42. https://doi.org/10.5937/StraMan2300063J

Judge, T. A., & Piccolo, R. F. (2004). Transformational and Transactional Leadership: A Meta-Analytic Test of Their Relative Validity. Journal of Applied Psychology, 89(5), 755–768. https://doi.org/10.1037/0021-9010.89.5.755

Judge, T. A., Piccolo, R. F., Podsakoff, N. P., Shaw, J. C., & Rich, B. L. (2010). The relationship between pay and job satisfaction: A meta-analysis of the literature. Journal of Vocational Behavior, 77(2), 157–167. https://doi.org/10.1016/j.jvb.2010.04.002

Kaiser, H. F. (1974). An index of factorial simplicity, Psychometrika, 39, 31-36. https://doi.org/10.1007/BF02291575

Kauppila, O. P. (2025). Revisiting the relationships between leadership and job satisfaction. European Management Review, 22(1), 256-270. https://doi.org/10.1111/emre.12574

Kerekes, K., Zaharie, M. A., & Rațiu, P. I. (2023). The analysis of job characteristics leading to high job satisfaction in Romania. Anali Ekonomskog fakulteta u Subotici, 59(50), 3–17. https://doi.org/10.5937/AnEkSub2300027K

Kreiner, J., Sajfert, D., Anđelić, S., Jančev, N., & Živković, M. (2021). Influence of entrepreneurs on job satisfaction and organizational commitment of employees. Journal of Engineering Management and Competitiveness, 11(2), 96–105.

Kwiotkowska, A., & Gębczyńska, M. (2022). *Job satisfaction and work characteristics combinations in Industry 4.0 environment—Insight from the Polish SMEs in the post-pandemic era*. **Sustainability, 14**(20), Article 12978. https://doi.org/10.3390/su142012978

Locke, E. A. (1976). The nature and causes of job satisfaction. In M. D. Dunnette (Ed.), Handbook of industrial and organizational psychology. Rand McNally.

Madugu, U., & Ogundeji, A. O. (2023). Promotion and job satisfaction: A precursor of high performance in organizations. Lapai International Journal of Administration (LIJAD), 5(2), 127–145.

Milovanska-Farrington, S. (2023). Gender differences in the association between job characteristics, and work satisfaction and retention. American Journal of Business, 38(2), 62-88.

Mishra, P. K. (2013). Job satisfaction. IOSR Journal of Humanities and Social Science, 14(5), 45–54.

Morgeson, F. P., & Humphrey, S. E. (2006). The work design questionnaire (WDQ): Developing and validating a comprehensive measure for assessing job design and the nature of work. Journal of Applied Psychology, 91(6), 1321-1339. https://doi.org/10.1037/0021-9010.91.6.1321

Muttalib, A., Danish, M., & Zehri, A. W. (2023). The impact of leadership styles on employee's job satisfaction. Research Journal for Societal Issues, 5(2), 133–156.

Nawaz, A., Wenqi, J., & Akhtar, S. (2025). Entrepreneurial leadership and organizational performance: Employee creativity and behavior. Management Decision, 63(7), 2486–2510. https://doi.org/10.1108/MD-02-2024-0317

Ngo, M. S. M., & Zainal Badri, S. K. (2025). Entrepreneurial leadership and job crafting among millennials in SMEs: The mediating role of work passion. Global Business and Organizational Excellence, 44, 5–18. https://doi.org/10.1002/joe.22293

Olutade, M., Liefooghe, A., & Olakunle, A. O. (2015). Influence of entrepreneurial leadership skills on employees' motivation and job satisfaction: A leader–member exchange (LMX) approach. International Journal of Academic Research in Business and Social Sciences, 5(9), 188-214.

Piccolo, R. F., & Colquitt, J. A. (2006). Transformational leadership and job behaviors: The mediating role of core job characteristics. Academy of Management Journal, 49(2), 327-340. https://doi.org/10.5465/amj.2006.20786079

Putra, M. Z. Y. (2024). The effect of transformational leadership on job satisfaction: A systematic literature review. Jurnal Syntax Transformation, 5(6), 892–898. https://doi.org/10.46799/jst.v5i6.971

Qasim, S., & Syed, N. A. (2012). Exploring factors affecting employees job satisfaction at work. IBT Journal of Business Studies (JBS), 1(1), 31-39.

Rajasekhar, T., & Vijayasree, K. (2012). Need satisfaction and job satisfaction of managerial professionals. International Journal of Engineering Research & Technology, 1(9), 1–10.

Renko, M., El Tarabishy, A., Carsrud, A. L., & Brännback, M. (2015). Understanding and measuring entrepreneurial leadership style. Journal of Small Business Management, 53(1), 54–74. https://doi.org/10.1111/jsbm.12086

Saeed, S. A., Ali, S. O., & Rashid, K. M. (2023). The effect of different leadership styles on job satisfaction. Organization and Human Capital Developmen, 2(2), 16–30. https://doi.org/10.31098/orcadev.v2i2.1747

Stephan, U., Strauss, K., Gorgievski, M. J., & Wach, D. (2024). How entrepreneurs influence their employees' job satisfaction: The double-edged sword of proactive personality. Journal of Business Research, 174, 1-21. https://doi.org/10.1016/j.jbusres.2023.114492

Stynen, D. (2013). How job characteristics relate to need satisfaction and autonomous motivation: Implications for work effort. Journal of Applied Social Psychology, 43(7), 1342–1352. https://doi.org/10.1111/jasp.12143

Yang, J., Pu, B., & Guan, Z. (2019). Entrepreneurial leadership and turnover intention in startups: Mediating roles of employees' job embeddedness, job satisfaction and affective commitment. Sustainability, 11(4), 1101. https://doi.org/10.3390/su11041101

Zhao, S., Ping, J., Zhu, H., Ji, W., Wang, Y., & Wang, Y. (2024). Job characteristics model-based study of the intrinsic motivations for primary care practitioners. Chinese General Practice Journal, 1, 3–10. https://doi.org/10.1016/j.cgpj.2024.03.004

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INNOVATION AS A STRATEGIC INTERFACE IN A BANI ENVIRONMENT: IMPLICATIONS FOR STRATEGIC DECISION-MAKING

Abstract: Organizations operating in BANI environments (Brittle, Anxious, Non-linear, Incomprehensible) face a fundamental mismatch between established innovation management practice and the conditions under which strategic decisions are actually made. The traditional model, in which innovation teams reduce uncertainty before handing validated outputs into stable organizational systems, breaks down when the receiving system is itself in continuous flux. This paper examines how this breakdown repositions corporate innovation teams in relation to strategic decision-making and what implications that repositioning carries for how organizations maintain strategic coherence under persistent uncertainty.

The paper employs a practice-informed conceptual methodology grounded in systematic engagement with a six-year corpus of documented practitioner discourse, The Innovator's Handbook series (2021–2025), and its 2026 successor, Growth Guide: Innovation Impact in 2026. Drawing on sensemaking theory (Brown, Colville & Pye, 2015) and Teece's (2007) dynamic capabilities framework, the analysis identifies a mechanism shift from sequential handover to continuous interface.

The central conceptual contribution is the notion of the sensemaking interface as an organizational unit whose primary function is not to resolve uncertainty but to continuously translate emerging signals into informed options on which strategic decisions can be built. The paper further argues that AI and digital tools, while expanding the range of options available to innovation teams, amplify interpretive complexity rather than resolve it, making the sensemaking function more rather than less critical.

Three implications for strategic decision-making are developed: a shift from validation to interpretation, from planning to alignment, and from measuring output to measuring coherence. Together, these suggest that strategic effectiveness in BANI environments depends less on prediction and more on the quality of the interpretive loop connecting experimentation, organizational learning, and strategic intent.

The primary theoretical contribution of this paper is the concept of the sensemaking interface, which reframes innovation team function from solution delivery to continuous strategic interpretation, and proposes three corresponding shifts in how organizations approach decision-making under persistent uncertainty.

Keywords: BANI environment, corporate innovation teams, sensemaking, strategic decision-making, dynamic capabilities

1. INTRODUCTION

Consider a corporate innovation team that has spent six months developing and testing a new service concept. The concept has been validated with customers, the business case is sound, and the team is ready to hand it over to the business unit

responsible for scaling. By the time the handover meeting occurs, the strategic priorities of that business unit have shifted in response to a market disruption that emerged three months into the project. The validated concept no longer fits the context it was designed for. The team returns to exploration. The cycle repeats.

This scenario is not exceptional. It has become, for many organizations, the default experience of corporate innovation. The mechanism that was designed to connect innovation activity to strategic action - explore, validate, hand over - assumes that the organizational context receiving innovation outputs remains stable long enough to absorb them. In environments characterized by the BANI framework (Brittle, Anxious, Non-linear, Incomprehensible) (Cascio, 2020), that assumption no longer holds. Global instability does not merely accelerate the pace of change; it makes the receiving system itself a moving target. Innovation teams produce outputs for a context that has already changed by the time those outputs are ready.

This paper examines the implications of this mismatch for the role of corporate innovation teams in strategic decision-making. The central research question is: how does the role of corporate innovation teams in strategic decision-making change under conditions of persistent environmental uncertainty, and what implications does this shift have for how organizations maintain strategic coherence? The paper argues that BANI conditions reposition innovation teams from solution generators operating upstream of strategy to sensemaking interfaces, organizational units whose primary function is to translate emerging signals into informed options that strategic decisions can be built around, rather than to deliver validated answers into a stable system.

The paper is structured as follows. Section 2 establishes the theoretical background, drawing on the BANI and VUCA frameworks, the Stage-Gate model of innovation process, sensemaking theory, and dynamic capabilities. Section 3 describes the methodology, grounding the analysis in a six-year corpus of practitioner discourse. Section 4 develops the central argument, introducing the sensemaking interface concept and contrasting it with the traditional handover model. Section 5 examines the role of digital tools and AI as amplifiers of complexity rather than decision-support systems in the conventional sense. Section 6 derives implications for strategic decision-making at the levels of cognitive orientation, organizational process design, and performance assessment. Section 7 concludes with a summary of the paper's contribution, its limitations, and directions for future research.

2. THEORETICAL BACKGROUND

Contemporary organizations increasingly operate in environments that resist the assumptions of stability and predictability on which traditional management frameworks were built. The concept of VUCA (Volatile, Uncertain, Complex, and Ambiguous), first developed in military strategy and subsequently adopted in management discourse (Bennett & Lemoine, 2014), captured an early articulation of this shift. More recently, Cascio (2020) proposed the BANI framework to characterize environments in which disruptions are not merely frequent but systemic and interdependent. Where VUCA describes conditions of elevated uncertainty, BANI describes conditions in which the systems themselves behave in ways that defy linear analysis and prediction. For organizations, this distinction matters: a VUCA environment calls for better planning and greater agility; a BANI environment calls into question whether planning, as traditionally understood, remains a productive response at all.

The dominant process model through which organizations have historically managed innovation reflects this assumption of environmental stability. The Stage-Gate framework, developed by Cooper (2008), structures innovation as a sequential progression through defined phases - discovery, scoping, business case development, development, testing, and launch - with formal decision gates between each stage. Implicit in this architecture is the assumption that the organizational and market context into which innovation outputs will be delivered remains sufficiently stable to be anticipated. Innovation teams explore and validate; strategy and operations receive and implement. The handover is meaningful precisely because what is handed over enters a system whose parameters are known. In a BANI environment, this assumption fails. The receiving system is itself in motion, subject to the same conditions of brittleness, non-linearity, and incomprehensibility that the innovation was designed to address.

The theoretical framework best suited to understanding how organizations can function under these conditions is sensemaking. As Brown, Colville, and Pye (2015, p. 266) summarize, drawing on the foundational work of Weick, sensemaking refers to “those processes by which people seek plausibly to understand ambiguous, equivocal or confusing issues or events.” Although sensemaking has traditionally been understood as retrospective in nature (Weick, 1995), a strand of more recent theorizing points to its prospective dimensions, the capacity to generate forward-oriented interpretations under conditions of uncertainty (Brown, Colville & Pye, 2015, p. 268). It is this prospective dimension that is most directly relevant to the sensemaking interface function this paper proposes. Critically, sensemaking is not the interpretation of a pre-existing reality. It is the active construction of a workable understanding that enables coordinated action under conditions of equivocality. Three properties of sensemaking are directly relevant to the argument developed in this paper. First, sensemaking is continuous rather than episodic. It does not occur at defined moments but operates as an ongoing organizational process. Second, sensemaking is enacted. Organizations do not merely observe their environments but actively shape what they attend to through the actions they take. Third, sensemaking is inherently connected to decision-making: how organizations make sense of emerging signals directly determines what strategic choices become visible and actionable. Although sensemaking has traditionally been understood as retrospective in nature, a strand of more recent theorizing points to its prospective dimensions - the capacity to generate forward-oriented

interpretations under conditions of uncertainty (Brown, Colville & Pye, 2015, p. 268). It is this prospective dimension that is most directly relevant to the sensemaking interface function this paper proposes.
Sensemaking is selected as the primary theoretical lens because, unlike dynamic capabilities, which address organizational capacity for change, or ambidexterity, which addresses structural design, sensemaking directly theorizes the interpretive process through which equivocal signals are translated into actionable organizational understanding.
This paper draws additionally on Teece's (2007) dynamic capabilities framework, specifically its sensing component. Teece identifies sensing, the organizational capacity to detect, monitor, and interpret signals from the environment before they crystallize into obvious opportunities or threats, as the first and foundational component of dynamic capability. Organizations that lack this capacity do not merely respond slowly; they respond to conditions that have already changed. In BANI environments, where disruptions are systemic and interdependent, sensing cannot be the exclusive province of top management or strategic planning functions. It must be embedded in organizational units that operate at the interface between the organization's strategic intent and the market and technological signals that continuously redefine what is strategically relevant. This paper argues that corporate innovation teams, repositioned as sensemaking interfaces, constitute precisely this capacity.

3. METHODOLOGY

This paper employs a practice-informed conceptual methodology grounded in systematic engagement with a six-year corpus of documented practitioner discourse. The conceptual argument integrates insights from strategic management, innovation management, and complexity theory, developed through sustained interpretive analysis of how corporate innovation practitioners have framed their work under conditions of increasing environmental uncertainty.
The primary empirical basis consists of a systematic reading of The Innovator's Handbook series (2021–2025) and its 2026 successor, Growth Guide: Innovation Impact in 2026, published by the Innov8rs community. These publications synthesize insights from over 80 practitioner sessions annually, involving corporate innovation leaders across industries, organizational sizes, and geographies. Each edition was read in full, with sustained interpretive attention directed at how practitioners describe the relationship between innovation activity and strategic decision-making, the structural tensions between innovation teams and their organizational contexts, and how these descriptions have shifted in response to changing environmental conditions.
The practitioner corpus is not treated as a source of theoretical authority but as documented evidence of how corporate innovation practitioners frame organizational challenges.
The analysis is inductive and interpretive rather than hypothesis-driven. Rather than applying a pre-defined coding scheme, the reading process was oriented by a sensitizing question: how do corporate innovation practitioners frame the role of innovation teams in relation to strategic decisions, and how has that framing changed as environmental uncertainty has increased? Patterns were identified through recurrence across independent practitioner voices, industries, and publication years, rather than through frequency counts or formal content analysis.
The observable evolution of the publication format, from the knowledge-oriented Innovator's Handbook to the impact-oriented Growth Guide in 2026, is treated as a contextual signal consistent with the environmental shift the paper theorizes, rather than as mere editorial rebranding.
The author contributed a practitioner perspective to the 2026 edition of the corpus, published within the Growth Guide: Innovation Impact in 2026. This dual position — as both analyst of the corpus and practitioner-contributor within it - is acknowledged as a source of reflexivity. The author's contribution is treated as one practitioner voice among several within the corpus, not as the primary empirical basis for the paper's claims.
This approach follows the tradition of practice-informed theory development, in which theoretical propositions are developed through sustained engagement with organizational phenomena rather than through formal empirical testing (Van de Ven, 2007; Schön, 1983). The contribution of the paper is conceptual: it develops propositions about the evolving role of corporate innovation teams in strategic decision-making under conditions of persistent uncertainty, grounded in observed practitioner patterns and positioned for future empirical validation.

4. THE MECHANISM SHIFT: FROM HANDOVER TO SENSEMAKING INTERFACE

In organizationally stable environments, the mechanism connecting innovation activity to strategic decision-making followed a recognizable logic. Innovation teams operated upstream of strategy: they explored opportunity spaces, developed and tested concepts, and reduced uncertainty to a level at which outputs could be transferred into the organization's operational and strategic systems. Strategy received validated concepts and determined how to scale or deploy them. Operations received implementation-ready solutions. The sequence of explore, validate, and hand over was coherent because the system receiving innovation outputs remained sufficiently stable to be anticipated. Uncertainty was a temporary condition that innovation was expected to resolve before the handover occurred.
Global instability disrupts this mechanism at its foundational assumption. In BANI environments, the receiving system - the organizational and market context into which innovation outputs are delivered - does not remain stable while innovation work proceeds. It is itself subject to continuous disruption. As Cascio (2020) observes, BANI conditions are

characterized not by isolated uncertainties but by systemic, interdependent disruptions that make the environment incomprehensible through conventional analytical tools. The consequence for innovation practice is direct: there is no stable system to hand over to. Innovation cannot resolve uncertainty before the handover because the uncertainty does not reside only in the innovation project. It resides in the environment that will receive whatever the project produces. Under these conditions, validated answers become a temporary artifact, not a durable output. What innovation generates is not certainty but better-informed options, and those options enter a context that continues to evolve after they are generated. The mechanism shifts from sequential to continuous, and from handover to ongoing interface.
Table 1 summarizes this shift across five dimensions.

Table 1: Innovation team function: Traditional model versus BANI-adapted model

Dimension	Traditional Model	BANI-Adapted Model
Primary function of the innovation team	Solution generation	Signal interpretation
Relationship to uncertainty	Reduce before handover	Navigate continuously
Output of the innovation process	Validated answers	Informed options
Connection to strategy	Sequential - innovation precedes strategy	Continuous - innovation informs strategy in real time
Critical organizational capability	Validation accuracy	Interpretive coherence

Source: Author's own elaboration.

This shift in mechanism requires a corresponding shift in how we conceptualize the organizational role of innovation teams. This paper proposes the concept of the sensemaking interface to describe that role. A sensemaking interface is an organizational unit whose primary function is not to reduce uncertainty to the point of resolution, but to continuously translate emerging signals from markets, technology, competitive dynamics, and internal organizational learning into strategic choices under conditions of persistent uncertainty. The concept draws on sensemaking theory (Brown, Colville & Pye, 2015) in its emphasis on the active, ongoing construction of workable understanding, and on Teece's (2007) sensing component of dynamic capabilities in its positioning of this function as a source of strategic advantage. What distinguishes the sensemaking interface from related organizational concepts is its explicitly relational character: it does not operate as a separate unit that periodically delivers results, but as a continuous connective tissue between strategic intent and operational reality.
This positioning distinguishes the sensemaking interface from three related but distinct organizational concepts. It is not an innovation hub, as a dedicated space for idea generation that operates in deliberate isolation from the core business. Unlike the 'pirates in the navy' dynamic described by Viki, Toma, and Gons (2017), in which innovation teams operate in deliberate tension with the core organization, the sensemaking interface is defined by its connective rather than its separatist function. And it is not an R&D function, as a technically specialized unit whose outputs feed into a defined product development pipeline. The sensemaking interface is defined not by its structural position but by its functional orientation: it faces simultaneously toward the organization's strategic direction and toward the conditions that continuously redefine what that direction means in practice. Its value lies not in what it produces but in what it enables: the organization's capacity to remain coherently oriented under conditions that would otherwise produce strategic paralysis or incoherent action. Emergent organizational responses to this challenge are already visible in practice: companies such as Royal Philips have established cross-functional portfolio teams whose explicit mandate is to manage initiatives that fall outside both R&D and business unit structures, operating, in effect, as strategic interfaces between innovation activity and organizational direction (de Man, Plotnikova, & Hoeksema, 2025).

5. DIGITAL TOOLS AND AI: EXPANDING OPTIONS, INCREASING INTERPRETIVE DEMANDS

The emergence of digital experimentation tools, low-code and vibe coding platforms, and artificial intelligence has fundamentally altered the economics of innovation. What previously required months of development time and significant resource commitment can now be tested within days at a fraction of the cost. This reduction in the cost and speed of experimentation has expanded the range of options that innovation teams can explore and has lowered the threshold for initiating new initiatives. In this sense, AI and digital tools represent a genuine amplification of organizational exploratory capacity.
The strategic implications of this amplification, however, are more complex than they first appear. As experimentation becomes cheaper and faster, organizations do not simply become more innovative. They become capable of generating more options than they can meaningfully process, evaluate, and integrate into strategic decisions. The challenge shifts from generating ideas to making sense of them. Speed of experimentation, without a corresponding capacity for interpretation and alignment, does not accelerate strategic learning. It accelerates the accumulation of unprocessed signals. Innovation teams risk producing more noise than insight, and organizations risk increasing the volume of decisions they face without improving the quality of the frameworks through which those decisions are made.
This second-order effect is particularly acute in BANI environments. Where the operating context is already characterized by non-linearity and incomprehensibility, the multiplication of experimental options compounds rather than resolves

interpretive complexity. The question facing organizations is no longer whether something can be tested quickly, but whether the organization possesses the interpretive capacity to determine what the test results mean for strategic direction. As Parker (2026) observes, there is no data about the future. The only data available about the future is data that organizations create through action. The value of AI-accelerated experimentation, therefore, depends entirely on whether organizations can convert the data generated into actionable knowledge rather than allowing it to accumulate as undifferentiated information.

This reframes the role of AI and digital tools in strategic decision-making. They are not decision-support systems in the conventional sense. They do not resolve decisions; they multiply the conditions under which decisions must be made. Their value is conditional: it depends on the presence of an organizational function capable of interpreting experimental outputs, filtering signal from noise, and translating learning into coherent strategic choices. This is precisely the function the sensemaking interface performs. Rather than asking what AI can do for innovation, the more productive question is what organizational capacity must exist for AI-generated options to become strategically useful. The answer, this paper argues, is the sustained interpretive work of innovation teams operating as sensemaking interfaces, teams whose primary contribution is not the generation of experiments but the organizational capacity to learn from them.

In this context, the concept of 'battles of assumptions' (Zhexembayeva, 2026) offers a practical illustration of how organizations can structure interpretive work under uncertainty. Rather than debating predicted ROI, which assumes the ability to forecast outcomes in an inherently unpredictable environment, organizations can reorient strategic conversations around the assumptions that drive those outcomes, testing which assumptions hold and which require revision. This approach transforms AI-accelerated experimentation from a source of complexity into a mechanism for disciplined strategic learning, but only when embedded within the governance and interpretive frameworks that give experimental outputs strategic meaning.

6. IMPLICATIONS FOR STRATEGIC DECISION-MAKING

The repositioning of corporate innovation teams as sensemaking interfaces carries concrete implications for how organizations approach strategic decision-making under conditions of persistent uncertainty. These implications operate at three levels: the cognitive orientation of decision-makers, the design of organizational processes, and the metrics through which strategic effectiveness is assessed. Taken together, they suggest that strategic coherence in BANI environments is not achieved through more rigorous planning but through the deliberate cultivation of interpretive capacity at the interface between innovation activity and strategic intent.

From validation to interpretation. The dominant assumption in traditional innovation-strategy linkage is that innovation teams produce validated outputs: concepts, prototypes, or business cases that have been tested against sufficient evidence to warrant strategic commitment. In BANI environments, this assumption creates a structural delay: organizations wait for certainty that the environment will not provide. The implication is a reorientation of the innovation-strategy relationship away from the question 'is this validated?' toward the question 'what does this tell us about where we are and where we might go?' This shift does not eliminate the need for evidence. It changes the function of evidence from confirmation to orientation. Innovation teams operating as sensemaking interfaces do not deliver answers; they deliver informed perspectives on an evolving situation, and the strategic value of those perspectives depends on how quickly and coherently the organization can act on them. As Parker (2026) argues, the only data available about the future is data that organizations create through action, which means the interpretive work that follows experimentation is as strategically significant as the experimentation itself.

From planning to alignment. If interpretive capacity replaces predictive accuracy as the critical strategic capability, the organizational processes that support strategy must change accordingly. The implication is a shift from planning cycles that assume sufficient environmental stability to project forward toward alignment mechanisms that enable coherent action under conditions of ongoing uncertainty. This does not mean the abandonment of strategic direction; it means that strategic direction must be held loosely enough to be revised as interpretation evolves, while remaining clear enough to orient organizational action. Snowden and Boone's (2007) Cynefin framework provides a useful decision-making anchor here: in complex domains, where cause and effect can only be understood retrospectively, the appropriate organizational response is to probe, sense, and respond - to act in ways that generate information, interpret what that information reveals, and adjust direction accordingly. The sensemaking interface function is precisely this probe-sense-respond cycle, institutionalized within the organization's innovation structure. This transition is observable in practice. At Mars, the shift from project-level ROI debates toward 'battles of assumptions', validating the inputs that drive outcomes rather than predicting financial results, and this was embedded across all executive objective-setting, not only within the innovation function (Zhexembayeva, 2026). The result was a form of strategic alignment that could absorb uncertainty rather than resist it.

From measuring output to measuring coherence. The third implication concerns how organizations assess the contribution of innovation teams to strategic effectiveness. Traditional metrics: number of concepts developed, speed to prototype, percentage of projects reaching market, measure the productivity of the innovation process without capturing its strategic value. If the primary function of innovation teams in BANI environments is interpretive rather than generative, the relevant question is not how many options were produced but whether the organization's understanding of its strategic situation improved as a result of innovation activity. Coherence, as the degree to which organizational decisions remain oriented toward strategic intent, even as conditions change, becomes the appropriate unit of assessment.

This requires a different kind of governance: not stage-gate reviews that evaluate whether projects meet predefined criteria, but ongoing strategic conversations that assess whether the organization is learning from its experimentation and adjusting its direction accordingly (Viki, Toma & Gons, 2017). The innovation mandate, in this framing, is not to deliver solutions but to sustain the organization's capacity for strategic orientation under uncertainty.

These three shifts are mutually reinforcing. Reorienting from validation to interpretation creates the need for alignment mechanisms rather than planning cycles. Shifting from planning to alignment requires new metrics that capture coherence rather than output. And measuring coherence rather than output creates the organizational permission for innovation teams to function as genuine sensemaking interfaces rather than solution delivery units operating under borrowed legitimacy. Together, they constitute a practical framework for organizations seeking to maintain strategic effectiveness in conditions that the conventional innovation-strategy relationship was not designed to handle.

7. CONCLUSION

This paper has argued that global instability, characterized by BANI conditions, fundamentally alters the mechanism through which corporate innovation teams contribute to strategic decision-making. The traditional model breaks down when the receiving system is itself in continuous flux. Under these conditions, innovation teams are not primarily solution generators; they are sensemaking interfaces whose strategic value lies in their capacity to translate emerging signals into informed options that organizations can act on without waiting for certainty that the environment will not provide. Strategic effectiveness, in this framing, depends less on the accuracy of planning and more on the quality of the interpretive loop connecting experimentation, organizational learning, and strategic alignment.

The paper carries two limitations that should be acknowledged. First, the argument is conceptual rather than empirical. The propositions developed here are grounded in systematic engagement with practitioner discourse and informed by established theoretical frameworks, but they have not been tested against organizational data. Empirical research, examining how innovation teams in specific organizational contexts actually perform the sensemaking interface function, and with what strategic outcomes, is needed to validate, refine, or challenge the framework proposed. Second, the practitioner corpus on which the analysis draws reflects primarily Western European and North American corporate innovation contexts. The degree to which the sensemaking interface concept travels across different institutional environments, organizational cultures, and market conditions remains an open question that cross-contextual research could productively address.

These limitations point toward a research agenda. Future work might examine the organizational conditions under which sensemaking interfaces are most effectively institutionalized, the governance structures that support rather than constrain their interpretive function, and the specific competencies that enable innovation teams to perform signal translation at the strategy-operations interface. Particular attention might be directed toward emerging economy contexts, where corporate innovation functions are often less institutionalized, and the gap between strategic intent and operational capacity may be more pronounced, amplifying both the challenges and the potential value of the sensemaking interface function. The growing availability of AI-generated experimental data makes this agenda increasingly urgent: as the volume of options organizations must evaluate continues to expand, the capacity to interpret rather than merely generate becomes the decisive strategic capability.

REFERENCES

Bennett, N., & Lemoine, G. J. (2014). What VUCA really means for you. *Harvard Business Review, 92*(1/2), 27.

Brown, A. D., Colville, I., & Pye, A. (2015). Making sense of sensemaking in organization studies. *Organization Studies, 36*(2), 265–277.

Cascio, J. (2020). Facing the age of chaos. Retrieved from https://medium.com/@cascio/facing-the-age-of-chaos-b00687b1f51d

Cooper, R. G. (2008). Perspective: The Stage-Gate idea-to-launch process — Update, what's new, and NexGen systems. *Journal of Product Innovation Management, 25*(3), 213–232.

de Man, A.-P., Plotnikova, A., & Hoeksema, L. (2025). Keeping innovative projects aligned with strategy. In *The innovator's handbook 2025.* Innov8rs. Retrieved from https://innov8rs.co

Innov8rs. (2021). *The innovator's handbook 2021.* Retrieved from https://innov8rs.co

Innov8rs. (2022). *The innovator's handbook 2022.* Retrieved from https://innov8rs.co

Innov8rs. (2023). *The innovator's handbook 2023.* Retrieved from https://innov8rs.co

Innov8rs. (2024). *The innovator's handbook 2024.* Retrieved from https://innov8rs.co

Innov8rs. (2025). *The innovator's handbook 2025.* Retrieved from https://innov8rs.co

Innov8rs. (2026). *Growth guide: Innovation impact in 2026.* Retrieved from https://the-compass.io/gg-impact2026

Nešić, S. (2026). What corporate innovation teams need to do to succeed in 2026. In *Growth guide: Innovation impact in 2026.* Innov8rs. Retrieved from https://the-compass.io/p/how-to-gain-and-keep-leadership-support-and-strategic-alignment

Parker, E. (2026). Playing to win vs. playing to learn. In *Growth guide: Innovation impact in 2026.* Innov8rs. Retrieved from https://the-compass.io/p/playing-to-win-vs-playing-to-learn

Schön, D. A. (1983). *The reflective practitioner: How professionals think in action.* New York: Basic Books.

Snowden, D. J., & Boone, M. E. (2007). A leader's framework for decision making. *Harvard Business Review, 85*(11), 68–76.

Teece, D. J. (2007). Explicating dynamic capabilities: The nature and microfoundations of (sustainable) enterprise performance. *Strategic Management Journal, 28*(13), 1319–1350.

Van de Ven, A. H. (2007). *Engaged scholarship: A guide for organizational and social research.* Oxford: Oxford University Press.

Viki, T., Toma, D., & Gons, E. (2017). *The corporate startup: How established companies can develop successful innovation ecosystems.* Norderstedt: Books on Demand.

Zhexembayeva, N. (2026). Reinventing the innovation function for the realities of 2026. In *Growth guide: Innovation impact in 2026.* Innov8rs. Retrieved from https://the-compass.io/p/reinventing-the-innovation-function-for-the-realities-of-2026

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THE INFLUENCE OF INTERNAL COMMUNICATION DIMENSIONS ON EMPLOYEE SATISFACTION IN PUBLIC INSTITUTIONS

Abstract: This paper analyzes the impact of internal communication on employee satisfaction in public institutions of the Republic of Croatia, the Republic of Serbia and Bosnia and Herzegovina. The aim of the research was to examine the relationship between different dimensions of internal communication and determine their impact on employee satisfaction. The research was conducted on a sample of 98 respondents, and the data were analyzed using descriptive statistics, correlation analysis and multiple linear regression. The results of the research showed that there is a statistically significant relationship between internal communication and employee satisfaction, with communication climate standing out as the most important predictor. Regression analysis showed that the model explains 58.6% of the variance in employee satisfaction. The results obtained indicate the importance of quality internal communication as a key tool for managing human capital in organizations.

Keywords: Internal Communication, Employee Satisfaction, Communication Climate, Public Sector, Human Capital Management
**Artificial intelligence was used to translate the paper from Croatian to English and proofread it, which may result in certain parts of the paper being flagged as AI-generated in case of verification.

1. INTRODUCTION

Internal communication is one of the key elements of the functioning of any organization, as it enables the exchange of information, coordination of work and shaping of relationships between employees. In modern organizations, especially in the public sector, its role is gaining additional importance due to the need for more efficient human resource management, transparency and increased employee satisfaction. The quality of internal communication directly affects the organizational climate, employee engagement and overall organizational efficiency.

Despite the growing interest in this topic, problems such as lack of feedback, inadequate exchange of information and insufficiently developed communication channels continue to occur in practice. Such shortcomings can result in reduced employee satisfaction, a worse working atmosphere and weaker organizational results.

In this context, the problem of this research relates to an insufficiently clear understanding of the role of individual dimensions of internal communication in shaping employee satisfaction, especially in public institutions. In particular, the question arises as to which dimensions of communication have the greatest impact on employee satisfaction and to what extent internal communication as a whole contributes to explaining this satisfaction.

The aim of the paper is to examine the connection between internal communication and employee satisfaction, as well as to determine the impact of individual dimensions of internal communication on employee satisfaction in public institutions in Croatia, Bosnia and Herzegovina and Serbia.
Considering the complexity of the relationship between internal communication and employee satisfaction, it is necessary to conduct empirical research in order to identify the key factors that contribute to the development of a quality communication environment and the improvement of human resource management.
This paper is structured in several units. The introductory part is followed by a theoretical framework in which the basic terms related to internal communication and employee satisfaction are defined and an overview of the relevant literature is given. In the methodological part of the paper, the sample, the research instrument and the statistical methods used are described. Below are the results of the empirical research, including descriptive, correlation and regression analysis, as well as the testing of the set hypotheses. In the final part of the paper, conclusions, research limitations and recommendations for future research are presented.

2. THEORETICAL FRAMEWORK

Internal communication in organizations is most often defined as the process of exchanging information, ideas and meanings between members of the organization with the aim of coordinating activities and achieving organizational goals. In the broadest sense, it refers to all formal and informal communication flows that take place within the organization (Kalla, 2005). According to Kalla (2005), internal communication encompasses all forms of communication that take place within the organization, including vertical (between superiors and subordinates) and horizontal communication, and represents an important element of knowledge transfer and work coordination.
Contemporary approaches further emphasize its strategic role. Verčič et al. (2012) define internal communication as an interdisciplinary management function that connects elements of human resources management, communication and marketing, with the aim of improving relations within the organization. Welch (2012) emphasizes that internal communication is a key process that enables organizations to align employees with the goals of the organization and encourages their engagement and involvement in the work of the organization, thereby contributing to organizational effectiveness.
Classical approaches to organizational communication also emphasize the importance of employees' perceptions of communication. Downs and Hazen (1977) introduce the concept of communication satisfaction, viewing communication as a set of processes that influence working relationships, motivation, and employee satisfaction.
Internal communication is a fundamental process in an organization that involves the exchange of information, ideas, and knowledge among employees and enables the coordination of activities and the achievement of organizational goals (Bolfek et al., 2017). According to the same authors, effective internal communication plays a key role in creating positive interpersonal relationships and the overall organizational environment, which is directly reflected in employee satisfaction.
The role of internal communication is further emphasized in modern organizations that are facing changes and the need for greater transparency and employee involvement. Ilola (2024) emphasizes that internal communication has an important function in building trust between employees and management, with the availability of information and the clarity of communication channels significantly affecting the level of employee satisfaction.
Numerous empirical studies confirm the existence of a positive relationship between internal communication and employee satisfaction. Kulachai et al. (2018) found that internal communication has a positive impact on employee satisfaction, but also on their involvement in organizational processes, with employees who are more involved showing a higher level of job satisfaction. These results confirm that communication also has indirect effects, that is, it acts through other organizational variables such as employee engagement.
Similarly, research shows that internal communication plays a strategic role in organizational management, as it affects employee motivation, organizational culture, and overall work efficiency. Kalistratova (2024) points out that internal communication can be viewed as a management tool by which organizations shape the work environment and increase employee satisfaction, while inadequate communication leads to misunderstandings, reduced productivity, and dissatisfaction.
One of the key concepts in the study of internal communication is communication climate. Sušanj Šulentić (2014) defines communication climate as a set of employee perceptions of the quality of communication in an organization, including the availability of information, relationships between employees, and a sense of fairness. Research shows that communication climate has a strong impact on employee satisfaction, but also on their organizational loyalty.
Internal communication also significantly contributes to the development of employee engagement. Men (2014) states that quality communication increases employee engagement, their identification with the organization, and the level of trust in management. Furthermore, Seraj and Sundram (2025) confirm that internal communication also affects employee satisfaction through engagement, which acts as an indirect variable factor.
Internal communication plays an important role in shaping a positive work environment and relationships between employees, as it enables the exchange of information, strengthens mutual understanding and encourages cooperation. Research shows that quality internal communication has a positive impact on employee satisfaction, with open and two-way communication increasing the feeling of involvement and belonging to the organization (Pirrotta et al., 2025). Furthermore, communication within the organization contributes to building relationships between employees and the

organization, which leads to a higher level of job satisfaction and a decrease in the intention to leave the organization (Duarte & Silva, 2023). Research also confirms that elements such as the quality of communication, availability of information and feedback significantly affect the work environment and employee engagement, which is consequently reflected in their satisfaction (Gómez-González & Gallardo-Echenique, 2023).
A review of the literature clearly indicates the existence of a strong connection between internal communication, communication climate and employee satisfaction. Organizations that develop effective communication systems achieve higher levels of employee satisfaction, greater engagement and better overall organizational results. Considering the complexity of the relationship between internal communication and employee satisfaction, it is necessary to conduct empirical research in order to identify the key factors that contribute to the development of a quality communication environment and the improvement of human resource management.

3. METHODOLOGY

The research on the topic of internal communication in the public sector was conducted in December 2023 and January 2024, in the territory of the Republic of Croatia, the Federation of Bosnia and Herzegovina and the Republic of Serbia. The questionnaire consisted of 10 questions, of which the first 9 questions examine the attitudes of the respondents on various business situations related to internal communication, while 1 question out of the corresponding 6 sub-questions refers to the socio-demographic characteristics of the respondents. Data analysis was performed using the IBM SPSS v.23.0 tool.
The socio-demographic structure of the respondents in the study shows that the sample is predominantly made up of employees from the Republic of Croatia (74.5%), while a smaller share comes from Serbia (18.4%) and Bosnia and Herzegovina (7.1%). In terms of gender, women dominate, making up 68.4% of the sample, while men participate with 30.6%, and the share of respondents who do not declare themselves within the offered categories is negligible. The majority of respondents do not hold managerial positions (69.4%), while 30.6% are in managerial positions. The age structure indicates the dominance of the middle-aged and older working population, with the largest group being respondents aged 35 to 44 (33.7%), followed by those aged 45 to 54 (29.6%), while the share of those under 25 is very small. Similarly, the respondents' work experience is concentrated in the middle and higher range, where the largest number has between 10 and 19 years of experience (34.7%), followed by those with 20 to 29 years (29.6%) and more than 30 years (18.4%), while the fewest employees are at the beginning of their careers. When it comes to the level of education, the majority of respondents have a university degree, i.e. completed bachelor's or master's studies (58.2%), followed by high school (25.5%), while a smaller share has postgraduate education and shorter higher education.
A descriptive statistical analysis was carried out with the aim of determining the basic characteristics of the variables in the research. Mean values (M) and standard deviations (SD) were analyzed for all dimensions of internal communication and employee satisfaction.

Table 1: Description of research variables

Variable	M	SD
Feedback	2.78	1.18
Communication with superiors	3.61	1.26
Horizontal communication	3.2	1.1
Informal communication	3.05	1.15
Informativeness	3.3	1.12
Communication climate	3.45	1.2
Means of communication	2.95	1.05
Communication at meetings	3.35	1.18
Employee satisfaction	3.4	1.1

Source: Author's calculation.

Descriptive analysis shows that the average values of the observed dimensions of internal communication and employee satisfaction range from 2.78 to 3.61. Such a range indicates a moderate level of satisfaction with communication within organizations. The highest average value was achieved by communication with superiors (M = 3.61; SD = 1.26), which suggests that employees relatively positively assess the relationship with their immediate superiors. High values were also recorded for communication climate (M = 3.45) and communication in meetings (M = 3.35), which indicates a relatively favorable perception of the communication environment and organizational processes of information exchange. On the other hand, the lowest average value was determined for the feedback dimension (M = 2.78; SD = 1.18), which indicates a lack of quality work evaluation and feedback communication to employees. Lower values were also recorded for communication media (M = 2.95), which may indicate limitations in the methods and channels of information transfer. Other dimensions, such as horizontal communication (M = 3.20), information (M = 3.30) and informal communication (M = 3.05), are in the middle range, indicating an average level of satisfaction with these aspects of communication. Overall employee satisfaction is M = 3.40 (SD = 1.10), confirming that respondents are moderately satisfied with their jobs on average.

4. RESULTS AND DISCUSSION

To check the internal consistency of the measurement scales, Cronbach's α coefficient was used. The analysis was conducted for each dimension of internal communication separately.

Table 2: Cronbach α of each internal communication dimension

Diension	Cronbach α
Feedback	0.81
Communication with superiors	0.87
Horizontal communication	0.83
Informal communication	0.78
Informativeness	0.85
Communication climate	0.9
Means of communication	0.76
Communication at meetings	0.88

Source: Author's calculation.

The obtained Cronbach α coefficient values range from 0.76 to 0.90, which, according to the usual criteria in the social sciences, indicates good to very high reliability of the scales. The highest value was recorded for communication climate (α = 0.90), while the lowest value was determined for communication media (α = 0.76). These results confirm that the items used within individual dimensions are mutually consistent and reliably measure the same constructs, which justifies their further use in statistical analyses (Cronbach, 1951). This means that the items used within each dimension are mutually consistent and reliably measure the same construct.

4.1. Hypotheses

As a continuation of the research by Glavaš et al. (2024), and in order to deepen this topic through empirical research, the following hypotheses were set:
H1: There is a statistically significant relationship between internal communication and employee satisfaction.
H2: Communication climate has a statistically significant impact on employee satisfaction.
H3: Communication with superiors has a positive impact on employee satisfaction.
H4: Different dimensions of internal communication have different impacts on employee satisfaction.
H5: Internal communication significantly explains the variation in employee satisfaction.

4.2. Correlation analysis

In order to examine the relationship between the dimensions of internal communication and employee satisfaction, a Pearson correlation analysis was performed.

Table 3: Pearson correlation analysis

Variable	Correlation
Communication climate	**0.74**
Communication at meetings	0.63
Informativeness	0.62
Informal communication	0.45
Horizontal communication	0.41
Communication with superiors	0.37
Feedback	0.28
Means of communication	0.18

Source: Author's calculation

The results show that there is a positive relationship between all observed dimensions of communication and employee satisfaction. The strongest correlation was found for communication climate (r = 0.74), while relatively high correlations were also recorded for communication at meetings (r = 0.63) and information (r = 0.62). Weaker but still positive correlations were observed with horizontal communication (r = 0.41), communication with superiors (r = 0.37) and feedback (r = 0.28), while communication media showed the weakest connection (r = 0.18). These results point to the conclusion that a higher level of communication quality in the organization leads to higher employee satisfaction, with the communication climate having the most pronounced influence.

4.3. Regression analysis

In order to determine the influence of individual dimensions of internal communication on employee satisfaction, a multiple linear regression analysis was conducted.

Table 4: Regression model summary

Indicator	Value
R^2	0.586

Source: Author's calculation

Table 5: Regression coefficients and significance levels

Variable	Beta coefficient	P-value
Communication climate	**0.66**	<0.05
Communication at meetings	0.2	>0.05
Horizontal communication	0.23	>0.05
Feedback	0.09	>0.05
Communication with superiors	-0.03	>0.05
Informal communication	-0.1	>0.05
Informativeness	0.08	>0.05
Means of communication	-0.09	>0.05

Source: Author's calculation.

The formula for multiple linear regression is derived as follows:

$$Y=\beta_0+0.66X_1+0.20X_2+0.23X_3+0.09X_4-0.03X_5-0.10X_6+0.08X_7-0.09X_8+\varepsilon$$

where Y stands for the dependent variable – Employee satisfaction, and the X_n variables are all of the independent variables describing internal communication dimensions.

The model results show that internal communication explains 58.6% of the variance in employee satisfaction (R^2 = 0.586), which is a relatively strong model in social research. Analysis of individual influences revealed that communication climate is the only variable that has a statistically significant impact on employee satisfaction ($\beta = 0.66$; $p < 0.05$). Other dimensions, such as communication in meetings, horizontal communication, information and feedback, although showing a certain positive direction of influence, did not prove to be statistically significant in this model. This result suggests that communication climate plays a dominant role in shaping employee satisfaction and that other dimensions partially share a common effect with it.

The research results enabled the verification of the hypotheses set.

The first hypothesis assumed the existence of a statistically significant relationship between internal communication and employee satisfaction. The conducted correlation analysis showed that all dimensions of internal communication are positively related to employee satisfaction, which confirmed this hypothesis. The obtained results indicate that improving communication processes within the organization leads to increased employee satisfaction.

The second hypothesis assumed that the communication climate has a statistically significant impact on employee satisfaction. The results confirmed this hypothesis, since the communication climate had the highest correlation with satisfaction ($r = 0.74$), but was also the only one to show a statistically significant impact in the regression model ($\beta = 0.66$). This confirms that the perception of the overall communication environment plays a key role in shaping employee satisfaction.

The third hypothesis related to the impact of communication with superiors on employee satisfaction. Although a positive relationship was found between communication with superiors and employee satisfaction, the regression analysis did not show a statistically significant impact of this variable. Therefore, this hypothesis can be considered partially confirmed. These results suggest that communication with superiors influences employee satisfaction, but its effect is not independent of other communication factors, especially communication climate.

The fourth hypothesis assumed that different dimensions of internal communication have a different impact on employee satisfaction. The results of the regression analysis clearly confirm this hypothesis, since the communication climate had a dominant influence, while the other dimensions showed a weaker or statistically insignificant effect. This confirms that internal communication is a multidimensional construct in which individual components do not have equal importance.

The last hypothesis assumed that internal communication significantly explains the variation in employee satisfaction. Given that the regression model explains as much as 58.6% of the variance of employee satisfaction, this hypothesis is confirmed. This result indicates that internal communication represents one of the key factors in understanding employee satisfaction, although part of the variance remains explained by other organizational and individual factors.

Overall, the research results confirm the complexity of the relationship between internal communication and employee satisfaction and indicate the need for further research into individual communication dimensions

The research results are largely consistent with previous empirical research. A significant association between internal communication and employee satisfaction was confirmed, as confirmed by Kulachai et al. (2018). Furthermore,

communication climate proved to be the most important predictor of satisfaction, which is consistent with the findings of Sušanj Šulentić (2014). Although communication with superiors shows a certain association with satisfaction, its impact was not statistically significant, which may indicate the dominance of the broader communication climate (Erjavec et al., 2017). It was also confirmed that different dimensions of communication have different impacts, which confirms the multidimensional nature of communication (Tkalac Verčič et al., 2021). Finally, the results of the regression analysis confirm that internal communication is a strong predictor of employee satisfaction, which is consistent with the research of Santos et al. (2024).

5. CONCLUSION

The results of the conducted research clearly confirm that internal communication has a significant impact on employee satisfaction in public institutions. The analysis of the obtained data established a positive correlation between all observed dimensions of internal communication and employee satisfaction, with communication climate standing out as the most important predictor. This finding indicates that employees do not value exclusively the quantity and availability of information, but especially value the overall quality of the communication environment, the relative level of openness, transparency and mutual trust in the organization.

The obtained results additionally confirm that the communication climate, as a broader context within which communication processes take place, plays a key role in shaping employee satisfaction. Although other dimensions of communication, such as communication with superiors, horizontal communication and information, have also shown a certain connection with satisfaction, their impact did not prove to be statistically significant when observed together with other variables. Such results confirm that internal communication represents a complex and multidimensional construct in which individual components do not have equal importance.

From a practical aspect, the research results indicate the need for systematic and strategic management of internal communication in organizations, especially in the public sector. Organizations should pay more attention to developing a communication climate that encourages open dialogue, timely exchange of information, and employee involvement in organizational processes. Such an approach can contribute to increasing employee satisfaction, strengthening their engagement, and consequently improving organizational efficiency. In conclusion, internal communication should not be viewed solely as an operational process of information exchange, but as an important strategic tool for human capital management. Investing in the development of a quality communication climate is a key prerequisite for creating a positive work environment and long-term successful operations of organizations.

5.1. Research limitations

This research has several limitations that need to be taken into account when interpreting the results. First of all, the research was conducted on a relatively limited sample of 98 respondents, which may affect the possibility of generalizing the results to a wider population of employees in public administration. Also, the sample was not evenly distributed by country, since the majority of respondents were employees from Croatia, which may affect the representativeness of the results in a regional context.

Furthermore, the data were collected using the self-assessment method via a questionnaire, which may lead to subjectivity of responses and the appearance of socially desirable responses. Also, the research was conducted at a single point in time, which is why it is not possible to determine cause-and-effect relationships between variables, but only their correlation.

In addition, the research focused exclusively on the dimensions of internal communication, without including other relevant factors such as organizational culture, leadership styles or working conditions, which can also have a significant impact on employee satisfaction.

5.2. Recommendations for future research

Given the above limitations, future research should include a larger and more representative sample of respondents to enable broader generalization of the results. It is also recommended to have a more even representation of respondents from different countries and organizational systems, which would allow for comparative analyses.

Also, future research could include additional variables, such as organizational culture, leadership styles, employee motivation and trust in the organization, to gain a more comprehensive insight into the factors that influence employee satisfaction. It is also recommended to apply a longitudinal approach to monitor how the relationship between communication and satisfaction changes over time.

In addition to quantitative methods, it would be useful to include qualitative approaches, such as interviews or focus groups, to gain a deeper understanding of employees' experiences and perceptions regarding internal communication. Finally, future research can be extended to other sectors to determine differences in the role of internal communication in different organizational contexts.

REFERENCES

Bolfek, B., Milković, V., & Lukavac, M. (2017). Utjecaj interne komunikacije na zadovoljstvo zaposlenika radnim mjestom. Oeconomica Jadertina, 7(1), 16-27.

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. Psychometrika, 16(3), 297-334.

Downs, C. W., & Hazen, M. D. (1977). A factor analytic study of communication satisfaction. The Journal of Business Communication (1973), 14(3), 63-73.

Duarte, A. P., & Silva, V. H. (2023). Satisfaction with internal communication and hospitality employees' turnover intention: Exploring the mediating role of organizational support and job satisfaction. Administrative Sciences, 13(10), 216.

Erjavec, K., Arsenijević, O., & Starc, J. (2018). Satisfaction with managers' use of communication channels and its effect on employee-organisation relationships. Journal of East European management studies, 23(4), 559-578.

Glavaš, J., Ravlić, S., & Crnković, J. (2024). The role of internal communication in public institutions: a comparative study of Croatia, Serbia, and Bosnia and Herzegovina. Interdisciplinary Management Research XX, 258-280.

Gómez-González, A., & Gallardo-Echenique, E. (2023). Impact of satisfaction with internal communication on work engagement: Correlational analysis. Comunicación y sociedad, 20.

Ilola, C. (2024). The role of internal communication in employee satisfaction via communication channels: Case study in multilingual international organization.

Kalistratova, T. (2024). Internal communications as a way to manage staff satisfaction. Journal of Management Sciences and Applications (JOMSA), 3(2), 223-231.

Kalla, H. K. (2005). Integrated internal communications: a multidisciplinary perspective. Corporate communications: An international journal, 10(4), 302-314.

Kulachai, W., Narkwatchara, P., Siripool, P., & Vilailert, K. (2018, March). Internal communication, employee participation, job satisfaction, and employee performance. In 15th International Symposium on Management (INSYMA 2018) (pp. 124-128). Atlantis Press.

Men, L. R. (2014). Strategic internal communication: Transformational leadership, communication channels, and employee satisfaction. Management communication quarterly, 28(2), 264-284.

Pirrotta, L., Ferrari, A., Cantarelli, P., & Belle, N. (2025). Communication and job satisfaction among public employees: evidence from large-scale surveys with healthcare professionals. International Journal of Public Sector Management, 38(5), 541-560.

Santos, T., Santos, E., Sousa, M., & Oliveira, M. (2024). The mediating effect of motivation between internal communication and job satisfaction. Administrative Sciences, 14(4), 69.

Seraj, A. H. A., & Sundram, V. P. K. (2025). The interplay between Leadership Communication, Internal Communication, Information & communication Technology and Satisfaction; Exploring the Mediating Role of Employee Engagement. International Journal of Operations and Quantitative Management, 31(2), 47-65.

Sušanj Šulentić, T. (2014). Research on the relationship between internal communication climate and job satisfaction and employee loyalty. Market-Tržište, 26(1), 59-76.

Tkalac Verčič, A., Sinčić Ćorić, D., & Pološki Vokić, N. (2021). Measuring internal communication satisfaction: validating the internal communication satisfaction questionnaire. Corporate Communications: An International Journal, 26(3), 589-604.

Vercic, A. T., Vercic, D., & Sriramesh, K. (2012). Internal communication: Definition, parameters, and the future. Public relations review, 38(2), 223-230.

Welch, M. (2012). Appropriateness and acceptability: Employee perspectives of internal communication. Public relations review, 38(2), 246-254.

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CONCENTRATION, COMPETITION AND EFFICIENCY OF COMPANIES IN THE MILK AND DAIRY PRODUCTS MARKET IN BOSNIA AND HERZEGOVINA

Abstract: This paper analyzes the milk and dairy products market in Bosnia and Herzegovina. It provides an overview of the current state of the market from the aspect of processing, production and foreign trade of Bosnia and Herzegovina with its important partners. The aim and subject of the paper is to determine the degree of concentration, as well as the impact of the degree of concentration on the efficiency and competition of companies in the milk and dairy products market in Bosnia and Herzegovina. The CRn index and the Herfindahl – Hirschman index were used to calculate the level of concentration in this market. The basic hypothesis in this research is that a low degree of concentration in the milk and dairy products market has a positive effect on the efficiency of the operations of companies in the milk and dairy products market in BiH. In order to more easily confirm or reject the main hypothesis, a subsidiary hypothesis was set: A low degree of concentration has a positive effect on the growth of competitive activities of companies and product differentiation. After conducting an analysis and measuring the level of concentration, it was determined that there has been a moderate level of concentration in recent years and that this contributes to greater competitiveness and efficiency of business operations of companies in the milk and dairy products market in BiH.
Keywords: production, efficiency, competition, concentration, milk market

1. INTRODUCTION

Market structures represent a key component of economic analysis, as they shape the way markets function and influence efficiency, competition and innovation within industries. Understanding the different forms of market structures, from perfect competition to monopolies and oligopolies, is of essential importance for evaluating market competitiveness, determining policies for the protection of competition and applying antitrust laws. In addition, the measurement of market concentration, which is used to assess the dominance of firms in certain industries, is a key tool in analyzing market efficiency and identifying potential threats from monopolies and cartels. Considering the importance of market structures, this paper focuses on the analysis of the market of milk and milk products in Bosnia and Herzegovina. The milk market is specific because different forms of competition and concentration occur on it, which enables a detailed analysis of market structures and the application of appropriate antimonopoly policies.

The research problem relates to the market of milk and dairy products in Bosnia and Herzegovina, which faces challenges related to high competition and concentration, which can affect the efficiency of companies. The lack of clear data on the level of market concentration, competitive strategies and their impact on business results makes it difficult to understand the dynamics of this sector and adopt effective policies for its improvement. Market concentration is a dynamic concept that describes different forms of linkages between firms and helps to understand how these linkages change in the market. The industry includes companies that are interconnected in some way, and its

significance is particularly evident in the study of competitiveness. Measuring industrial concentration is important not only for business entities, but also for government, economists and scientific research.

The market of milk and dairy products in Bosnia and Herzegovina is characterized by specific challenges related to the market structure, such as different levels of concentration and intensity of competition. Understanding how these factors affect the efficiency of companies is essential for making quality business and regulatory decisions that can improve the overall competitiveness of the sector, stimulate growth and preserve market stability. The main goal of this work and research is to analyze the degree of market concentration and the level of competition on the market of milk and dairy products in Bosnia and Herzegovina, and to examine their impact on the efficiency of business operations of companies, in order to provide guidelines for improving competitiveness and efficiency in this sector. In order to investigate the problem and the subject of the research, two basic and auxiliary hypotheses were set. H1: The low degree of concentration in the market of milk and milk products has a positive effect on the efficiency of business operations of companies in the market of milk and milk products in Bosnia and Herzegovina. H2: A low level of concentration has a positive effect on the growth of competitive activities of companies and product differentiation. The industry is constantly changing and developing, and it is affected by various factors that can increase or decrease market concentration. Through the available literature and research, we will try to show how concentrated the market of milk and dairy products is and what impact this concentration has on the competitiveness and efficiency of companies in Bosnia and Herzegovina.

2. LITERATURE REVIEW

Perfect competition represents an idealized market model in the economy in which all market participants (producers and consumers) have complete information, and the products offered are homogeneous, i.e. identical. This model enables the optimal allocation of resources and makes the most of the advantages of competition, however, in the real world perfect competition almost never exists. Nevertheless, the analysis of perfect competition allows economists to better understand market behavior and competition dynamics (Samuelson & Nordhaus, 2010, Mankiw, 2014 & Varian, 2014). According to Samuelson, demand curves in imperfectly competitive markets have a negative slope, which means that firms act as price makers rather than price takers. In addition, imperfect competition has certain characteristics such as supply and demand imbalance, market asymmetry, lack of complete transparency and unequal value of money for buyers and sellers. Imperfect competition includes monopoly, monopolistic competition and oligopoly. (Samuelson & Nordhaus, 2010, Mankiw, 2014).

There are various types of monopolies, pure and partial monopolies, we also have a division according to the way of their creation into natural, legal economic, octopod (Pindyck & Rubinfeld, 2017). According to Posner (1969), unlike a classic monopoly, a natural monopoly does not depend only on the number of bidders, but also on the relationship between demand and production technology. In a situation of natural monopoly, competition is not sustainable, because additional companies would consume more resources than necessary, which can lead to mergers or the disappearance of competition (Posner, 1969).

Since competitors can react in many different ways, there is not a single, but several oligopoly models, which are based on the reaction of competitors to the actions of others. Because of this, decision-making in oligopolies is much more complex than in other forms of market structure. Depending on whether the oligopolists agree or not, we have non-agreed and consensual oligopoly (Bakalar, 2009). Since competitors can react in many different ways, there is not a single, but several oligopoly models, which are based on the reaction of competitors to the actions of others. Oligopolies can enter into agreements in different ways: publicly, secretly or tacitly. In many countries, agreements on prices and market sharing are prohibited. In addition, there are international cartels that set uniform prices, share the market and agree on production quotas. To avoid fierce competition and price wars, oligopolies often enter into secret agreements, and in countries where this is not prohibited, they may publicly agree on prices, production quotas, market sharing and profits. This type of organization of oligopolistic firms is called a cartel (Bakalar, 2009).

Anti-monopoly policy is a tool that enables the market to function smoothly and efficiently, as well as to suppress any form of monopolistic and anti-competitive behavior. The goal is to ensure economic efficiency, thereby contributing to the maximization of social well-being. The anti-monopoly policy takes place in two directions: it prohibits certain types of business behavior, such as, for example, agreeing on prices; preventing the creation and strengthening of market structures such as trusts, cartels or other forms of monopoly (Petković & Kostić, 2014).

Market concentration represents one of the most significant measures of the competitiveness of the economy, which shows how market shares are distributed among companies operating in a certain market. According to the definition of the Organization for Economic Cooperation and Development (OECD), market concentration is a quantitative instrument of market structure analysis that is used to assess the possible effects of business behavior and company mergers, as well as to assess the degree and effectiveness of market competition in preserving competitive conditions at

the level of the entire economy (OECD, 2018). A number of authors emphasize the importance of market concentration as a key factor in explaining variations in efficiency among different industries. The basic forms of the industrial structure are determined by the number of companies and their size distribution, while by including the consumer structure we get a complete picture of the market structure. The author Tipurić and others single out two key factors that determine the level of concentration. The first factor that determines the level of concentration is the absolute number of companies on the market, and the second is the size of companies or firms on the market (Tipurić, Kolaković & Dumičić, 2003). On the other hand, author Tirol in his book analyzes market concentration and its influence on market concentration. According to him, Market concentration is a measure that shows the extent to which a small number of firms dominate the market (Tirole, 1988).

Contemporary literature emphasizes the complex relationship between market concentration, competition intensity and company efficiency. Research such as that conducted by De Loecker and Eeckhout (2020) indicates an increase in market concentration and margins, which may be related to a reduction in competitive pressure and a decline in allocative efficiency. Similarly, Gutiérrez and Philippon (2019) find that increased concentration in certain sectors leads to weaker investment activity and lower productivity, which confirms the hypothesis of negative effects of market power. Also, Aghion et al. (2021) emphasize that competition has a non-linear effect on innovation and efficiency, whereby a moderate level of competition encourages technological progress, while too much or too little competition can have the opposite effect. These findings indicate that the relationship between concentration, competition and efficiency is not unambiguous, but depends on the structure of the market, the institutional environment and the technological characteristics of the industry.

The growth of market concentration in modern economies is often associated with the emergence of the so-called "superstar companies", which, thanks to higher productivity and technological advantage, achieve dominant market positions, thereby further strengthening their market power (Autor et al., 2020). At the same time, empirical research shows that the increase in margins and concentration does not have to have unequivocal negative effects, but their impact depends on the specific sectoral and institutional context, as well as the dynamics of competition within the industry (Berry et al., 2019; Syverson, 2019). In addition, long-term analyzes indicate a pronounced trend of industrial concentration growth in developed economies, especially in technology-intensive sectors, which further complicates the relationship between market structure and economic efficiency (Bajgar et al., 2020; Grullon et al., 2019).

Given that maintaining a low level of concentration is an important prerequisite for its efficient functioning. Therefore, the analysis of concentration levels, as well as the study and improvement of methods and techniques that enable the measurement of concentration levels on the market, is a very important task. High concentration can reduce competition, which can lead to higher prices and lower quality of services and products. On the other hand, lower concentration usually indicates more competition, which can be beneficial for consumers. Market concentration is an important indicator when analyzing the market power of firms. If a few firms control a large part of the market, this can lead to monopolistic behavior, which negatively affects consumers and the economy. On the other hand, in some cases, concentration can contribute to more efficient operations and greater innovation (Tomaš, 2013). At the same time, empirical evidence for the United States of America shows that the long-term growth of concentration in certain industries is accompanied by a decrease in the dynamics of the entry of new firms and a strengthening of the market power of dominant companies (Covarrubias et al., 2020). In addition, macroeconomic analysis indicates that the growth of differences between firms and the strengthening of market power can have wider consequences for productivity and income distribution in the economy (Van Reenen, 2018). Together, these findings confirm that the effects of market concentration must be viewed in the broader context of industrial dynamics and competition policy.

3. RESEARCH METHODOLOGY

When researching market concentration, various sources were used, including professional literature, the Internet, reports and professional magazines, in order to gather important information for the subject of the research. To obtain accurate and reliable results, various methods were applied that ensure objectivity, reliability, systematicity and general applicability. The paper used data from the field of market concentration, market structure and microeconomics, as well as statistical data on dairy operations in Bosnia and Herzegovina. Concentration indices were used for the analysis. The methods of scientific and research work that have been applied include comparative, analytical, inductive and deductive methods, as well as statistical and mathematical methods, and the method of data compilation.

The measurement of market concentration represents one of the key aspects in the analysis of the market and market structure. Market concentration shows how much the market is controlled by a few dominant companies. High concentration indicates a smaller number of large players who hold the majority of the market share, while low concentration indicates that the market is more competitive and fragmented. There are different methods for measuring market concentration, and the most commonly used indicators are (Podrug, 2011):

- Big Four Index (CRn) – It is calculated as the sum of the market shares of the most important companies on the market. CR3 or CR4 is most often used, which indicates the concentration of 3 or 4 largest companies. This ratio gives a simple picture of the dominance of the leading companies.
- Herfindahl-Hirschman index (HHI) – It is calculated as the sum of the squares of the market shares of all companies on the market. This index better reflects market distribution and is more sensitive to changes in market shares, especially in the case of large firms.

The concentration index CRn is the so-called index of the big four and it shows us how much production in the industry is accounted for by the four largest companies. The closer the coefficient is to one, the higher the concentration in the branch, the closer to zero the lower the level of concentration in the branch:

$$CR_n = \sum_{i=1}^{N} S_i / S_t ;$$

The level of concentration in the market can be low, medium and high. The interval in which the concentration level of C4 moves is from 0 to 100. When the concentration level is 0, then the market is extremely competitive, while on the other hand, we have a situation where the market concentration level is 100, which shows that it is a monopoly. We use the Herfindahl-Hirschman index (HHI) to calculate the level of market concentration. According to the formula, the Herfinadahl – Hirschmsn index represents the sum of the squares of the company's market share:

$$HHI = \sum_{i=1}^{N} S_i^2 ;$$

Si represents the market share of the company, while N represents the total number of companies in the given industry. The value of this index cannot theoretically be less than zero. We can interpret the index values as follows:

- from 0 to 1.000 => low concentrated market,
- over 1.000 to 1.800 => moderate concentrated market,
- over 1.800 to 10.000 => high concentrated market.

We took the data that was not suitable for the calculation of these indices from the dairy's financial statements (income statement and balance sheet). The data sources used in this work are the Agency for Statistics of BiH, the Institute for Statistics of the RS, Company Wall pages, the Federal Institute for Statistics, the Agency for Intermediary, IT and Financial Affairs of the Republic of Srpska and the Financial and IT Agency of the Federation of Bosnia and Herzegovina.

4. RESEARCH RESULTS AND DISCUSSIONS

Table 1 gives an overview of sales of dairies on the market of milk and milk products in Bosnia and Herzegovina for a period of 5 years.

Table 1: Revenues from the sale of dairies on the market of milk and milk products in BIH for the period from 2019 to 2023

Name		SALES REVENUE				
		2019.	**2020.**	**2021.**	**2022.**	**2023.**
1.	Mlijekoprodukt „Kozarska Dubica“	122.185.576,00	104.856.625,00	92.541.854,00	116.571.190,00	143.539.944,00
2.	Meggle „Posušje“	90.171.635,00	91.194.915,00	97.507.367,00	114.108.357,00	129.846.942,00
3.	Meggle Bihać		66.283.227,00	75.220.384,00	87.870.508,00	96.782.422,00
4.	INMER	45.235.897,00	48.054.216,00	50.096.136,00	60.382.439,00	66.613.500,00
5.	Mi 99 Grdačac	40.662.162,00	44.011.632,00	42.245.341,00	48.476.043,00	60.812.076,00
6.	"MilkoS" d.o.o. Sarajevo	24.273.020,00	21.810.822,00	17.418.184,00	15.046.578,00	13.937.294,00
7.	Pađeni Bileća	17.586.733,00	17.632.941,00	18.341.170,00	24.637.568,00	28.231.302,00
8.	Zim Zenica	10.402.692,00	9.475.361,00	8.797.368,00	9.256.163,00	9.775.309,00
9.	Mljekara Livno	6.957.673,00	6.963.208,00	7.623.269,00	8.591.519,00	11.877.682,00
10.	Eko sir Puđa Livno	5.666.734,00	5.093.585,00		6.818.479,00	8.079.879,00
11.	D.o.o. "MLJEKARA DULE" Srednji Dragaljevac	5.649.449,00	5.919.398,00	6.512.772,00	5.167.525,00	7.692.256,00
12.	Mljekara Laktaši	10.000,00	0,00	0,00	2.911.256,00	0,00
13.	Tena				4.251,00	13.089,00
14.	"MLJEKARA SUŠA" d.o.o. Megdan Livno	164.594,00	126.182,00	123.685,00	146.379,00	131.862,00
	Total	**368.966.165,00**	**421.422.112,00**	**416.427.530,00**	**499.988.255,00**	**577.333.557,00**

Source: Processing by the author, according to the financial reports of APIF, AFIA and Company Wall 2024

According to the data presented in table 1, we see that the dairy Mlijekoprodukt from Kozarska Dubica has achieved the highest business income from sales in a period of 5 years. Right behind her is Meggle from Posušje, and then Meggle from Bihać. On the other hand, we note that the dairies Laktaši, Tena and Suša had the lowest income from sales. Table 2 shows the market share of dairy products according to sales revenue for various dairies in the period from 2019 to 2023. Market share represents the percentage of the total market on which each dairy generates its revenues.

Table 2: Market share of dairies according to sales revenue

	Name	Market share in %				
		2019	**2020**	**2021**	**2022**	**2023**
1.	Mlijekoprodukt „ Kozarska Dubica“	33,11	24,88	22,22	23,31	24,87
2.	Meggle „Posušje“	24,44	21,64	23,41	22,82	22,49
3.	Meggle Bihać		15,73	18,06	17,57	16,76
4.	INMER	12,26	11,4	12,02	12,08	11,54
5.	Mi 99 Grdačac	11,02	10,44	10,14	9,7	10,53
6.	MilkoS d.o.o. Sarajevo	6,58	5,18	4,18	3,01	2,41
7.	Pađeni Bileća	4,77	4,19	4,40	4,93	4,89
8.	Zim Zenica	2,82	2,25	2,11	1,85	1,69
9.	Mljekara Livno	1,89	1,65	1,83	1,72	2,06
10.	Eko sir Puđa Livno	1,54	1,21	0	1,36	1,4
11.	D.o.o. "MLJEKARA DULE" Srednji Dragaljevac	1,53	1,4	1,56	1,03	1,33
12.	Mljekara Laktaši	0	0	0	0,58	0
13.	Tena	0	0	0	0	0
14.	"MLJEKARA SUŠA" d.o.o. Megdan Livno	0,04	0,03	0,04	0,04	0,03
	Total	**100**	**100**	**100**	**100**	**100**

Source: Author's calculation

From the given review of market shares of dairies on the milk market and dairy data in BiH, we see that the largest dominance is held by the dairy Mlijekoprodukt "Kozarska Dubica". This dairy dominated the market in almost all years and its market share fell from 33.11% in 2019 to 24.87% in 2023. Meggle "Posušje" is also stable in second place, with slight oscillations, ending 2023 with a share of 22.49%, while on the other hand, Meggle Bihać did not have data for 2019, but from 2020 to 2023 it holds the third position, with slightly lower shares in the last two years. INMER and Mi 99 Gradačac alternate in 4th and 5th place, with relatively stable market shares, while Milkos d.o.o. Sarajevo records a constant decline from year to year, from 6.58% in 2019 to only 2.41% in 2023. Padjeni Bileća and Mljekara Livno have slight oscillations, but a stable share, while Zim Zenica is gradually losing its market share. Smaller producers such as Eko sir Puđa, Mljekara Dula, Mljekara Laktaši and others have a minimal market share, mostly below 2%.

The CRn index (market concentration) is an indicator that measures market concentration, i.e. the extent to which the market is dominated by a few large firms. The CRn index is calculated as the sum of the squares of the market shares of the n largest companies on the market. In this case, the CRn index for each year represents market concentration in the dairy sector, where n is the number of the largest dairies (the largest by market share).

Table 3: Big Four CRn Index for the period 2019 – 2023.

CRn index	**2019**	**2020**	**2021**	**2022**	**2023**
	69,81	73,65	75,73	75,79	75,66

Source: Author's calculation

The CRn index in 2019 was 69.81%. This index indicates that the market was more moderately concentrated in 2019. There were larger differences in market shares, but the largest dairies still held a significant share of the market. In 2020, the market has become somewhat more concentrated than the previous year. This growth may indicate that a few leading dairies have increased their market share, while smaller producers may have seen a decline. From 2021 to 2022, the Big Four index shows further market concentration. The market is becoming even more dominated by a few large dairies, while smaller producers have a smaller share. In 2023, the index decreased slightly compared to the previous year, which indicates a slight decrease in market concentration. This may mean that the market shares of some larger dairies have decreased, while smaller producers may have been able to improve their market share. The Herfindahl-Hirschman Index (HHI) is another key indicator used to measure market concentration. The HHI is calculated as the sum of the squares of the market shares of all firms in the market.

Table 4: Herfindal-Hirschman Index (HHI) index for the period from 2019 to 2023

HHI indeks	2019	2020	2021	2022	2023
	2047,62	4418,07	1662,29	1655,82	1689,65

Source: Author's calculation

According to the data in Table 4, this index indicates that the market had moderate concentration in 2019. The market was not too concentrated, but it was not completely competitive either. In this period, there were dominant companies that held a significant market share, but the market still allowed for competition. In the following year, there will be a significant jump in the value of this index. This significant jump in the HHI value indicates high market concentration. The market has become significantly less competitive, with a few large firms taking over. This may be a consequence of the growth of the market shares of the largest dairies, while the smaller producers could fall in share or even disappear from the market. The decline in 2021 compared to 2020 indicates a less concentrated market in 2021, but the market is still moderately concentrated. This may indicate an improvement in competition, with a smaller decrease in the market shares of the largest firms, but the market is still largely dominated by a few large manufacturers. An additional drop in the HHI value indicates a further decrease in market concentration and an increase in competition in 2022. The market has become moderately competitive, meaning that smaller producers may have gained market shares or new competitors have emerged, and a few large dairies have not been as dominant as before. Although there was a slight increase in 2023 compared to 2022, the market is still moderately competitive. The market remained relatively balanced, without drastic changes compared to the previous year. Smaller producers still have a chance to compete, and the market is not too concentrated.

5. CONCLUSION

Changes in market share occurred at several major dairies such as Mlijekoprodukt "Kozarska Dubica" and Meggle "Posušje", which had the largest market share. Many dairies had a stable market share, while some smaller producers had fluctuations or declining market share, such as Milkos d.o.o. Sarajevo and Zim Zenica. In 2019, the market was moderately concentrated (CRn = 69.81), but later there was an increase in market concentration in 2020 (CRn = 73.65), which showed that the market became less competitive. In 2021, the market was further concentrated (CRn = 75.73), and by 2023, market concentration remained at a high level (CRn = 75.66), although there were small fluctuations. This indicates the dominance of a few large dairy farmers, while smaller producers do not have a significant market share. The Herfindahl-Hirschman Index (HHI) index had significant changes during the analyzed period. In 2020, the HHI was high (4418.07), which indicates a high concentration of the market, i.e. the dominance of a few large firms, with very little competition. Later, the HHI decreased (2021 HHI = 1662.29, 2022 HHI = 1655.82, 2023 HHI = 1689.65), indicating a decrease in market concentration and an increase in competition. The market has become moderately competitive (with HHI values between 1,500 and 2,500), which is a sign that smaller producers are managing to improve their market shares and that there is room for competition.

Market efficiency can be seen through competition and balance on the market. If the market becomes too concentrated, this can lead to less competition, which could reduce efficiency (eg higher prices and less innovation). In 2020, with high market concentration (HHI = 4418.07 and CRn = 73.65), the market had less competition, which could negatively affect efficiency in terms of prices and product quality. If only a few firms dominate, there is less opportunity for price competition and innovation, which can reduce consumer welfare and market efficiency. However, in 2021-2023. In 2008, with the decline of the HHI and CRn indices, the market became moderately competitive, which may indicate an increase in competition and the possibility of price reductions, better quality and greater choice for consumers. These changes can increase market efficiency, as competition leads to better conditions for consumers and encourages companies to improve their products.

Large dairies continue to dominate the market, which means that they have larger capacities, better distribution and greater influence on market prices. However, high market concentration can lead to market consolidation problems, which means that it could be difficult for new players to enter the market, thus reducing the dynamics of competition. On the other hand, the market shares of smaller producers in 2020 indicated their marginalization, the decline in market concentration in the following years (2021-2023) indicates an increase in competition from smaller producers. These producers can become more efficient, especially if they have the possibility of specialization, product quality or lower prices, in order to compete with the big players.

So, here we can conclude that the CRn index shows that the market is becoming more concentrated, which is the opposite of the hypothesis, while the HHI index shows a decline in market concentration in the last two years, which partially supports the hypothesis. However, considering that the market still has a high concentration, it is difficult to conclude that a low degree of concentration has a positive effect on the efficiency of the company's operations. Also, it will be necessary to analyze other factors that affect the efficiency of the company's operations, such as competition, innovations, imports, costs and other economic variables. Based on current data and calculation results, the hypothesis

can be considered partially rejected, because the market still shows significant concentration, although there is a trend of decreasing concentration in recent years.

If the level of concentration in the milk and milk products market in Bosnia and Herzegovina (BiH) continues to grow, there are several recommendations that could help reduce concentration and preserve competition. First, *encouraging competition through regulatory measures*. The BiH Competition Council should carefully monitor and regulate all cases of mergers and acquisitions between companies in the milk and milk products industry. If mergers of larger firms are proposed, which could increase market concentration and reduce competition, such processes should be subject to stricter supervision. If it is estimated that the merger would have a negative impact on competition and consumers, it should be prohibited. Introducing or strengthening laws that prevent monopolistic practices can help maintain market balance. This includes legislative measures that would facilitate the initiation of proceedings against excessive concentration and unfair business practices. Second, *maintenance and strengthening of small and medium enterprises*. The state can provide financial and technical support to small producers of milk and milk products, which would increase competition on the market. Subsidy programs or facilitation of access to capital can help small businesses to expand and become more competitive in the market. Organizational and business moments, as well as training for small and medium producers, can help these companies to improve their production and efficiency. This can enable them to become more competitive against the large firms that dominate the market. Third, *increasing market transparency*. Reducing market concentration can be facilitated by increasing the transparency of prices and product information. Consumers and competitors should have easily accessible information about offers, which increases competition and reduces the possibility of market manipulation. Public procurement and other forms of public tender procedures can be aimed at strengthening competition, encouraging balance and reducing the dominance of large players. Fourth, *export promotion and internationalization*. Encouraging small and medium-sized producers to export their products to foreign markets can help them diversify their business, increase production volume and become more competitive. Through export, domestic companies can achieve greater efficiency and innovation. Fifth, *improvement of market conditions.* Through regulations and policies, authorities can encourage competitive practices such as reducing barriers to entry for new firms in the market, better conditions for small producers, and encouraging innovation in the production and distribution of dairy products. Sixth, *the role of the BiH Competition Council*. If the level of market concentration continues to grow, the BiH Competition Council should become more active in monitoring the milk and milk products market. This advice should monitor changes in concentration and identify potential anti-competitive practices and prevent them, in order to ensure adequate regulation of the market. Also, if it is noticed that large companies are using their market share to stifle competition (eg through aggressive price reduction or exclusive contracts with distributors), the BiH Competition Council can initiate investigations and take appropriate legal measures. The BiH Competition Council can also provide advice to companies on competition rules and provide education on how to avoid monopolistic practices and how to maintain competition in the industry. Its role would be crucial in preserving competition, protecting small and medium-sized companies, as well as in preventive action to prevent the negative consequences of excessive concentration. Also, regulations that support innovation, facilitate the entry of new companies into the market and enable a balance between large and small producers and can significantly contribute to healthy competition on the market.

5. LITERATURE

Aghion, P., Bloom, N., Blundell, R., Griffith, R., & Howitt, P. (2005). Competition and innovation: An inverted-U relationship. *The Quarterly Journal of Economics*, *120*(2), 701–728. https://doi.org/10.1093/qje/120.2.701

Autor, D., Dorn, D., Katz, L. F., Patterson, C., & Van Reenen, J. (2020). The fall of the labor share and the rise of superstar firms. *The Quarterly Journal of Economics*, *135*(2), 645–709. https://doi.org/10.1093/qje/qjaa004

Bajgar, M., Berlingieri, G., Calligaris, S., Criscuolo, C., & Timmis, J. (2020). Industry concentration in Europe and North America. *OECD Productivity Working Papers*, 2019(18), 1–53. https://doi.org/10.1787/2ff98246-en

Bakalar, J. (2009). *Mikroekonomija*. HKD Napredak. Sarajevo.

Berry, S., Gaynor, M., & Scott Morton, F. (2019). Do increasing markups matter? Lessons from empirical industrial organization. *Journal of Economic Perspectives*, *33*(3), 44–68. https://doi.org/10.1257/jep.33.3.44

Covarrubias, M., Gutiérrez, G., & Philippon, T. (2020). From good to bad concentration? U.S. industries over the past 30 years. *NBER Macroeconomics Annual*, *34*, 1–46.

De Loecker, J., Eeckhout, J., & Unger, G. (2020). The rise of market power and the macroeconomic implications. *The Quarterly Journal of Economics*, *135*(2), 561–644. https://doi.org/10.1093/qje/qjz041

Grullon, G., Larkin, Y., & Michaely, R. (2019). Are US industries becoming more concentrated? *Review of Finance*, *23*(4), 697–743. https://doi.org/10.1093/rof/rfz007

Gutiérrez, G., & Philippon, T. (2019). Fading stars. *American Economic Review*, *109*(4), 1104–1144.

Mankiw, N. G. (2014). *Principles of economics*. South-Western Pub. Cincinnati.

Organisation for Economic Co-operation and Development. (2018). *Market concentration: Issues and trends*. OECD Publishing.

Petković, M., & Kostić, Lj. (2014). Antimonopolska politika Republike Srbije. *Ekonomski vidici*. 19(4), 493-504.

Pindyck, R. S., & Rubinfeld, D. L. (2017). *Microeconomics*. Pearson, London.

Podrug, N. (2011). *Osnove mikroekonomije*. Školska knjiga. Zagreb.

Posner, R. A. (1969). Natural monopoly and its regulation. *Stanford Law Review*, *21*(3), 548–643.

Samuelson, P. A., & Nordhaus, W. D. (2010). *Ekonomija*. Mate. Zagreb.

Syverson, C. (2019). Macroeconomics and market power: Context, implications, and open questions. *Journal of Economic Perspectives*, *33*(3), 23–43. https://doi.org/10.1257/jep.33.3.23

Tipurić, D., Kolaković, M., & Dumičić, K. (2003). Koncentracijske promjene hrvatske bankarske industrije u desetogodišnjem razdoblju (1993–2002). *Zbornik Ekonomskog fakulteta u Zagrebu*, 1(1).

Tirole, J. (1988). *The theory of industrial organization*. MIT Press. Cambridge.

Tomaš, D. (2013). Lorencova kriva kao pokazatelj tržišne koncentracije u sektoru osiguranja Republike Srbije. *Financing*, *4*(2), 22–29.

Varian, H. R. (2014). *Intermediate microeconomics: A modern approach, 9th edition* . W.W. Norton & Company. New York.

Van Reenen, J. (2018). Increasing differences between firms: Market power and the macroeconomy. CEPR Discussion Paper, DP13444.

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TRANSMISSION OF FERTILIZER PRICE SHOCKS TO FOOD INFLATION IN SERBIA

Abstract: Over the past five years, the global economy has faced a series of major shocks and crises that have led to periods of exceptionally high inflation across both advanced and developing economies. Rising costs of energy, raw materials, and agricultural inputs have placed additional pressure on production chains, ultimately affecting consumer prices. In Serbia, food prices play a particularly important role in overall inflation dynamics due to their significant weight in the Consumer Price Index (CPI), 31.6% according to the COICOP classification. Additionally, the two indicators, the overall CPI and the Food Consumer Price Index in Serbia, exhibit positive linear relationship. Within this context, this study analyzes if shocks originating from agricultural input markets, specifically fertilizer prices, transmit through the production chain and are significantly affecting food prices in Serbia. Using a Vector Autoregression (VAR) framework, the analysis explores the relationship between Fertilizer Price Index, Agricultural Producer Price Index, and Food Consumer Price Index in Serbia, over the past twelve years. The findings suggest a transmission of fertilizer price shocks to agricultural PPI and indicate an indirect but economically meaningful effect on food inflation over the medium term.

Keywords: Fertilizer Prices, Food Inflation, Agricultural PPI, Vector Autoregression (VAR), Serbia

1. INTRODUCTION

Fertilizers represent an irreplaceable input in modern agriculture, contributing to plant health and enabling intensive farming on limited land. The large-scale application of ammonia-based fertilizers has increased global crop yields by 30-50%, especially for nitrogen-demanding staples such as corn, wheat, and rice, as well as for crops cultivated in nitrogen-poor soils (MIT Sloan, 2025), making them essential for global food security. This strong dependence on fertilizers also links agricultural productivity to developments in the energy sector.

Fertilizer production is closely tied to energy prices, as natural gas and coal are key inputs in the production of ammonia. Moreover, countries that are major exporters of crude oil and gas are often significant producers and exporters of fertilizers, since production costs are lower for them. As a result, the two markets share similar dynamics, with price fluctuations and supply and demand disruptions in the energy sector often reflected in the fertilizer market. As a global industry, the energy sector has frequently experienced major shocks and price volatility driven by such disruptions. Over the past decade, energy prices have been highly volatile, with two major shocks shaping the market. In 2020, the world faced the global COVID-19 pandemic, which led countries to close borders and impose quarantines in an effort to slow the spread of the virus. The sharp decline in travel, daily commuting, production, and industrial activity created a significant imbalance in the energy sector. The pandemic caused a sudden drop in demand for crude oil, increasing uncertainty and triggering a major economic recession in both developed and developing economies. Oil

prices reached record lows during this period, leaving oil-exporting countries with reduced revenues. As a result, the energy sector faced serious challenges, including layoffs and reduced investment in research and development.
The recovery of the energy sector that began as COVID-19 restrictions were eased was interrupted in early 2022, when Russia invaded Ukraine. In response, many countries, including the European Union and G7 nations, imposed sanctions on Russian crude oil and gas, among other products. This created demand-side pressures, contributing to high inflation and slowing economic growth, with Europe being particularly affected. Before the crisis, the European Union imported more than 150 bcm of gas per year from Russia. Between 2021 and 2023, these imports fell by over 70%, to approximately 43 bcm per year. Although imports increased slightly in 2024, they remained well below pre-war levels. Despite ongoing efforts to diversify supply, Russian gas is still expected to account for around 13% of the EU's total gas imports in 2025, highlighting the region's continued, though reduced, dependence on Russian energy sources (European Parliament, 2025).
Global shocks like these have a major impact on fertilizer prices, not only due to their close link with gas prices, but also because of the nature of the fertilizer industry. Similar to energy sector, the global fertilizer industry is characterized by a high degree of concentration, both geographically and at the company level. Production capacity for major fertilizer products is largely concentrated in a limited number of countries, reflecting the uneven distribution of key raw materials as well as the capital-intensive nature of fertilizer production (Hernandez and Torero, 2013). According to FAO Fertilizer Trade data, the top six exporting countries of nitrogen accounted for 53% of global nitrogen trade, with the Russian Federation as the largest exporter, holding 18.4% of total trade, followed by China and Qatar (details in Table 1). Figures for phosphate and potash are even higher, with the six largest exporters accounting for 67.3% of total phosphate trade, with Morocco leading at 18.9% of total trade. The six largest exporters of potash accounted for 79.3% of global potash trade, with the two largest players contributing almost 54% of total trade in 2023.
In many cases, only a few producers account for a substantial share of national production capacity, indicating the oligopolistic structure of the sector. At the same time, the fertilizer market has become increasingly globalized, with international trade expanding significantly, which has led to price formation becoming increasingly influenced by global market conditions. The integration of supply chains has also encouraged the adoption of "just-in-time" supply practices aimed at reducing inventory costs, which are particularly high for fertilizer products. However, relatively low stock levels make the industry highly vulnerable to unexpected disruptions (Ott, 2012).

Table 1: Export quantities and global trade share

A) Nitrogen Exports

Country	Export quantity (t) - Nitrogen	% in total Nitrogen trade
Russian Federation	8,234,299.99	18.73%
China	6,681,534.64	15.20%
Qatar	2,226,358.04	5.06%
Saudi Arabia	2,205,119.72	5.02%
United States of America	2,037,576.49	4.63%
Algeria	1,932,566.58	4.40%

Source: FAOSTAT, 2023

B) Phosphate Exports

Country	Export quantity (t) - Phosphate	% in total Phosphate trade
Morocco	4,670,279.38	18.91%
China	4,228,345.42	17.12%
Russian Federation	3,733,773.27	15.12%
Saudi Arabia	1,857,238.94	7.52%
United States of America	1,654,369.60	6.70%
Israel	466,428.31	1.89%

Source: FAOSTAT, 2023

C) Potash Exports

Country	Export quantity (t) - Potash	% in total Potash trade
Canada	13,705,612.16	34.77%
Russian Federation	7,561,333.59	19.18%
Belarus	2,930,829.51	7.43%
Jordan	2,675,788.06	6.79%
Israel	2,370,193.96	6.01%
Germany	2,014,131.94	5.11%

Source: FAOSTAT, 2023

With global markets facing two major shocks within a short time span, these events had significant consequences for both developed and developing economies. Prices of both energy and fertilizers increased sharply in 2022 and remained volatile in the following years. In 2022, after Russo-Ukrainian conflict started in late February, the price of crude oil increased by over 44% compared to January same year (World Bank, 2025). Fertilizers, most notably potassium chloride, also known as muriate of potash (MOP), followed this trend. In April 2022, the price of MOP, which is mainly

exported by Russia and Belarus, was 53% higher than in January of the same year (U.S. Department of Agriculture, 2023). These shocks were transmitted to final prices, contributing to a surge in overall inflation. In the European Union, annual inflation reached a record high of 9.2% in 2022, more than tripling from 2.9% in 2021 (Eurostat, 2023). However, inflation was even higher for essential consumer goods. According to Eurostat, among the twelve main consumption categories, prices for housing, water, electricity, gas, and other fuels recorded the largest increase in 2022, rising by an average of 18.0%. Transport followed with an average increase of 12.1%, while food and non-alcoholic beverages increased by 11.9% on average, indicating that the cost of living rose prominently during this period.

Smaller and developing countries were the most affected, with inflation rates often surpassing those in developed economies. A key reason for this discrepancy is their strong reliance on imported fertilizer as well as food imports, in some cases. When faced with significant increases in fertilizer prices, fertilizer use tends to decline, leading to lower agricultural production. This reduction in domestic supply drives up both food prices and food imports. As a result, fertilizer price shocks put pressure on food prices not only in the short term but also over subsequent harvest cycles. In the case of Serbia, the estimated annual inflation rate reached 15.1% in 2022, following an already high rate of 7.8% in 2021 (Statistical Office of the Republic of Serbia [SORS], 2022). By 2025, annual inflation stabilized at an estimated 2.8%, while real GDP recorded annual growth of 2%. Although macroeconomic conditions improved, agricultural production saw a slight decline, with physical volume falling by 0.3% in 2025 compared to 2024 (Statistical Office of the Republic of Serbia, 2025a).

Focusing specifically on food, its role in both inflation and household budgets in Serbia is important. In 2025, food made up 34.3% of the total Consumer Price Index (CPI), reflecting its large weight in overall price developments. Over the years, food price inflation has consistently outpaced headline inflation, as shown in Figure 1, with the gap becoming especially noticeable from 2022 crisis when food prices rose more sharply than the general price level. Between January 2020 and December 2025, overall inflation grew at a compound annual rate (CAGR) of 6.3%, while food prices rose faster, at 7.5% per year. Looking at specific categories, some food items became noticeably more expensive: fruit prices recorded a CAGR of 10.14% between 2020 and 2025, followed by oils and fats at 9.3%, and milk, cheese, and eggs at 8.4% (SORS, 2024b). This matters even more given that, in Serbia, food represents a substantial share of household spending, averaging around 21% between 2020 and 2024 (SORS, 2024a), well above the EU average of 13.2% (Eurostat, 2026). During this period, household expenditure on food grew at a CAGR of 9.6%, SORS, 2024b). Altogether, these trends suggest that rising food prices have placed a growing strain on household budgets.

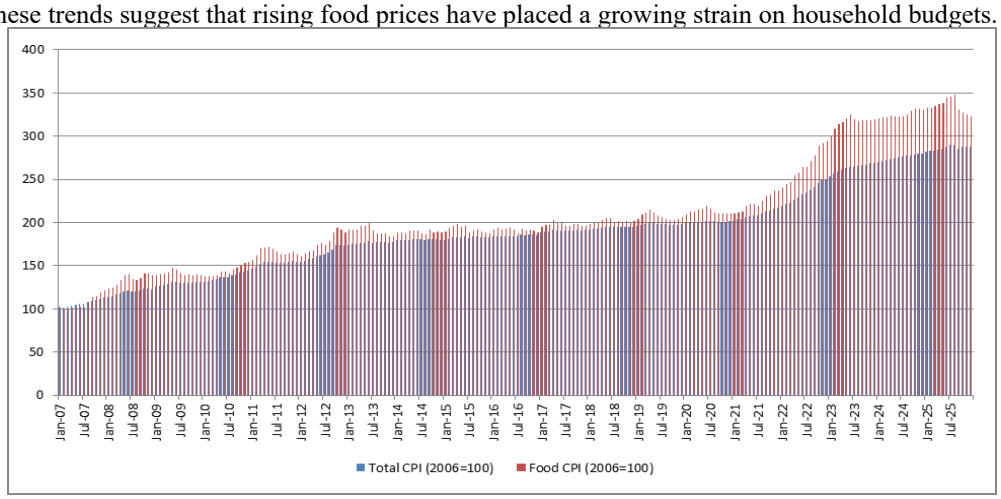


Figure 1: Consumer Price Index and Food Consumer Price Index from 2007 - 2025
Source: Statistical Office of the Republic of Serbia, 2025

To meet its domestic agricultural needs, Serbia relies on fertilizer imports. Serbia's total fertilizer imports in 2025 amounted to 832,900 tons (excluding raw fertilizers), equivalent to USD 363.6 million, along with 657,799.8 tons of raw fertilizers, valued at USD 75.4 million. At the same time, Serbia exported a significant amount of fertilizer, reaching 539,230.8 tons (excluding raw fertilizers) in 2025, valued at USD 272.7 million (SORS, 2025b). The largest suppliers of raw fertilizers are Jordan, Romania, and Egypt, together accounting for 79.3% of Serbia's total raw fertilizer imports. For other types of fertilizers, the Russian Federation presents the main supplier, accounting for 63% of total imports. Together with Hungary and Austria, these three countries represent 77% of total fertilizer imports in Serbia.

Considering Serbia's dependence on imported fertilizer, the republic is exposed to all global market shocks, emphasizing the importance of discovering how these shocks affect food prices. The aim of this study is to analyze whether shocks originating from agricultural input markets, specifically fertilizer prices, are transmitted through the production chain and significantly affect food prices in Serbia. The paper is organized as follows: after the introduction, the literature overview presents global and regional-focused studies related to fertilizer and energy markets and food prices. The next section describes the data and empirical methodology. Based on data spanning 2014–2025, the model includes consumer food, agricultural producer, and fertilizer prices within a VAR framework. The results illustrate the responses of food inflation and agricultural producer prices to fertilizer shocks supported by Granger causality and

forecast error variance decomposition. The final section provides concluding remarks and discusses the main implications of the results.

2. LITERATURE OVERVIEW

Analyzing correlation between fertilizer and energy prices with core and food inflation is subject of many authors works over the years (e.g. Alexander et al. (2023); Clark & Terry (2010); Hamilton (2009); Kilian (2008a)). This relationship is important due to its vast implications on business cycles, government policies, social dynamics, and in worst cases even world hunger. With two major crises over the last two decades, including 2008 world crisis and 2020-2022 turbulences, there has been a rising literature covering these correlations.

Ott (2012) analyzed the interaction between fertilizer, food, and energy prices in the EU, utilizing monthly price indices from the World Bank (1960-2012) for fertilizers, energy, and grains. Using VAR models and Granger causality tests, the paper analyzed price interdependencies, together with unit root tests to identify if speculative bubbles exist in the physical market. The research established a "triangular interdependency", where energy prices trigger nitrogen cost spikes, but study found food prices in EU Granger-cause fertilizer price movements more than vice-versa. A speculative bubble in 2008 was revealed to be driven by low global inventory levels and uncertainty rather than the derivatives market, according to authors' findings.

Corsello and Tagliabracci (2023) researched the transmission of energy price shocks to inflation dynamics using Monthly Eurostat data for HICP (Headline, Food, Core), negotiated wages, and unemployment in the Euro area, covering period from 2002-2022. Data was analyzed by applying a Bayesian VAR model with Choleski decomposition to identify exogenous energy shocks. Their empirical results indicated that the pass-through from energy prices to core and food inflation, while historically modest, becomes considerably more pronounced during periods of shocks. Accordingly, the study found that during 2022 energy crisis, energy shocks accounted for over 60% of euro-area headline inflation. Authors discovered that the sensitivity of food prices to these shocks is three times higher than that of core inflation

Another study on the recent surge in global fertilizer prices and its implications for food prices and food security was done by Hebebrand and Laborde Debucquet (2023). With emphasis on the underlying supply and demand drivers, using IFPRI and FAOSTAT data, this study highlighted that 75% of countries were dependent on imports for over 50% of their fertilizer use. It identified extreme supply concentration: Russia and Belarus controlled 41% of global potash trade, while Russia alone accounted for 15% of nitrogenous fertilizer exports in 2022. The study put an emphasis on how this low concentration makes the global food supply chain vulnerable to regional conflicts and trade sanctions.

Focusing on the most recent and fertilizer-oriented studies, Vos et al. (2025) investigated the effects of global fertilizer price shocks, exploring the mechanisms through which these shocks transmit to agricultural markets in recent years. Researchers analyzed weekly price data for European and US natural gas and international fertilizer benchmarks from 2019 to 2024. The authors showed that fertilizer prices are strongly linked to energy markets: the estimated pass-through elasticity of European natural gas prices to nitrogen fertilizer was 0.43 for every 1% gas price increase. The pass-through from US gas was shown to be significantly higher at 0.89. The study noted that, while global demand fell only 4.5% in 2022 and higher crop prices mitigated the impact of rising fertilizer costs for many commercial producers, smallholder farmers in import-dependent regions faced severe profitability losses.

Morão (2025) focused the analysis of fertilizer-related shocks by explaining their broader macroeconomic consequences focused on relatively smaller economy. Morão developed a novel "Fertilizer Supply Index" (FSI) using text-mining analysis of news from over 30 countries (1974–2023) to capture disruptions, including export bans and sanctions. Employing a structural Bayesian VAR, the study found that fertilizer supply shocks because an immediate and significant increase in food industry output prices in Portugal. Author revealed that, due to inelastic food demand, companies successfully pass the majority of these input costs to consumers. Notably, labor market responses, presented in wages and hours, are delayed, rising several months after the initial shock.

Focusing specifically on Serbia, Brankov and Puškarić (2023) analyzed the effects of the Ukraine conflict on Serbia's agricultural sector, using the trade data from WITS and price indices from the Statistical Office of the Republic of Serbia (SORS) for the period from 2020 to 2023. In this study, Serbia is identified as the most fertilizer-dependent country in the Western Balkans, relying on imports for 70% of its needs. Crucially, it sourced 75.9% of its NPK requirements from Russia. The authors reported that mineral fertilizer costs in Serbia surged by 177% year-on-year in Q2 2022. This shock, combined with energy price hikes, drastically reduced yields for wheat and corn, hence threatening exports, but more importantly, food security.

Mladenović and Milošević (2025) examined the role of energy prices and food inflation dynamics in Serbia. Covering period from 2007-2022, the study utilized ARDL Bounds Testing for cointegration and Structural VAR to analyze food prices (FCPI), core prices, oil, and a custom macroeconomic uncertainty index. Long-run elasticity showed that a 1% increase in oil prices leads to a 0.1% increase in food prices in Serbia. While uncertainty shocks peak within six months, oil price shocks become the dominant factor in food price variability after 18 months, eventually explaining 51% of fluctuations.

While existing literature offers valuable insights into inflation dynamics in Serbia, especially the role of energy prices and broader input costs, fertilizer prices and their interaction with other price categories received less direct attention. This paper researches that channel by focusing on how fertilizer prices are linked to food inflation in Serbia. Using a

VAR framework, the aim is to contribute to a better understanding of cost-push pressures in an import-dependent economy, where global shocks can have wider effects on overall price movements and food stability.

3. DATA AND EMPIRYCAL ANALYSIS

Given that the analysis is focused on prices in the Republic of Serbia, data was obtained from the Statistical Office of the Republic of Serbia. Analyzed indices include mineral fertilizer price index (SORS, 2025d), the producer price index for agricultural products (agricultural PPI) (SORS, 2025e), and the consumer price index for food (food CPI) (SORS, 2025c). The CPI and PPI series were available at a monthly frequency, while the fertilizer price index was reported at a quarterly frequency. Indices are expressed as year-on-year indices, defined as the percentage change relative to the same month or quarter of the previous year. Data was available for period from January 2014 and first quarter of 2024 to December 2025, for monthly series, and fourth quarter of 2025, for the fertilizer index. Monthly variables were transformed to quarterly values by taking simple averages within each quarter, while the fertilizer index is used in its original form. The final dataset comprises 48 quarterly observations and is analyzed using the R software.
Analyzed indices are presented in Figure 2, each graph showing inflation over the analyzed period. Fertilizer inflation increased sharply during 2021 and reached its peak in mid-2022, while agricultural PPI peaked shortly after, in third quarter of 2022. Food inflation peaked with a slight delay in the first quarter of 2023. Food inflation presents relatively stable series when compared to the other two, with its values ranging roughly from 0.5% to 16%, indicating that there are no extreme values in this dataset. Given that its mean (4.2%) exceeds the median (2.5%), there is mild right-skewness indicating a high inflation period. Agricultural PPI is considerably more volatile, with values ranging from -26.7% to 34%, which confirms its cyclical nature and strong reaction to market shocks. Its average value is also higher than median. Fertilizer price inflation displays the highest volatility, with extreme movements between -39.5% and 177%, and the large gap between the mean (around 9.2%) and the median (-0.2%) value.

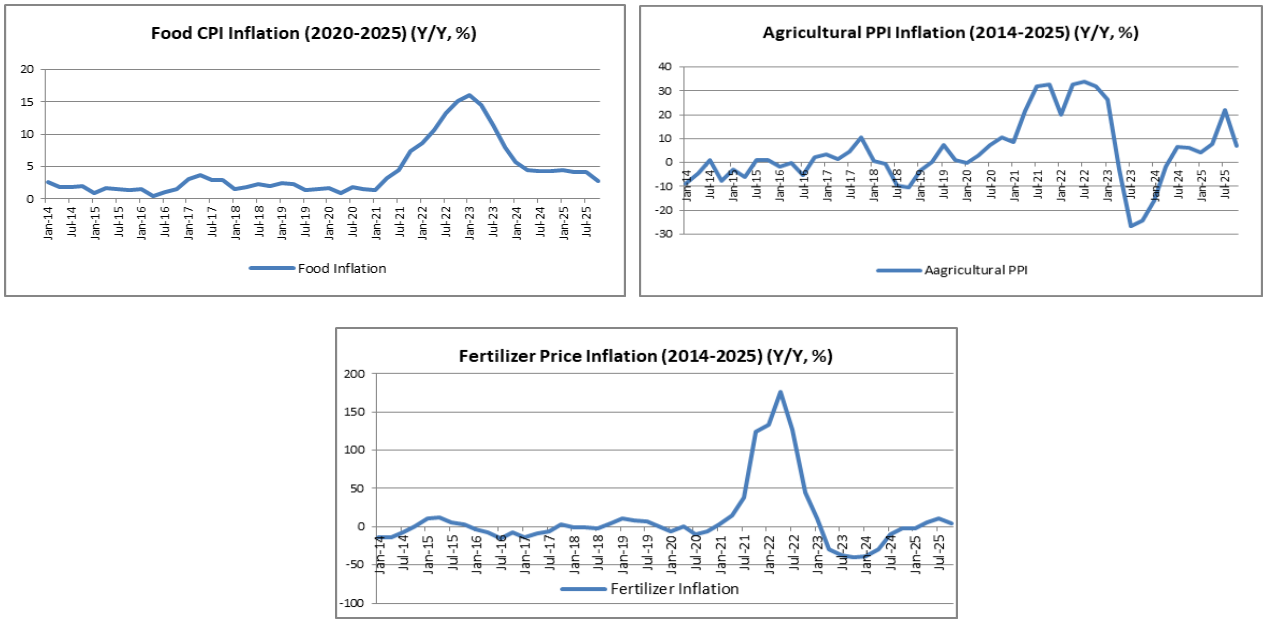


Figure 2: Year on year quarterly inflation for food prices, agricultural PPI, and fertilizer prices for period from Q1/2014 to Q4/2025
Source: Statistical Office of the Republic of Serbia, 2025

The analysis employs a Vector Autoregression (VAR) model, which treats all variables as endogenous and allows for the examination of dynamic interactions and feedback effects among them. Following Sims (1980), a VAR(p) model can be written as:

$$Y_t = c + A_1 Y_{t-1} + A_2 Y_{t-2} + \cdots + A_p Y_{t-p} + \varepsilon_t \quad (1)$$

Where Y_t is a vector of endogenous variables, c is a vector of constants, A_i are matrices of coefficients capturing lagged relationships between variables, and ε_t is a vector of innovations with zero mean and covariance matrix $\sum$.
Stationarity of the variables was tested using the Augmented Dickey-Fuller (ADF) test, which indicated that food inflation and PPI inflation are non-stationary, while fertilizer inflation is borderline stationary. As argued by Kilian et al. (2020), unit root tests have low power in short samples and often fail to clearly distinguish between I(0) process and I(1) process, which is particularly relevant for this paper, given the limited sample size (T = 48). In addition, Sims (1980) emphasized that in macroeconomic applications with persistent data, strict reliance on such pre-tests may be misleading, as variables may appear non-stationary in finite samples even when their long-run behavior is more stable.

Since the variables are already expressed as year-over-year inflation rates, further differencing would risk removing economically meaningful variation. Given that the aim of the study is to capture the transmission from fertilizer prices to food and producer prices, the VAR was estimated in levels, in order to preserve these relationships. The results should therefore be interpreted with due caution.
Structural shocks are identified using a recursive scheme based on the Choleski decomposition of the variance-covariance matrix of residuals (Lütkepohl, 2005). Following previous studies, specifically the seminar paper by (Kilian, 2008b) where energy prices are treated as exogenous within the system, fertilizer price inflation is ordered first, assuming that it is contemporaneously exogenous to other variables. This implies that fertilizer price inflation is affected only by its own structural shocks, while agricultural producer prices and food inflation can respond to fertilizer price changes. This assumption was considered appropriate, given the largely exogenous and internationally determined nature of fertilizer prices. The lag length was selected based on standard information criteria (AIC, HQ, SC, and FPE). With AIC and FPE indicating an optimal lag length of three, a VAR (3) model was estimated.

4. RESULTS

Initial model evaluation showed that the model is stable and statistically strong across all three equations, including fertilizer equation, PPI equation, and CPI equation. Food inflation is the most inertial, PPI responds to fertilizer shocks with a one to two quarter lag, while fertilizer prices are largely driven by their own dynamics. Diagnostic assessments indicate that the model demonstrates robust performance concerning autocorrelation and heteroskedasticity, given that the residuals do not display serial correlation or ARCH effects. Conversely, the normality assumption is not upheld, as evidenced by skewness and excess kurtosis. This is likely attributable to significant inflationary shocks experienced during the crisis period, especially in 2022.
Impulse response function reveals the impact of a one standard deviation shock in fertilizer price inflation, and is illustrated in Figure 3. The findings are as follows:

- A one standard deviation shock in fertilizer price inflation leads to a rapid and pronounced increase in agricultural PPI. The effect emerges almost immediately, peaks around the 3rd and 4th quarter (approximately 4%), and then gradually declines, approaching zero by the 6th-7th period and turning slightly negative at longer horizon. The confidence interval is above zero in the early horizons, confirming a statistically significant short-run effect.
- A one standard deviation shock in fertilizer price inflation precipitates a gradual increase in food inflation. Initially, the effect is modest, however, it subsequently intensifies, peaking around the 5th and 6th quarter (approximately 1.25%), before slowly declining and losing significance in later periods. The confidence interval stays above zero in the initial periods, suggesting a statistically significant effect, but gradually moves closer to zero over time, indicating that the impact fades in the medium term.

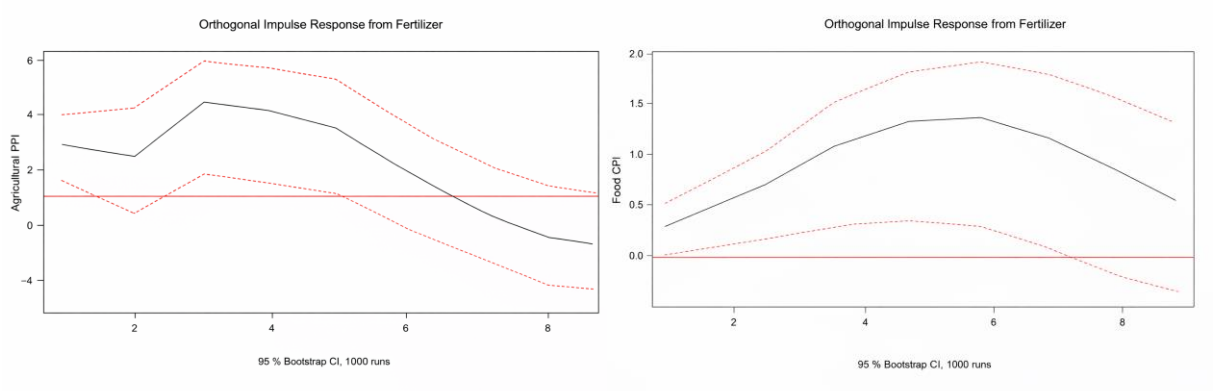


Figure 3: Orthogonal Impulse Response Function: Reaction of agricultural producer prices and food prices to shock in fertilizer
Source: Author's calculation output from R, based on the SORS' data, 2025

Following the impulse response analysis, Granger causality is used to assess the relationships that were analyzed and identified above. Results are presented in Table 2 The null hypothesis that fertilizer price inflation does not Granger-cause agricultural PPI and food inflation is rejected:

- The F-test ($p = 0.0067 < 0.05$) indicates that, within the system, fertilizer price inflation Granger-causes both agricultural PPI and food inflation, confirming the relationships suggested by the IRF results.
- The instant causality test ($p = 0.028 < 0.05$) suggests the presence of instantaneous linkages.

To complement these results, Wald test provided more detailed evidence on the significance of lagged effects in each equation.

- The result confirms that past changes in fertilizer prices have a statistically significant effect on agricultural PPI ($p = 0.0089 < 0.01$), the effect on food inflation is also significant but weaker ($p = 0.032 < 0.05$).

Table 2: Granger Causality and Wald Test

Test	Statistic (F)	p-value	Interpretation
Granger causality	3.1697	0.0067	H0 Rejected
Instant causality	–	0.0280	Instant linkage
Wald test – PPI	4.5092	0.0089	H0 Rejected
Wald test – CPI	3.2754	0.0324	H0 Rejected

Source: Author's calculation based on the SORS data, 2025

The Forecast Error Variance Decomposition (FEVD) shows the share of unexpected or unexplained variations in agricultural PPI and food CPI that are tied to shocks in fertilizer prices. After eight quarters, 60.3% of the variance is explained by its own shocks, while the feedback from food inflation remains relatively small (6.3%), and the contribution of agricultural PPI is more substantial (about 33.4% after two years). In the case of agricultural PPI, 35.9% of its variance is explained by fertilizer shocks after eight quarters, whereas the role of food inflation is negligible (around 2%). Approximately 49.7% of food inflation variance is driven by fertilizer price shocks, with 30.7% explained by shocks in PPI, after eight quarters. At the same time, the importance of its own dynamics declines markedly, from about 79% in the first period to around 20% after eight quarters.

5. CONCLUSION

World economy was faced with several shocks in recent years, starting from 2020 and continuing through 2026. After the global slowdown in 2020, Europe experienced exceptionally high prices, caused by geopolitical instabilities. Prices of energy and fertilizers surged, disturbing national economies and drawing attention to how energy supply is strongly influenced by political relationships and global events. As such, this period amplified the need for countries to diversify their energy and fertilizer supply channels. High inflation also hit Serbia, similar to many smaller economies, more strongly than EU and other developed economies, which makes this topic especially relevant.

The empirical results point to a consistent pattern. The impulse response functions show that fertilizer price shocks have a strong and immediate impact on agricultural PPI, with the peak in the third quarter after the shock. The response of food inflation is more gradual, reaching its peak after six quarters. These results indicate that the transmission from fertilizer prices to consumer prices is not instantaneous, but rather takes place through the production chain, affecting producer prices first and then passing on to consumers. Confirming that fertilizers play the primary role within the system, study showed that, at the 5% significance level, fertilizer price inflation Granger-causes both agricultural PPI and food inflation, though the effect is stronger at the producer level. Finally, the variance decomposition indicated that fertilizer shocks explain around 36% of the variation in PPI and nearly 50% of food inflation after eight quarters. It should be noted that this effect increases over time, from 12% after one quarter to almost 50% after eight quarters for food prices, while the effect of its own dynamics gradually decreases.

Considered together, the results point to a significant transmission of fertilizer price shocks through the production chain, indicating that producers are able to pass increased fertilizer costs to final consumers over time. The findings are in line with previous researches, suggesting that such expenses can be passed on consumers due to non-elasticity of food (Morão, 2025; Vos et al., 2025). These results suggest that policymakers should pay closer attention to developments in input markets and monitor the changes in them, as the delay in transmission offers a window for early action. Stabilizing fertilizer prices, whether through larger reserves or direct subsidies for fertilizer purchases by farmers, could help limit future inflationary pressures on food. Finally, strengthening supply chains and reducing reliance on a narrow set of external suppliers could improve resilience to external shocks and support more stable price dynamics over time.

On the other hand, the analysis has certain limitations. First, these findings should be viewed in light of the short sample period and the non-stationary nature of the data. Second, the use of quarterly data might limit the ability to capture more complex dynamics. Additionally, inclusion of additional variables, specifically energy prices, could provide additional context. The constraints outlined above call for cautious interpretation of the results, while also offering ideas for future research.

REFERENCES

Alexander, P., Arneth, A., Henry, R., Maire, J., Rabin, S. & Rounsevell, M.D.A. (2023). "High Energy and Fertilizer Prices Are More Damaging than Food Export Curtailment from Ukraine and Russia for Food Prices, Health and the Environment." Nature Food 4(1): 84–95. doi:10.1038/s43016-022-00659-9.

Brankov, T., & Puškarić, A. (2023). "EFFECTS OF THE UKRAINIAN CONFLICT: ANALYSIS OF ITS IMPACT ON THE AGRICULTURAL SECTOR OF SERBIA."

Clark, T.E., & Terry, S.J. (2010). "Time Variation in the Inflation Passthrough of Energy Prices." Journal of Money, Credit and Banking 42(7): 1419–33. doi:10.1111/j.1538-4616.2010.00347.x.

Corsello, F., & Tagliabracci, A. (2023). "Assessing the Pass-through of Energy Prices to Inflation in the Euro Area." doi:10.2139/ssrn.4350522.

European Parliament (2025). “Phasing out Russian Fossil Fuel Imports.” https://www.europarl.europa.eu/thinktank/en/document/EPRS_BRI(2025)775863, (March 15, 2026).

Eurostat (2023). “Annual Inflation More than Tripled in the EU in 2022.” Eurostat. https://ec.europa.eu/eurostat/web/products-eurostat-news/w/ddn-20230309-2, (March 23, 2026).

Eurostat (2026). “Household Final Consumption Expenditure by Purpose (COICOP 2018).” Eurostat. doi:https://doi.org/10.2908/NAMA_10_CP18

Hamilton, J.D. (2009). “Causes and Consequences of the Oil Shock of 2007–08.” Brookings Papers on Economic Activity 2009: 215–61.

Hebebrand, C., & Laborde Debucquet, D. (2023). High Fertilizer Prices Contribute to Rising Global Food Security Concerns. 0 ed. Washington, DC: International Food Policy Research Institute. doi:10.2499/9780896294394_07.

Hernandez, M., &Torero, M. (2013). “Market Concentration and Pricing Behavior in the Fertilizer Industry: A Global Approach.” https://onlinelibrary.wiley.com/doi/abs/10.1111/agec.12084, (March 23, 2026).

Kilian, L. (2008a). “Exogenous Oil Supply Shocks: How Big Are They and How Much Do They Matter for the U.S. Economy?” The Review of Economics and Statistics 90(2): 216–40. doi:10.1162/rest.90.2.216.

Kilian, L. (2008b). “The Economic Effects of Energy Price Shocks.” Journal of Economic Literature 46(4): 871–909. doi:10.1257/jel.46.4.871.

Kilian, L., & Zhou, X., Federal Reserve Bank of Dallas, and Federal Reserve Bank of Dallas (2020). “The Econometrics of Oil Market VAR Models.” Federal Reserve Bank of Dallas, Working Papers 2020(2006). doi:10.24149/wp2006.

Mladenović, Z., & Milošević, E. (2025). “THE IMPACT OF MACROECONOMIC UNCERTAINTY AND OIL PRICES ON FOOD PRICES: EMPIRICAL EVIDENCE FROM SERBIA.” Ekonomika poljoprivrede 72(1): 271–88. doi:10.59267/ekoPolj2501271M.

MIT Sloan (2025). “Fertilizer Production & Food Self-Sufficiency in Global Growth Markets”. https://mitsloan.mit.edu/centers-initiatives/ksc/fertilizer-production-food-self-sufficiency-global-growth-markets, (March 14, 2026).

Morão, H. (2025). “The Economic Consequences of Fertilizer Supply Shocks.” Food Policy 133: 102835. doi:10.1016/j.foodpol.2025.102835.

Ott, H. (2012). “Fertilizer Markets and Their Interplay with Commodity and Food Prices.” JRC Publications Repository. doi:10.2791/82136.

Sims, C.A. (1980). “Macroeconomics and Reality.” Econometrica 48(1): 1–48. doi:10.2307/1912017.

Statistical Office of the Republic of Serbia (2022). “Economic Trends in the Republic of Serbia in 2022.” https://www.stat.gov.rs/en-us/vesti/20221229-ekonomska-kretanja-2022/?s=090201, (March 23, 2026).

Statistical Office of the Republic of Serbia (2024a). “Individual Consumption of Households.”, (March 23, 2026)

Statistical Office of the Republic of Serbia (2024b). “Personal Household Consumption, by NSTU2 and Type of Settlements.” , (March 23, 2026)

Statistical Office of the Republic of Serbia (2025a). “Economic Trends in the Republic of Serbia.” https://www.stat.gov.rs/en-us/vesti/20251230-ekonomska-kretanja-2025/?a=09&s=0, (March 23, 2026).

Statistical Office of the Republic of Serbia (2025b). “Exports and Imports, by Commodity Groups SITC, Rev. 4, 272 – Crude Fertilizers, except Those of Division 56; 562 – Fertilizers (Excluding Crude)).” , (March 3, 2026)

Statistical Office of the Republic of Serbia. 2025c. “Consumer Price Indices”, (February 5, 2026)

Statistical Office of the Republic of Serbia. 2025d. “Input Price Indices in Agriculture - Fertilizer.” , (February 5, 2026)

Statistical Office of the Republic of Serbia. 2025e. “Monthly Producer Price Indices of Agricultural and Fishery Products by CA2010 (NACE Rev.2).” , (February 5, 2026)

U.S. Department of Agriculture (2023). “Global Fertilizer Market Challenged by Russia’s Invasion of Ukraine.” Economic Research Service, U.S. Department of Agriculture. https://www.ers.usda.gov/amber-waves/2023/september/global-fertilizer-market-challenged-by-russia-s-invasion-of-ukraine, (March 23, 2026).

Vos, R., Glauber, J., Hebebrand, C., & Rice, B. (2025). “Global Shocks to Fertilizer Markets: Impacts on Prices, Demand and Farm Profitability.” Food Policy 133: 102790. doi:10.1016/j.foodpol.2024.102790.

World Bank (2025). “Fertilizer Markets Soften but Remain Constrained by Trade Policies.” World Bank Blogs. https://blogs.worldbank.org/en/opendata/fertilizer-markets-soften-but-remain-constrained-by-trade-polici, (March 23, 2026).

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THE FOOD SUPPLY CHAINS DISRUPRIONS AND GLOBAL INSTABILITY: A THEORETICAL APPROACH

Abstract: The food supply chain is a network of interconnected entities that aims to deliver sufficient and healthy agri-food products to end consumers. In recent years different factors such as global health crises, climate change, extreme weather events, and geopolitical conflicts has significantly affected the functioning of food supply chains. Given that food represents a basic need and a key factor of economic and social stability, understanding these dynamics is of crucial importance. Bearing this in mind, this paper aims to analyze, based on a review of the relevant literature, the impact various shocks have on the functioning of food supply chains, as well as their potential effects on global instability. Special attention is given to the identification of key sources of disruption and the mechanisms through which these disturbances are transmitted across different stages of the supply chain, with the objective of highlighting the main drivers of instability and their implications in the recent period.

Lanac snabdevanja hranom je mreža međusobno povezanih entiteta koja ima za cilj da isporuči dovoljne i zdrave poljoprivredno-prehrambene proizvode krajnjim potrošačima. Poslednjih godina različiti faktori poput globalnih zdravstvenih kriza, klimatskih promena, ekstremnih vremenskih prilika i geopolitičkih sukoba značajno su uticali na funkcionisanje lanaca snabdevanja hranom. S obzirom na to da hrana predstavlja osnovnu egzistencijalnu potrebu i ključni faktor ekonomske i društvene stabilnosti, razumevanje ove dinamike je od ključne važnosti. Imajući ovo u vidu, ovaj rad ima za cilj da, na osnovu pregleda relevantne literature, analizira uticaj različitih šokova na funkcionisanje lanaca snabdevanja hranom, kao i njihove potencijalne efekte na globalnu nestabilnost. Posebna pažnja je posvećena identifikaciji ključnih izvora poremećaja i mehanizama putem kojih se ovi poremećaji prenose kroz različite faze lanca snabdevanja, sa ciljem da se istaknu glavni pokretači nestabilnosti i njihove implikacije u skorijem periodu.

Keywords: food chain, supply, disruption, shock

1. INTRODUCTION

Food supply chains represent a complex system of interconnected participants whose main goal is to provide a sufficient amount of health-safe products to end consumers. They include all stages, from agricultural production, through processing, storage and transport, to wholesale, retail and final consumption (Jeremić, Matkovski & Zekić, 2024). In these chains, millions of agricultural producers are connected to a large number of consumers through a relatively small number of intermediaries (Deconinck et al., 2023). Given the large number of participants of different sizes, as well as the presence of public and private sectors, food supply chains are characterized by a high degree of

complexity and specific decision-making processes at all stages (Rojas-Reyes, Rivera-Cadavid, & Peña-Orozco, 2024). They can also take different forms, from traditional to modern, as well as local or global chains that span multiple countries.

Food supply chains have always been subject to various disruptions, or shocks, such as extreme weather conditions, wars, conflicts and pandemics, which also contribute significantly to global instability. Disruptions in supply chains can be defined as external events that are difficult to predict and control, which affect the functioning of the system by reducing the efficiency of production, processing and distribution (Rojas-Reyes, Rivera-Cadavid, & Peña-Orozco, 2024). The specific features of agricultural production, such as the dependence on natural resources such as land, water and climate, make this sector particularly sensitive to various shocks. Also, short-term inelasticity of supply, labor-intensive work processes, and increasing concentration in the food supply chain further exacerbate vulnerability to shocks. At the same time, due to the increasingly pronounced interdependence between sectors of the supply chain, the negative effects that arise in one segment of the chain are transmitted to others, both upstream and downstream. The negative effects of shocks generated in any segment of the food supply chain can also spill over into other related sectors and the economy as a whole with very negative consequences for employment, income and growth. Likewise, disruptions in other sectors, such as energy and finance, can also have a significant impact on the functioning of food supply chains. With the development of global supply chains, shocks within the food supply chains are increasingly transmitted across national borders, further contributing to global instability (FAO, 2025). In modern conditions, shocks, such as the COVID-19 pandemic, the war in Ukraine (Deconinck et al., 2023) and conflicts in the Middle East (FAO, 2026), together with the increasingly pronounced effects of climate change, further emphasize the importance of studying this issue.

Bearing in mind the above, the aim of this paper is to analyze, based on a review of the relevant literature, the impact of shocks on the functioning of the food supply chains and their contribution to global instability, with a special focus on the identification of key sources of disruption and mechanisms of their transmission through the various stages of the supply chain. The paper tries to point out the main sources of instability in the previous time period, and to look at their impact on the functioning of the supply chain. The structure of the paper is organized into four thematic units. After the introductory considerations and short presentation of the methodological framework of the research, the third part of the paper discusses the concept and types of shocks, i.e. disruptions that complicate the functioning of the food supply chain. Below is an overview of the literature that deals with analyzing the key sources of instability in the previous period. The last segment of the paper refers to concluding considerations.

2. RESEARCH METHODOLOGY

The literature review on disruptions in food supply chains and the selection of references were mainly based on the Scopus database. The analyzed literature includes papers published in English, including scientific articles, review papers, papers from conferences, as well as reports of relevant international organizations (FAO, OECD). When selecting sources, special attention was paid to their relevance to the subject of the research, with a focus on papers that analyze contemporary global disruptions and their implications for food supply chains.

3. DISRUPTIONS IN THE FOOD SUPPLY CHAIN: THEORETICAL FRAMEWORK AND LITERATURE REVIEW

Global food supply chains are characterized by a high degree of complexity, which significantly complicates their effective management. This complexity stems from the fact that the production, processing and distribution of food products include a large number of interrelated actors, who jointly participate in the process of meeting the needs of end consumers. Such systems, in which the interdependence of a large number of different actors as well as intersectoral connections and influences is expressed, are particularly sensitive to disruptions (Jeremić et al. 2024; Haessner, Haessner, & McMurtrey, 2024) More precisely, changes or dysfunctions in one segment of the chain can cause the so-called domino effect, generating chain reactions that reflect on the functioning of the entire system (Haessner, Haessner, & McMurtrey, 2024).

3.1. Concept and types of disruptions in the food supply chain

Disruptions in food supply chains are defined as external events that are difficult to predict and control, and which greatly affect the efficiency of the food supply chains. These disruptions can affect all segments of the food supply chain from production to consumption, thereby challenging food security and food safety. Additional complexity is represented by the very nature of food products, whose characteristics such as perishability, nutritional value and short shelf life increase the sensitivity of the supply chain to disruptions. Food supply chains are exposed to a wide range of disruptions that can potentially generate shocks of varying intensity, from minor disruptions that require limited adjustments, to disruptions that lead to a complete interruption of activities and disruption of connections between participants, thereby questioning the survival and functionality of the system as a whole. In this context, it is important

to distinguish shocks from stresses, and while shocks represent sudden and intense disturbances, stresses manifest themselves as long-term and cumulative pressures. However, both can significantly influence the stability of the supply chains. There is no single classification of these disorders in the literature, i.e. of shocks. For example, Rojas-Reyes, Rivera-Cadavid, & Peña-Orozco (2024) classify disorders according to origin into two categories: natural or man made origin. On the other hand, Deconinck et al., (2023) offers a more detailed typology and classifies disorders into five different categories, namely: extreme events, pest and animal diseases, food safety shocks, socio-economic systems and trade restrictions. According to FAO (2025), the most commonly accepted approach is the division of these shocks into two categories, namely natural or man-made (Table 1), with the possibility of their mutual interaction. *Natural hazards* arise from natural processes and phenomena and can be biological, geophysical, climatological, hydrological and meteorological. Biological hazards are of organic origin and spread by biological vectors, while geophysical hazards include earthquakes, tsunamis, volcanic activity and landslides. Climatological, hydrological and meteorological hazards are associated with extreme weather conditions and include droughts, floods, storms, typhoons and hurricanes. With these types of disturbances, the initial impact is seen mainly on agricultural production, where they can lead to the destruction of crops, loss of livestock, damage to infrastructure and reduced productivity. The consequences are then transmitted throughout the food supply chain, affecting its stability and efficiency. According to Deconinck et al., (2023), droughts represent one of the most common climatic disturbances and refer to a long-term lack of atmospheric, surface or underground water, which directly affects crop yields and livestock production. Their impact is primarily manifested at the producer level, but it can have wider consequences when it affects significant production regions, especially key areas for grain cultivation. In such cases, there is disruption in local and global food supply chains, which is further reflected in rising food prices and jeopardizing food security. The global impact of drought is greater if it affects a major growing region. Other extreme weather events and natural disasters, such as major storms or earthquakes, can have similar effects, leading to a sharp reduction in local production and disrupting the functioning of supply chains at the national and international level.

On the other hand, *man-made hazards* arise as a consequence of human activities and choices and include armed conflicts, changes in economic policies, financial crises, as well as technological hazards such as pollution, nuclear incidents, bioterrorism and cyber attacks. In practice, these dangers often occur simultaneously or are interconnected, whereby one disorder can initiate or intensify another. It is particularly significant that human activities can additionally intensify the consequences of natural disasters, which is why the border between natural and man-made hazards is often not clearly defined.
This interconnectedness is particularly evident in contemporary global crises, where climate change, conflicts and limited resources operate simultaneously. For example, countries often respond to rising food prices by introducing trade measures. Export restrictions were used during the food crises of 2006–2008 and 2010–2011 year, as well as during the COVID-19 pandemic and after the outbreak of the war in Ukraine. On the other hand, import restrictions such as tariffs, quotas and sanitary and phytosanitary standards can be applied to protect domestic production or because of food safety concerns, but also as part of a broader trade or political strategy. (Deconinck et al., 2023)

Table 1: Food supply chain hazards

Natural hazards
Biological: • Plant pests; • Transboundary animal diseases; • Zoonoses; • Viruses; • Epidemics.
Geophysical: • Earthquakes; • Landslides; • Volcanic activity; • Tsunamis.
Climatological, hydrological i meteorological: • Droughts; • Extreme temperatures; • Floods; • Storms;

- Typhoons;
- Hurricanes;
- Wildfires.

Human induced hazards

- Conflict;
- Trade embargos;
- Financial crises;
- Nuclear events;
- Industrial pollution;
- Bioterrorism...

Source: According to, FAO (p.6, 2025).

In the following section of the paper, the focus is on the analysis of shocks that significantly affected the functioning of food supply chains in the previous period. Special attention was paid to disorders that had broad, long-term and systemic consequences. In this context, special attention is focused on key global shocks in the recent period, primarily the pandemic caused by the COVID-19 virus, the war in Ukraine and the current conflicts in the Middle East, which have significantly disrupted the stability and functioning of modern food supply chains, and contributed to global instability.

3.2. A literature review on disruptions in the food supply chain

Risks of disruption and uncertainty in food supply chains are continuously increasing, with these systems being among the most vulnerable to external shocks. Various hazards can disrupt the functioning of both local and global food systems, and their intensity and frequency are expected to increase further in the future. The dynamic and globalized nature of the modern world has significantly increased the complexity and interdependence of these chains, making them more susceptible to disruption. At the same time, the growth of the world's population and the increasing demand for food create additional pressure on their long-term sustainability (Hobbs & Hadachek, 2024). The sensitivity of food supply chains to different sources of shocks has become particularly evident in recent years, due to a series of crises that have shaken the global food system, including the COVID-19 pandemic, the emergence of plant and animal diseases, as well as geopolitical conflicts in Ukraine and the Middle East.

In modern conditions, the impact of climate change and increasing pressure on natural resources further intensify the exposure of food supply chains to various stresses and shocks. Although the spectrum of dangers has not changed significantly, the increase in the probability and frequency of their manifestation is evident. Of particular note is the increase in the frequency of extreme weather events such as droughts, floods and storms which, according to available data, has increased up to four times in the last fifty years. In contrast, the frequency of geophysical phenomena, such as earthquakes, has remained relatively stable. At the same time, there has been a significant increase in plant pests and diseases, despite progress in early warning and control systems. A similar trend is present in cross-border animal diseases, especially zoonoses, which further increases the risks in the agricultural and food sector. It should be borne in mind that the available statistics often underestimate the actual extent of damage, since they include only disturbances of greater intensity, while economic losses are most often estimated solely on the basis of deviations of agricultural production from expected trends. This ignores the fact that agricultural production is only one segment of the supply chain, and that the total effects of the disruption go far beyond this level. (FAO, 2025)

Climate change has a particularly pronounced impact on global food production. Rising temperatures and changes in precipitation patterns affect plant development, shorten growing seasons, and lead to reduced yields, especially under conditions of extreme weather events such as droughts, floods, heat waves, and storms. In addition to the direct effects on production, these conditions cause damage to transport, logistics, energy and communication infrastructure, further hampering the functioning of supply chains and reducing the efficiency of food distribution. Finally, climate change affects the stability of the global food market, causing fluctuations in supply and prices. In response to these challenges, some countries are resorting to measures such as export restrictions, agricultural subsidies and other policies aimed at preserving domestic food security and price stability. (Jin, Liu, & Huang, 2025)

The pandemic caused by the COVID-19 virus was a global shock that simultaneously affected all segments of the food supply chains, from primary production, through processing and logistics, to demand itself. However, the intensity of the impact was not uniform, as different sectors and products were affected at different stages of the chain. In agricultural production, the key problem was bottlenecks in the availability of labor, especially seasonal ones. Mobility restrictions significantly reduced the supply of workers for sowing and harvesting, which particularly affected labor-intensive sectors such as fruit and vegetable production, while less labor-dependent sectors such as cereals and oilseeds were relatively more resilient. At the same time, the initial uncertainty regarding the supply of inputs, such as

pesticides, further increased concerns, although disruptions in the supply of fertilizers and energy were less pronounced. The food industry was also significantly affected, due to the implementation of social distancing measures, a reduction in the available workforce and temporary plant closures. In particular, the meat processing sector stood out, which due to its labor-intensive nature was more susceptible to disruptions, in contrast to the highly automated grain processing, which showed greater resilience. Transport and logistics faced additional challenges. While the transport of bulk cargo (such as grain) did not suffer significant disruptions, the biggest problems arose in air transport, due to a sudden decrease in passenger traffic, which normally provides a large part of the capacity for the transport of perishable goods. Disruptions in container and road transport were moderate, but they additionally contributed to slowing down the flow of goods. One of the most pronounced effects of the pandemic was a sharp turn in the structure of demand. The closure of restaurants and catering facilities led to a decline in consumption of food outside the household, while at the same time retail demand for food for home use, especially for packaged and frozen products, increased significantly. This change required rapid adaptation of supply chains, which had to redirect goods flows and change logistics patterns. In that process, there was an imbalance between supply and demand: interruptions in processing, especially meat, created situations in which producers had surpluses, while consumers were simultaneously faced with shortages of certain products. In the case of certain products, such as raw materials intended for catering, there was a temporary surplus of supply due to reduced demand. At the same time, in the initial stages of the pandemic, empty retail shelves were also recorded, which was a consequence of the sudden increase in demand and the time delay in adjusting the supply chains. (OECD, 2020; Rojas-Reyes, Rivera-Cadavid, & Peña-Orozco, 2024; Hobbs & Hadachek, 2024; Haessner, Haessner, & McMurtrey, 2024; FAO, 2025)

Approximately two and a half years after the outbreak of the COVID-19 pandemic, the global food supply system faced another significant shock, the war between Russia and Ukraine. This conflict further worsened the already damaged stability of food supply chains. Namely, Russia and Ukraine had a key role in the world market of agricultural products, especially when it comes to the export of wheat, corn, barley and sunflower products, while Russia was also one of the world's largest exporters of mineral fertilizers. The war had multiple negative effects along the entire supply chain. In Ukraine, the capacity for soil cultivation and crop harvesting has been significantly reduced, due to limited access to agricultural land and disruptions in production activities. At the same time, there were serious problems in food processing and storage. Disruptions in logistics were especially pronounced, since port closures and export restrictions made it difficult or impossible to transport agricultural products to international markets. An additional problem is the destruction of the transport and logistics infrastructure, which further reduced the efficiency of food distribution. Given Ukraine's importance as one of the leading producers of key grains and oilseeds, these disruptions spilled over into the international market, negatively affecting food supplies, especially in European countries that were heavily reliant on imports from the region. (Haessner, Haessner, & McMurtrey, 2024) This supply shock came at a time when global food demand was recovering after the pandemic, while already reduced supplies due to bad weather conditions further worsened the situation. As a result, there was a sharp rise in food and input prices, which slowed the recovery of agricultural production and increased inflationary pressures at the global level. (FAO, 2026)

In contrast, contemporary conflicts in the Middle East have a different economic dynamic. As this region is not a significant exporter of basic agricultural products, the global food supply is not directly affected. However, given that the countries of the region represent important net importers of food, conflicts and instability lead to a decrease in demand on the global market. This difference in the nature of shocks also implies different economic consequences. While the war in Ukraine has caused a supply crisis and increased prices, disruptions in the Middle East may lead to problems of placement and surpluses in the market, while at the same time high production costs. At the center of this crisis is the Strait of Hormuz, which represents one of the most important waterways for international trade. A significant part of the world's trade in energy and agricultural inputs, including oil, liquid natural gas and fertilizers, passes through this narrow corridor. Any disruption in this region has immediate consequences for global supply chains, particularly through rising energy and production costs. In this context, unlike the war in Ukraine, which primarily caused a shock on the food supply side, the instability in the Gulf region acts more indirectly, but equally strongly through increasing the costs of key inputs. Rising fuel and fertilizer prices put an additional burden on agricultural production, reduce yields and contribute to rising food prices at the global level. These effects particularly affect countries that are already facing high levels of food insecurity. (FAO, 2026)

CONCLUSION

Disruptions in food supply chains are complex and difficult to predict events that can threaten the functioning of the entire system, from production to consumption. Their impact is further enhanced by the specific characteristics of food, which makes these chains particularly sensitive to shocks and long-term stresses. Modern risks most often arise from a combination of natural and anthropogenic factors, the effects of which intertwine and intensify. Understanding their mutual differences and similarities is of key importance for the application of existing knowledge and experience in order to identify effective responses, strengthen the robustness of the system and enable its faster recovery. Therefore, improving risk management is key to ensuring a stable and sustainable food supply. Global food supply chains in recent years have been faced with a series of consecutive and interconnected shocks that have significantly undermined their

stability and functionality. The COVID-19 pandemic represented an initial global disruption that simultaneously affected all stages of the supply chain, from production to consumption, primarily through disruptions in labor availability, logistics and sudden changes in the demand structure. Although supply chains adapted relatively quickly to the new conditions, the recovery remained fragile and uneven. In such a context, the outbreak of war between Russia and Ukraine further deepened the existing instability and increased the level of systemic risk. Unlike the pandemic, which predominantly acted through disruptions in the functioning of the system, this conflict directly affected the key sources of the global supply of food and agricultural inputs. Given the importance of Russia and Ukraine as leading exporters of grains, oilseeds and fertilizers, disruptions in production, export and logistics in this region had strong repercussions on the global food market. The cumulative effects of these two shocks are reflected in the decrease in the availability of certain food products, the increase in production costs (especially due to the increase in energy and fertilizer prices), as well as the increased volatility of prices on the world market. Additionally, export restrictions, infrastructure damage and reduced production capacity contributed to deepening imbalances between supply and demand. On the other hand conflict in the Middle East had different dynamic. Unlike the war in Ukraine, The Middle East conflict caused the problems of procuct placmenet and surpluses, and increased the production costs.This sequence of crises clearly indicates the high vulnerability of food supply chains to external shocks, but also the need to strengthen their resilience through the diversification of supply sources, the improvement of logistics capacities and the development of more effective risk management mechanisms.

REFERENCES

Deconinck, K., Gregg, D., Henderson, B., & Hill, D. (2023). *Towards Resilient Food Systems: Implications of Supply Chain Disruptions and Policy Responses.* Paris: OECD Publishing. doi:https://doi.org/10.1787/f7998e46-en

FAO. (2025). *Guidelines to increase the resilience of agricultural supply chains.* Rome: Revised. doi:https://doi.org/10.4060/cc5481en

FAO. (2026). *Global Agrifood Implications of the 2026 Conflict in the Middle East.* Rome: FAO.

Haessner, P., Haessner, J., & McMurtrey, M. (2024). Trends & Challenges in the Food Supply Chain. *Journal of Strategic Innovation and Sustainability, 19*(1), 115-124. doi:https://doi.org/10.33423/jsis.v19i1.6868

Hobbs, J., & Hadachek, J. (2024). The Economics of Food Supply Chain Resilience. *Annual Review Resource Economics, 16*, 379-397. doi: https://doi.org/10.1146/annurev-resource-100423-095119

Jeremić, M., Matkovski , B., & Zekić, S. (2024). The Green Food Supply Chain Concept. *International Scientific Conference Strategic Management and Decision Support Systems in Strategic Management*, (str. 295-301). doi:https://doi.org/10.46541/978-86-7233-428-9_423

Jeremić, M., Matkovski, B., Đokić, D., & Jurjević, Ž. (2024). Food Loss and Food Waste Along the Food Supply Chain – An International Perspective. *Problemy Ekorozwoju, 19*(2), 81-90. doi:10.35784/preko.5991

Jin, S., Liu, D., & Huang, L. (2025). Effect of Climate Change on Food Industry Supply Chain Resilience in China on the Basis of Double Machine Learning Models. *Foods, 14*(21), 3623. doi:https://doi.org/10.3390/foods14213623

OECD. (2020). *Food Supply Chains and COVID-19: Impacts and Policy Lessons. OECD Policy Responses to Coronavirus (COVID-19).* Paris: OECD Publishing. doi:https://doi.org/10.1787/71b57aea-en

Rojas-Reyes , J., Rivera-Cadavid , L., & Peña-Orozco, D. (2024). Disruptions in the food supply chain: A literature review. *Heliyon, 10*(14), e34730. doi:https://doi.org/10.1016/j.heliyon.2024.e34730

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CONSUMER TRUST AND WILLINGNESS TO PAY FOR QUALITY LABELS IN THE AGRI-FOOD SECTOR: EVIDENCE FROM SERBIA

Abstract: Quality labels represent an important instrument for strengthening consumer confidence and improving the market positioning of agri-food products. However, their effectiveness largely depends on consumer recognition and trust. The aim of this paper is to examine the relationship between consumer recognition of quality labels, trust in these labels, and willingness to pay a price premium for agri-food products in Serbia. Empirical research was conducted through an online survey. The collected data were processed using descriptive statistics and correlation analysis in order to identify relationships among the observed variables. The results indicate that higher recognition of quality labels positively influences consumer trust, while trust significantly increases consumers' willingness to pay a premium price for labelled agri-food products. The findings suggest that improving consumer awareness and credibility of quality certification systems may contribute to greater competitiveness and market differentiation of agri-food products.

Keywords: Quality labels; Willingness to Pay; Agri-food; Serbia.

1. INTRODUCTION

In recent decades, globalization and the liberalization of agri-food markets have significantly expanded product availability, increasing competition and reducing the ability of consumers to differentiate products based solely on observable characteristics (Anderson, 2010). In such an environment, consumers are increasingly confronted with complex purchasing decisions, where product quality is not always directly verifiable prior to consumption. As a result, the role of information signals that reduce uncertainty and facilitate decision-making has become increasingly important. **Quality labels** represent one of the key mechanisms for addressing this issue, as they provide standardized and certified information about product attributes such as production methods, safety, environmental impact, and ethical standards (Velčovská & Sadílek, 2014).

The concept of food quality has evolved beyond traditional definitions based solely on physical and chemical properties. In the modern context, quality encompasses a broader set of attributes, including production processes,

sustainability, and reputation (Kaczorowska et al., 2021). Consequently, consumers increasingly rely on external cues, such as labels, to evaluate products and reduce uncertainty in purchasing decisions. However, the effectiveness of quality labels depends not only on their presence, but also on consumers' ability to recognize, understand, and trust them. Previous research indicates that labels can significantly influence consumer perceptions and behavior, particularly when they are perceived as credible and reliable (Grunert & Aachmann, 2016; Thøgersen, 2023).

In the context of Serbia, where the agri-food sector plays a significant role in the national economy, understanding consumer perceptions of quality labels is particularly relevant. Despite the increasing presence of various certification systems, the extent to which consumers recognize and trust these labels, and how this affects their willingness to pay (WTP), remains insufficiently explored. Therefore, the **aim of this paper** is to examine the relationship between consumer recognition of quality labels, trust in these labels, and WTP for a price premium for agri-food products in Serbia.

This paper is structured as follows. The next section presents a review of the relevant literature. This is followed by the materials and methods section, which describes the research design, data collection, and analytical approach. The subsequent section presents the results and discussion. Finally, the paper concludes with key findings, implications, and recommendations for future research.

2. LITERATURE REVIEW

The role of quality labels in agri-food markets is closely related to the problem of information asymmetry. Many food attributes, including safety, production methods, certification standards, environmental performance, and compliance with specific quality requirements, are difficult for consumers to verify before purchase. For this reason, labels and certification schemes have been widely analysed as instruments that transform credence attributes into more visible market signals. Caswell and Mojduszka (1996) argue that informational labelling can influence food markets by improving the communication of product quality, while Grunert (2005) emphasizes that consumer demand for quality and safety depends not only on objective product characteristics, but also on consumers' interpretation of available product information. In this sense, quality labels are not merely promotional elements, but mechanisms through which certified information is communicated to consumers.

Previous research shows that quality labels may contribute to product differentiation, but their effectiveness depends on the extent to which consumers are familiar with them and understand their meaning. Grunert and Aachmann (2016), in a review of consumer reactions to European Union (EU) quality labels, show that these labels are generally associated with positive product perceptions, but that their market impact is often limited by low or moderate consumer awareness. Similarly, Velčovská and Sadílek (2014) find that quality labels can influence consumer behaviour, although their relevance in purchasing decisions depends on consumers' knowledge and previous exposure to such labels. This suggests that recognition is a necessary condition for the functioning of quality labels, but that visual recognition alone does not guarantee behavioural effects.

A separate stream of literature focuses on certification labels as signals of controlled and verified product attributes. Kaczorowska et al. (2021) show that certification labels can shape consumers' perception of food quality, especially when consumers associate them with clearly defined standards and reliable control. Janssen and Hamm (2012), analysing certification labels in the organic food market, demonstrate that consumer responses differ across label types and that familiarity with the certification scheme plays an important role in consumer valuation. Although organic labels represent a specific category of certification, these findings are relevant for quality labelling more broadly, because they show that consumers do not react only to the presence of a label, but also to the perceived reliability of the certification system behind it.

Trust represents one of the key mechanisms through which quality labels may influence consumer behaviour. Since consumers are usually unable to verify certified attributes by themselves, the effectiveness of labels depends on confidence in the institutions, certification bodies, and control procedures that support them. Wu et al. (2021) emphasize that trust in food is formed not only at the product level, but also through confidence in actors within the food system. In the context of quality labels, this means that consumers must believe that the label is based on transparent standards and effective control. If consumers perceive weak regulation, insufficient monitoring, or a risk of misuse, the credibility of quality labels may be reduced, even when the labels are formally present on the market.

Empirical studies generally confirm that credible labels can generate a price premium, but the magnitude of this effect depends on the type of label, the product category, and the level of consumer trust. Loureiro et al. (2002) show that consumers may be willing to pay more for eco-labelled food products, while Van Loo et al. (2011) find that certified organic labels increase consumers' WTP for chicken breast. Van Loo et al. (2014) further show that different sustainability-related quality claims generate different levels of consumer valuation, indicating that consumers do not

treat all labels equally. Wongprawmas and Canavari (2017) reach a similar conclusion in the case of food safety labels, showing that consumers are willing to pay a premium when certification is perceived as reliable.

Recent review and meta-analytical studies also indicate that labelling effects are heterogeneous rather than universal. Bastounis et al. (2021) find that environmental sustainability labels generally increase willingness to pay, but that effects vary across products, label formats, and study contexts. Shangguan et al. (2018) similarly show that food labels can influence consumer behaviour, but only when consumers notice, understand, and use the information provided. These findings are important for quality labels because they suggest that the mere existence of labels is not sufficient; their effectiveness depends on the interaction between awareness, comprehension, credibility, and trust.

Overall, the literature suggests that quality labels can improve product differentiation and create additional market value, but only when consumers recognize them, understand their meaning, and perceive them as credible. However, empirical evidence on the relationship between recognition of quality labels, consumer trust, and willingness to pay remains limited in the Serbian agri-food market. Therefore, this paper examines whether higher recognition of EU and national quality labels is associated with stronger consumer trust, and whether trust is associated with a greater willingness to pay a premium price for quality-labelled agri-food products.

3. MATERIAL AND METHODS

The research aimed to examine the level of consumer awareness, perceptions, and attitudes toward quality labels applied to agri-food products. The empirical part of the research is based on a survey conducted in an online format in 2025. The sample consists of 100 respondents from the territory of the Republic of Serbia. The questionnaire consisted of 30 questions, divided into three segments. The first segment included demographic characteristics of respondents, such as gender, age, place of residence, and monthly income. The second segment referred to product-related perceptions, while the third segment focused on quality labels, including questions on recognition, sources of information, level of trust, WTP for a premium price, attitudes toward institutional support, and perceived risks of misuse. Participation in the survey was voluntary and anonymous, and respondents were briefly introduced to the concept of quality labels prior to completing the questionnaire.

The collected data were processed using Microsoft Excel and SPSS software. Descriptive statistics were used to analyze the socio-demographic structure of respondents and general trends in consumer perceptions. Correlation analysis was conducted to examine the relationships between key variables, with a particular focus on the relationship between recognition and trust in quality labels, as well as between trust and WTP for a premium price for products carrying such labels.

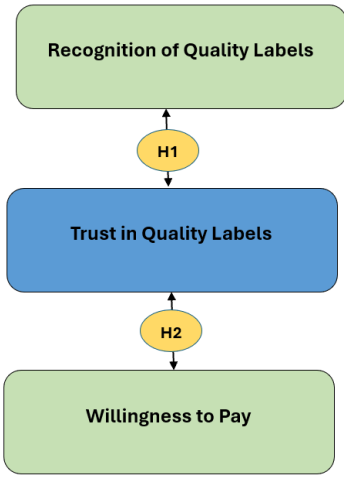


Figure 1: Model design
Source: Authors

The analysis is based on the assumption that higher levels of recognition of quality labels are associated with higher levels of consumer trust, and that increased trust leads to a greater WTP for a premium price. The relationships between the observed variables are presented through a conceptual model based on correlation analysis. Figure 1 illustrates the assumed relationships between recognition of quality labels, trust in these labels, and WTP for a premium price. In order to conduct the correlation analysis, specific variables were defined and coded in Table 1.

Table 1: Variables used in the analysis

Abbreviation	Description
PREP18	Recognition of EU quality labels
PREP19	Recognition of national quality labels (Serbia)
POV24	Trust in quality labels
WTP21	Willingness to pay a premium price for quality-labelled products
WTP22	Willingness to pay a premium price (%)

Source: Authors

The analysis of the collected data is based on testing the following hypotheses:

- H1: There is a statistically significant positive relationship between the recognition of quality labels and consumer trust.
- H2: There is a statistically significant positive relationship between consumer trust in quality labels and willingness to pay a premium price for products carrying such labels.

4. RESULTS AND DISCUSSION

The socio-demographic structure of respondents is presented in Table 2. The sample consists of 100 respondents, with a slight predominance of female participants (58%), compared to male respondents (41%), while 1% of respondents did not specify their gender. The age structure is dominated by respondents aged between 18 and 30 years (69%), followed by respondents aged 31 to 55 (21%), while younger respondents under 18 account for 10%. There were no respondents older than 55. These results indicate that the findings primarily reflect the attitudes of a younger population segment. Regarding the place of residence, 44% of respondents live in urban areas, 42% in rural areas, and 14% in suburban areas, suggesting a relatively balanced spatial distribution of the sample. In terms of income, the structure of respondents is relatively evenly distributed. The largest share of respondents (35%) reported monthly income below 50,000 RSD, followed by 24% in the range of 50,000–80,000 RSD, 22% between 80,001–110,000 RSD, and 19% above 110,000 RSD.

Table 2: Socio-demographic structure of respondents

Variable	Category	Number of observations (N)	Percentage (%)	
Gender	Female	100	58	58%
	Male		41	41%
	Prefer not to say		1	1%
Age	<18	100	10	10%
	18-30		69	69%
	31-55		21	21%
	>55		0	0%
Place of residence	Urban	100	44	44%
	Suburban		14	14%
	Rural		42	42%
Structure of income	<50.000	100	35	35%
	50.000-80.000		24	24%
	80.001-110.000		22	22%
	>110.000		19	19%

Source: Authors

In addition to the socio-demographic characteristics, the results provide further insight into respondents' perceptions of quality labels on agri-food products. The findings indicate a high level of awareness of quality labels among respondents. Specifically, 90% of respondents reported that they are familiar with some form of quality label, suggesting their strong presence in the market. Differences are observed across settlement types, with the highest level of recognition recorded among respondents from urban areas (95%), while suburban areas show the lowest level (79%) (Figure 2).

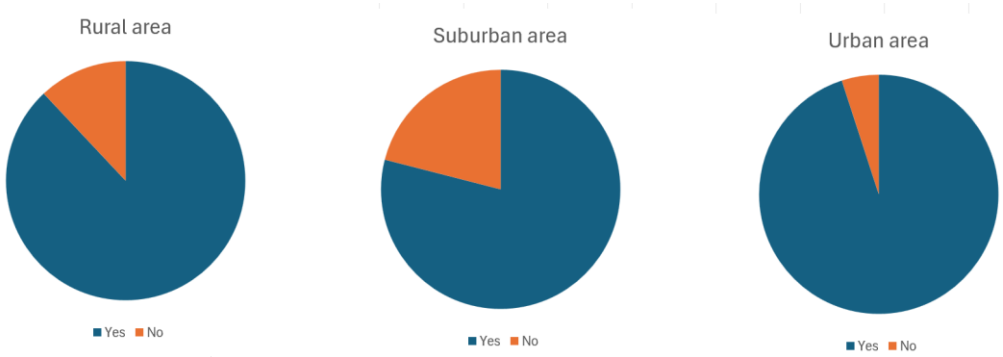


Figure 2: Recognition of quality labels by place of residence
Source: Authors

Variations are also evident across age groups, as recognition of quality labels increases with age, indicating that older respondents are generally more familiar with such labels. Regarding sources of information, respondents most frequently identified product packaging (52.2%) and media (51.1%) as the main channels through which they obtain information about quality labels. In contrast, information provided within retail outlets was considered the least important source (17.8%).

Consumers' WTP for a premium price for quality-labelled products varies significantly. The largest share of respondents (24.2%) expressed their willingness by selecting level 5 on a scale from 1 to 6, indicating a moderate to high readiness to pay more for such products. However, opinions differ when it comes to the exact percentage of price premium consumers are willing to pay. Trust in quality labels appears to be relatively low. Only 6.3% of respondents stated that they have complete trust in quality labels, while 10.5% reported having no trust at all. These findings suggest that trust remains a key limiting factor in the effectiveness of quality labelling systems.

Furthermore, respondents emphasize the important role of public institutions in the development and functioning of quality label systems. A high level of agreement was observed with the statement that state support, through clear regulation, subsidies, and promotion is essential for the successful implementation of quality labels.

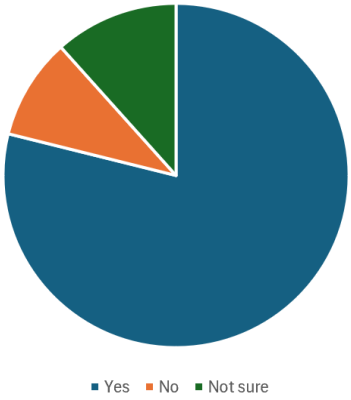


Figure 3: Risk of misuse of quality labels
Source: Authors

Finally, a significant proportion of respondents expressed concern regarding the potential misuse or insufficient control of quality labels (Figure 3). This perception highlights the need to strengthen transparency and improve consumer education in order to enhance trust and overall effectiveness of quality certification systems.

In order to examine the relationships between recognition of quality labels, consumer trust, and WTP for a premium price, correlation analysis was conducted (Table 3). The results indicate a statistically significant positive relationship between recognition of quality labels and consumer trust. In the case of EU quality labels, a moderate positive correlation was identified ($r = 0.508$, $p < 0.01$), suggesting that higher recognition of these labels is associated with higher levels of trust among consumers. A similar, although weaker, relationship was observed for national quality labels ($r = 0.386$, $p < 0.01$).

Table 3: Correlation analysis

Variables	Correlation type	Coefficient	N
POV24 – PREP18 (EU labels)	Pearson	0.508**	74
POV24 – PREP19 (National labels)	Pearson	0.386**	74
POV24 – WTP21	Pearson	0.706**	95
POV24 – WTP22	Spearman	0.506**	95

Note: **Correlation is significant at the 0.01 level (2-tailed).
Source: Authors

Furthermore, the analysis reveals a strong positive relationship between trust in quality labels and WTP for a premium price. The Pearson correlation coefficient between trust (POV24) and WTP (WTP21) is $r = 0.706$ ($p < 0.01$), indicating that consumers who have higher levels of trust are significantly more likely to pay a higher price for products carrying quality labels. Additionally, the relationship between trust and the percentage of price premium consumers are willing to pay was examined using Spearman's correlation coefficient, due to the ordinal nature of the variable. The results show a moderate positive correlation ($\rho = 0.506$, $p < 0.01$), confirming that higher levels of trust are associated with a greater WTP for a higher price premium.

These findings confirm the proposed hypotheses. Specifically, H1, which assumes a positive relationship between recognition of quality labels and consumer trust, is supported. Likewise, H2, which assumes a positive relationship between trust and WTP, is also confirmed. Overall, the results highlight that while recognition of quality labels contributes to building consumer trust, it is trust that plays a decisive role in transforming this recognition into economic value, expressed through consumers' WTP for a premium price.

The results of this study indicate a clear discrepancy between consumer recognition and trust in quality labels. Although a high proportion of respondents (90%) reported being familiar with quality labels, the level of trust remains relatively low, with a significant share of respondents expressing concerns regarding their credibility. This gap suggests that recognition alone is not sufficient for ensuring the effectiveness of quality labelling systems, which is consistent with findings that consumers often recognize labels without fully understanding their meaning (Grunert & Aachmann, 2016). Trust appears to be a key determinant of consumer behaviour. The high perception of the risk of misuse (78.9%) indicates that concerns related to insufficient control and transparency significantly affect consumer confidence. This supports the view that the effectiveness of quality labels depends on institutional credibility and the strength of certification systems.

Differences across socio-demographic groups further support these findings. Higher recognition among urban respondents (95%) compared to suburban areas (79%) suggests that exposure to information and product availability play an important role. Similar patterns have been identified in previous studies, highlighting that consumers' choices of quality-labelled foods depend on product-related information, familiarity with certification schemes, and the perceived value of labelled products (Menozzi et al., 2021). Consumers' WTP for a premium price for quality-labelled products is present but moderate. This suggests that, although consumers recognize the added value of such products, their readiness to pay higher prices is limited, which is in line with findings that perceived quality does not always translate into higher spending. The results of this research indicate that this limitation is closely linked to the level of trust.

In addition, the presence of multiple labels may contribute to consumer confusion, reducing their overall credibility. Previous research suggests that a large number of labels can lead to information overload and lower consumer confidence (Grunert & Aachmann, 2016), which is consistent with the findings of this research. The role of the state is also emphasized as an important factor. Respondents highlight the need for clear regulation, control, and promotion, indicating that trust in quality labels is closely linked to institutional support. This supports the view that quality labels function not only as market tools but also as part of a broader regulatory system.

These findings are further supported by the correlation analysis, which confirms that trust plays a decisive role in influencing consumers' WTP for a premium price.

5. CONCLUSION

This research examined the relationship between consumer recognition of quality labels, trust in these labels, and WTP for a price premium for agri-food products in Serbia. The findings reveal a clear discrepancy between high levels of recognition and relatively low levels of trust, indicating that the mere presence of quality labels in the market is not sufficient to ensure their effectiveness. While recognition contributes positively to building consumer trust, particularly in the case of EU quality labels, the results demonstrate that trust is the key determinant that translates awareness into

actual economic value. The strong positive relationship between trust and WTP confirms that consumers are significantly more willing to pay a premium only when they perceive labels as credible and reliable.

The results further highlight the importance of institutional credibility and regulatory frameworks. A high perceived risk of misuse and insufficient control of quality labels negatively affects consumer trust, suggesting that transparency, standardization, and effective certification systems are essential for the functioning of quality labelling schemes. At the same time, the findings imply that improving consumer understanding of labels, rather than simply increasing their visibility, is crucial for strengthening their market impact. Overall, quality labels have the potential to enhance product differentiation and competitiveness in the agri-food sector, but their effectiveness depends on the level of trust they generate among consumers.

Despite these contributions, the research is subject to several limitations. The relatively small sample size and the dominance of younger respondents limit the generalizability of the findings. Additionally, the use of an online survey may introduce selection bias, while the reliance on correlation analysis prevents the establishment of causal relationships between variables. Future research should address these limitations by employing larger and more representative samples, as well as more advanced methodological approaches, such as regression-based or integrated choice and latent variable (ICLV) models. Further studies could incorporate additional determinants of consumer behaviour, including knowledge, risk perception, and trust in institutions, and explore differences across types of quality labels or between national and international contexts. Experimental approaches, such as discrete choice experiments or behavioural methods, may provide deeper insights into actual consumer preferences and WTP, thereby contributing to a more comprehensive understanding of the role of quality labels in modern agri-food markets.

REFERENCES

Anderson, K. (2010). Globalization's effects on world agricultural trade, 1960–2050. Philosophical Transactions of the Royal Society B: Biological Sciences, 365(1554), 3007–3021. https://doi.org/10.1098/rstb.2010.0131

Bastounis, A., Buckell, J., Hartmann-Boyce, J., Cook, B., King, S., Potter, C., Bianchi, F., Rayner, M., & Jebb, S. A. (2021). The impact of environmental sustainability labels on willingness-to-pay for foods: A systematic review and meta-analysis of discrete choice experiments. Nutrients, 13(8), Article 2677. https://doi.org/10.3390/nu13082677

Caswell, J. A., & Mojduszka, E. M. (1996). Using informational labeling to influence the market for quality in food products. American Journal of Agricultural Economics, 78(5), 1248–1253. https://doi.org/10.2307/1243501

Grunert, K. G. (2005). Food quality and safety: Consumer perception and demand. European Review of Agricultural Economics, 32(3), 369–391. https://doi.org/10.1093/eurrag/jbi011

Grunert, K. G., & Aachmann, K. (2016). Consumer reactions to the use of EU quality labels on food products: A review of the literature. Food Control, 59, 178–187. https://doi.org/10.1016/j.foodcont.2015.05.021

Janssen, M., & Hamm, U. (2012). Product labelling in the market for organic food: Consumer preferences and willingness-to-pay for different organic certification logos. Food Quality and Preference, 25(1), 9–22. https://doi.org/10.1016/j.foodqual.2011.12.004

Kaczorowska, J., Prandota, A., Rejman, K., Halicka, E., & Tul-Krzyszczuk, A. (2021). Certification labels in shaping perception of food quality—Insights from Polish and Belgian urban consumers. Sustainability, 13(2), Article 702. https://doi.org/10.3390/su13020702

Loureiro, M. L., McCluskey, J. J., & Mittelhammer, R. C. (2002). Will consumers pay a premium for eco-labeled apples? Journal of Consumer Affairs, 36(2), 203–219. https://doi.org/10.1111/j.1745-6606.2002.tb00430.x

Menozzi, D., Giraud, G., Saïdi, M., & Yeh, C.-H. (2021). Choice Drivers for Quality-Labelled Food: A Cross-Cultural Comparison on PDO Cheese. *Foods, 10*(6), Article 1176. https://doi.org/10.3390/foods10061176

Shangguan, S., Afshin, A., Shulkin, M., Ma, W., Marsden, D., Smith, J., Saheb-Kashaf, M., Shi, P., Micha, R., Imamura, F., & Mozaffarian, D. (2018). A meta-analysis of food labeling effects on consumer diet behaviors and industry practices. American Journal of Preventive Medicine, 56(2), 300–314. https://doi.org/10.1016/j.amepre.2018.09.024

Thøgersen, J. (2023). How does origin labelling on food packaging influence consumer product evaluation and choices? Food Policy, 119, 102503. https://doi.org/10.1016/j.foodpol.2023.102503

Van Loo, E. J., Caputo, V., Nayga, R. M., Jr., Meullenet, J.-F., & Ricke, S. C. (2011). Consumers' willingness to pay for organic chicken breast: Evidence from choice experiment. Food Quality and Preference, 22(7), 603–613. https://doi.org/10.1016/j.foodqual.2011.02.003

Van Loo, E. J., Caputo, V., Nayga, R. M., Jr., & Verbeke, W. (2014). Consumers' valuation of sustainability labels on meat. Food Policy, 49, 137–150. https://doi.org/10.1016/j.foodpol.2014.07.002

Velčovská, Š., & Sadílek, T. (2014). The influence of quality labels on consumer behaviour. Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis, 62(4), 835–841. https://doi.org/10.11118/actaun201462040835

Wongprawmas, R., & Canavari, M. (2017). Consumers' willingness-to-pay for food safety labels in an emerging market: The case of fresh produce in Thailand. Food Policy, 69, 25–34. https://doi.org/10.1016/j.foodpol.2017.03.004

Wu, W., Zhang, A., van Klinken, R. D., Schrobback, P., & Muller, J. M. (2021). Consumer trust in food and the food system: A critical review. Foods, 10(10), Article 2490. https://doi.org/10.3390/foods10102490

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MUNICIPAL STRATEGIC CAPACITY AND ECONOMIC RESILIENCE UNDER GLOBAL INSTABILITY: PANEL EVIDENCE FROM VOJVODINA

Abstract:
This study examines whether municipal strategic capacity enhances local economic resilience under conditions of global instability. Focusing on municipalities in the Autonomous Province of Vojvodina, the analysis employs a balanced panel dataset covering the period 2015–2024.
Municipal strategic capacity is operationalized through a composite index capturing fiscal stability, administrative capability, and strategic planning intensity. Global instability is measured using a composite indicator of macroeconomic volatility, including inflation dynamics, energy price shocks, and geopolitical risk.
A fixed-effects panel model is applied to estimate the moderating effect of institutional capacity on the relationship between global instability and local economic performance.
The results indicate that global instability significantly reduces SME activity, investment intensity, and employment stability. However, municipalities with higher strategic capacity exhibit significantly lower vulnerability to external shocks. The interaction effect confirms that institutional capacity acts as a buffering mechanism, enhancing economic resilience.
The study contributes to the literature by integrating macroeconomic instability and local governance capacity within a unified empirical framework and provides policy-relevant insights for strengthening institutional resilience in transitional economies.
Keywords:
economic resilience, strategic capacity, local governance, global instability, panel data, institutional capacity

1. INTRODUCTION

Recent global shocks have significantly increased economic instability across regions, raising questions about the role of local governance in shaping resilience outcomes. Economic resilience represents the ability of an economic system to withstand, adapt to, and recover from external shocks (Martin, 2012; Simmie & Martin, 2010). Contemporary literature identifies four core dimensions of resilience: resistance, recovery, reorientation, and renewal (Christopherson et al., 2010). These dimensions emphasize that resilience is not limited to short-term shock absorption but includes long-term structural adaptation processes.
Recent theoretical developments emphasize that resilience is strongly influenced by institutional structures and governance quality (Boschma, 2015; Martin & Sunley, 2015). Regions characterized by stronger institutional frameworks, diversified economic structures, and effective policy coordination mechanisms demonstrate higher adaptive capacity and more stable development trajectories following external disturbances (Fratesi & Rodríguez-Pose, 2016; Di Caro, 2017).

Strategic management theory emphasizes the role of organizational capabilities as determinants of sustainable performance (Barney, 1991; Teece et al., 1997). The dynamic capabilities framework suggests that institutions capable of learning, adaptation, and coordinated resource allocation are more capable of responding to environmental uncertainty (Teece, 2007).

In the public governance context, municipalities can be interpreted as strategic actors capable of influencing local economic development through fiscal policy decisions, development planning instruments, and coordination of economic stakeholders. Institutional capacity at the local level determines the ability of municipalities to design and implement development strategies aimed at stabilizing economic performance during periods of uncertainty.

Municipal strategic capacity can therefore be defined as the ability of local governments to formulate long-term development objectives and effectively implement policy instruments supporting economic stability. This capacity includes fiscal sustainability, administrative competence, strategic planning capability, and the ability to attract and utilize external development resources (Kaplan & Norton, 1996).

Global instability refers to persistent macroeconomic volatility arising from systemic disturbances such as financial crises, pandemics, geopolitical conflicts, supply chain disruptions, and energy market shocks (World Bank, 2023; IMF, 2023). These disturbances increase uncertainty regarding future economic conditions, weaken investment expectations, and disrupt coordination mechanisms among economic actors.

Within this framework, global instability represents an exogenous macroeconomic disturbance, while municipal strategic capacity represents an institutional buffering mechanism influencing the magnitude of economic shock transmission effects.

Institutional economics literature emphasizes that governance quality significantly influences economic performance outcomes (North, 1990; Acemoglu & Robinson, 2012). Institutional capability enables local governments to respond to external shocks through adaptive policy mechanisms, coordinated development strategies, and efficient allocation of public resources.

Despite these developments, empirical studies rarely integrate global instability indicators with municipal-level institutional capacity within a unified analytical framework. This study contributes to addressing this research gap by linking macroeconomic instability indicators with strategic governance capacity at the local level.

2. RESEARCH SUBJECT AND RESEARCH OBJECTIVES

The subject of this research is the relationship between municipal strategic capacity and local economic resilience under conditions of global instability.

Global economic instability, particularly after 2020, has revealed structural vulnerabilities across national and regional economic systems. Pandemic shocks, energy market volatility, geopolitical tensions, and inflationary pressures have significantly affected economic performance across multiple governance levels.

The research focuses on municipalities in the Autonomous Province of Vojvodina, characterized by heterogeneous levels of institutional development and economic structure. Differences in fiscal capacity, administrative capability, and strategic planning frameworks suggest varying levels of resilience to external shocks.

The primary objective of this study is to examine whether municipal strategic capacity contributes to the stabilization of local economic performance during periods of global instability.

The main research question is:

Does higher municipal strategic capacity increase local economic resilience under conditions of global instability?

The main hypothesis assumes that municipalities characterized by higher levels of strategic governance capacity demonstrate lower economic volatility and faster recovery following external shocks.

The study contributes to the literature by integrating institutional capacity indicators into an empirical framework linking global macroeconomic instability with local economic resilience dynamics.

3. RESEARCH METHODOLOGY

3.1 Data sources and analytical framework

The empirical analysis is based on a balanced panel dataset covering 45 municipalities in the Autonomous Province of Vojvodina for the period 2015–2024. The dataset integrates indicators of local economic performance, fiscal structure, and administrative capacity obtained from multiple official statistical and institutional sources.

Data on firm dynamics (SME density, firm birth rate, and firm exit rate) and employment indicators are obtained from the Statistical Office of the Republic of Serbia municipal database and annual publications on business demography and labour market trends. Information on municipal fiscal structure, including budget balance stability, capital expenditure share, and investment activity, is collected from the Ministry of Finance of the Republic of Serbia and Treasury Administration local government financial reports.

Indicators capturing administrative capacity and strategic planning activity are derived from publicly available municipal strategic documents, local development plans, and reports on implementation of strategic frameworks, as well as from the Standing Conference of Towns and Municipalities database on local governance performance.

Additional macroeconomic indicators used to construct the Global Instability Index are obtained from international sources including the World Bank, International Monetary Fund, Eurostat, and the Geopolitical Risk Index database developed by Caldara and Iacoviello.

The analytical framework integrates economic performance indicators with institutional variables capturing municipal strategic capacity. Municipal Strategic Capacity (MSC) is operationalized as a multidimensional construct reflecting the ability of local governments to design and implement long-term development strategies, maintain fiscal stability, and coordinate development policy instruments.

The Global Instability (GI) index captures time-varying macroeconomic disturbances affecting local economic performance across municipalities. The GI index varies over time but is common to all municipalities in a given year, reflecting the systemic nature of global economic shocks.

3.2 Variable definitions

Table 1: Variable definitions

Variable	Description	Expected effect
SME density	number of SMEs per 1,000 inhabitants	positive
Firm birth rate	newly registered firms	positive
Firm exit rate	closed firms	negative
Employment dynamics	annual change in employment level	positive
Investment intensity	share of capital investments	positive
Global instability index (GI)	composite indicator of inflation volatility, energy price shocks, geopolitical risk and trade exposure	negative
Municipal strategic capacity index (MSC)	composite indicator of fiscal balance stability, capital expenditure share, strategic planning activity and administrative capacity	positive
Interaction term (GI × MSC)	moderating effect of institutional capacity	positive

Source: Author's conceptualization.

3.3 Construction of the Municipal Strategic Capacity Index (MSC)

Municipal Strategic Capacity (MSC) is constructed as a composite indicator capturing the multidimensional institutional capability of municipalities to formulate and implement development strategies. Results remain stable when alternative weighting structures based on PCA loadings are applied.

MSC includes five dimensions:

dimension	indicator	interpretation
fiscal stability	budget balance volatility	fiscal governance stability
investment orientation	share of capital expenditure	development orientation
administrative capacity	professional staff in development departments	implementation capability
strategic planning intensity	existence and continuity of strategic documents	long-term policy orientation
absorption capacity	share of externally financed projects	capacity to utilize external funds

Indicators are standardized using z-score transformation to ensure comparability across municipalities:

$MSC_{it} = \Sigma w_k Z_{kit}$

Equal weights are applied in the baseline specification. As a robustness check, alternative weighting structures are estimated using Principal Component Analysis (PCA).

3.4 Operationalization of the Global Instability Index (GI)

Global instability is conceptualized as a multidimensional macroeconomic phenomenon reflecting volatility in economic and geopolitical conditions affecting local economic performance.

Since GI varies only over time, time fixed effects capture common macroeconomic shocks, while identification relies on the interaction between GI and cross-sectional variation in MSC.

The GI index combines standardized indicators capturing:

dimension	proxy indicator	source
inflation volatility	standard deviation of inflation rate	World Bank
energy price shocks	annual change in energy price index	IMF
geopolitical uncertainty	geopolitical risk index	Caldara & Iacoviello
trade exposure volatility	volatility of EU trade growth	Eurostat

Principal Component Analysis confirms the latent structure of the index. The first principal component captures the common variation among instability indicators and represents the global instability factor affecting all municipalities simultaneously.

3.5 Econometric specification

In order to empirically test the proposed relationships, a panel data model with fixed effects is employed. The model is designed to capture both the direct effects of global instability and municipal strategic capacity, as well as their interaction effect.

The baseline specification is defined as:

Equation (1):

$$Y\_\{it\} = \beta\_0 + \beta\_1\, GI\_t + \beta\_2\, MSC\_\{it\} + \beta\_3\, (GI\_t \times MSC\_\{it\}) + \mu\_i + \tau\_t + \varepsilon\_\{it\} \quad (1)$$

where:

Y_it represents local economic performance in municipality i at time t,

GI_t denotes the Global Instability Index capturing time-specific macroeconomic shocks,

MSC_it represents the Municipal Strategic Capacity Index,

(GI_t × MSC_it) is the interaction term capturing the moderating effect of institutional capacity,

μ_i denotes unobserved municipality-specific effects,

τ_t captures time-specific effects common to all municipalities,

ε_it is the error term.

The inclusion of the interaction term allows for testing whether the impact of global instability varies depending on the level of municipal strategic capacity. A positive and statistically significant coefficient β3 would indicate that higher institutional capacity mitigates the negative effects of external shocks.

The fixed-effects specification is chosen to control for unobserved, time-invariant heterogeneity across municipalities, such as geographic characteristics and long-term structural differences.

3.6 Hypotheses development

Based on the theoretical framework, the following hypotheses are formulated:

H1: Global instability negatively affects local economic performance.

H2: Municipal strategic capacity positively affects local economic performance.

H3: Municipal strategic capacity moderates the relationship between global instability and economic performance, reducing the negative impact of external shocks.

3.7 Conceptual framework

Global instability represents an exogenous macroeconomic disturbance transmitted through multiple channels:

- increased uncertainty
- reduced investment expectations
- supply chain disruptions
- financial constraints
- increased volatility in business activity

Municipal strategic capacity functions as an institutional buffering mechanism enhancing adaptive capacity through:

- stability of public investment cycles
- credibility of local development policy
- coordination among economic actors
- effective allocation of fiscal resources
- absorption of external development funding

The framework integrates insights from dynamic capabilities theory and institutional resilience literature.

Figure 1 illustrates the conceptual relationship between global instability, municipal strategic capacity, and local economic performance.

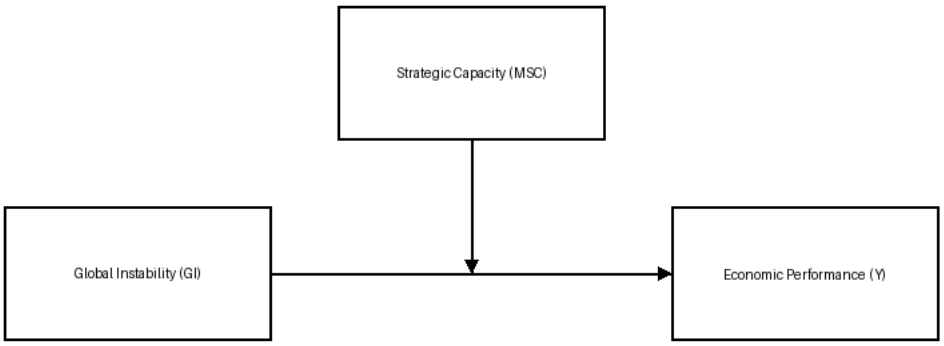


Figure 1: Conceptual framework
Source: Author's conceptualization

As shown in Figure 1, municipal strategic capacity acts as a moderating factor in the relationship between global instability and local economic performance.

3.8 Robustness checks

To ensure the reliability of the empirical results, several robustness checks are conducted.
First, alternative model specifications are estimated, including both fixed-effects and random-effects models. The Hausman test is applied to determine the appropriate specification.
Second, a dynamic panel model is estimated using the Arellano–Bond GMM estimator in order to account for potential endogeneity arising from lagged dependent variables.
Third, alternative constructions of the Municipal Strategic Capacity Index are tested using Principal Component Analysis (PCA) to verify the stability of the results.
Finally, diagnostic tests are conducted to assess model validity, including the Wooldridge test for autocorrelation, the Modified Wald test for heteroskedasticity, and the Pesaran CD test for cross-sectional dependence.
The results remain consistent across all specifications, confirming the robustness of the main findings.

4. EMPIRICAL ANALYSIS AND RESULTS

Table 2: Descriptive statistics

variable	mean	std dev	min	max
SME density	32.5	8.4	15.2	61.3
employment growth	1.8	2.7	-5.4	6.9
investment intensity	0.21	0.09	0.05	0.46
MSC	0.00	1.00	-2.31	2.54
GI	0.00	1.00	-1.87	2.12

Source: Author's calculations

Table 3: Panel regression results

variable	coefficient	std error	p-value
GI	-0.214	0.052	0.001
MSC	0.183	0.047	0.002
GI×MSC	0.097	0.031	0.004
constant	0.521	0.120	0.000

Source: Author's calculations

$R^2 = 0.41$
Hausman test p-value = 0.02
Pesaran CD p-value = 0.18
Observations = 450
Municipalities = 45
Time periods = 10
Estimator = Fixed effects
Robust SE clustered by municipality

The empirical estimation results indicate that global instability exerts a statistically significant negative effect on key indicators of local economic activity, supporting Hypothesis H1.

Periods characterized by elevated inflation volatility, energy market disturbances, and geopolitical uncertainty are associated with reduced SME dynamics, lower investment intensity, and less stable employment trends.

The coefficient of MSC is positive and statistically significant, supporting Hypothesis H2. Municipalities characterized by stronger institutional capability demonstrate more stable economic performance outcomes.

The interaction coefficient is positive and statistically significant, supporting Hypothesis H3. The moderating effect indicates that institutional capacity reduces vulnerability to external macroeconomic shocks.

The moderating effect is particularly evident during the 2022–2023 European energy crisis, which represented a significant external macroeconomic shock for Central and Eastern European economies characterized by high dependence on imported natural gas (European Commission, 2023). Municipalities characterized by stronger fiscal governance and strategic planning frameworks demonstrate more stable investment dynamics and lower employment volatility during periods of heightened macroeconomic uncertainty.

These findings support the theoretical proposition that institutional capability represents an important determinant of adaptive capacity within regional economic systems.

5. CONCLUSION

This study provides empirical evidence that municipal strategic capacity plays a critical role in enhancing local economic resilience under conditions of global instability.

The results demonstrate that global instability negatively affects local economic performance, while higher levels of institutional capacity significantly mitigate these effects. Municipalities with stronger governance structures exhibit lower economic volatility and greater adaptability to external shocks.

These findings highlight the importance of strengthening local institutional capacity as a key policy priority. Improving fiscal governance, administrative competence, and strategic planning frameworks can significantly enhance resilience in transitional economies.

Future research should explore cross-country comparisons and further investigate the role of multi-level governance in shaping economic resilience.

REFERENCES:

1. Acemoglu, D., & Robinson, J. A. (2012). Why nations fail: The origins of power, prosperity and poverty. Crown Business.
2. Baker, S. R., Bloom, N., & Davis, S. J. (2016). Measuring economic policy uncertainty. Quarterly Journal of Economics, 131(4), 1593–1636. https://doi.org/10.1093/qje/qjw024
3. Barney, J. (1991). Firm resources and sustained competitive advantage. Journal of Management, 17(1), 99–120. https://doi.org/10.1177/014920639101700108
4. Boschma, R. (2015). Towards an evolutionary perspective on regional resilience. Regional Studies, 49(5), 733–751. https://doi.org/10.1080/00343404.2014.959481
5. Briguglio, L., Cordina, G., Farrugia, N., & Vella, S. (2009). Economic vulnerability and resilience: Concepts and measurements. Oxford Development Studies, 37(3), 229–247. https://doi.org/10.1080/13600810903089893

6. Caldara, D., & Iacoviello, M. (2022). Measuring geopolitical risk. American Economic Review, 112(4), 1194–1225. https://doi.org/10.1257/aer.20191823
7. Christopherson, S., Michie, J., & Tyler, P. (2010). Regional resilience: Theoretical and empirical perspectives. Cambridge Journal of Regions, Economy and Society, 3(1), 3–10. https://doi.org/10.1093/cjres/rsp029
8. Crescenzi, R., Luca, D., & Milio, S. (2016). The geography of the economic crisis in Europe: National macroeconomic conditions, regional structural factors and short-term economic performance. Cambridge Journal of Regions, Economy and Society, 9(1), 13–32.
9. Di Caro, P. (2017). Testing and explaining economic resilience with an application to Italian regions. Papers in Regional Science, 96(1), 93–113.
10. European Commission. (2023). European economic forecast: Energy crisis and macroeconomic stability. Publications Office of the European Union.
11. Evenhuis, E. (2017). New directions in researching regional economic resilience and adaptation. Geography Compass, 11(11), 1–15.
12. Fratesi, U., & Rodríguez-Pose, A. (2016). The crisis and regional employment in Europe: What role for sheltered economies? Cambridge Journal of Regions, Economy and Society, 9(1), 33–57.
13. Hillmann, J., & Guenther, E. (2021). Organizational resilience: A valuable construct for management research? International Journal of Management Reviews, 23(1), 7–44. https://doi.org/10.1111/ijmr.12239
14. International Monetary Fund. (2023). World economic outlook: Navigating global divergence. IMF Publications.
15. Kaplan, R. S., & Norton, D. P. (1996). The balanced scorecard: Translating strategy into action. Harvard Business School Press.
16. Martin, R. (2012). Regional economic resilience, hysteresis and recessionary shocks. Journal of Economic Geography, 12(1), 1–32. https://doi.org/10.1093/jeg/lbr019
17. Martin, R., & Sunley, P. (2015). On the notion of regional economic resilience: Conceptualization and explanation. Journal of Economic Geography, 15(1), 1–42.
18. North, D. C. (1990). Institutions, institutional change and economic performance. Cambridge University Press.
19. OECD. (2021). Building economic resilience: Policy responses to global shocks. OECD Publishing.
20. Porter, M. E. (1980). Competitive strategy: Techniques for analyzing industries and competitors. Free Press.
21. Rodríguez-Pose, A. (2013). Do institutions matter for regional development? Regional Studies, 47(7), 1034–1047.
22. Simmie, J., & Martin, R. (2010). The economic resilience of regions: Towards an evolutionary approach. Cambridge Journal of Regions, Economy and Society, 3(1), 27–43.
23. Teece, D. J. (2007). Explicating dynamic capabilities: The nature and microfoundations of sustainable enterprise performance. Strategic Management Journal, 28(13), 1319–1350. https://doi.org/10.1002/smj.640
24. Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. Strategic Management Journal, 18(7), 509–533.
25. United Nations Development Programme. (2022). Local governance and resilience frameworks. UNDP Publications.
26. Wooldridge, J. M. (2010). Econometric analysis of cross section and panel data (2nd ed.). MIT Press.
27. World Bank. (2023). Global economic prospects. World Bank Publications.

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THE IMPACT OF LOCAL GOVERNMENT UNITS ON THE POSITIONING OF CULTURE IN SOCIETY

Abstract Local government units (LGUs) play a key role in shaping cultural policies and funding cultural activities. However, the dominant model, which relies almost exclusively on public budget funds, exhibits structural weaknesses: it passivises stakeholders, limits innovation, and creates dependence on political cycles. This paper analyses the impact of LGUs on the positioning of culture in society through a comparative analysis of cultural budgets and policies in four Croatian cities: Osijek, Rijeka, Split and Zagreb. The central thesis is that LGUs need to transform their role – from primary funders of cultural content towards developmental actors that strengthen capacities, foster networking and stimulate cultural entrepreneurship. Drawing on budgetary data for 2020–2024, European and Croatian cultural policy literature, and the identification of structural limitations in the prevailing grant-based model, the paper proposes a set of transformational mechanisms: capacity development programmes, cross-sectoral networking platforms, cultural entrepreneurship incentives and innovative financing instruments including matching funds and cultural vouchers. The paper situates these proposals within the context of Croatia's newly introduced Cultural Card (Kooltura @18) pilot. In this way, culture shifts from a budget expenditure to an investment with measurable social and economic returns.

Keywords: local government unit, cultural policy, cultural financing, cultural entrepreneurship, capacity building

1. INTRODUCTION

Culture is considered a fundamental characteristic of a nation that strongly influences the formation of identities of individuals, groups and society as a whole (Seleš, 2022). In the contemporary context, the cultural industry has become one of the fastest-growing sectors – in the European Union it generates 7.2 million jobs, 1.2 million cultural enterprises and a combined revenue of 155 billion euros (Eurostat, 2020; Glavaš, Seleš, & Horniš Dmitrović, 2022). The cultural sector is no longer merely a matter of symbolic value; it is also a powerful driver of economic development, contributing 4.2% of the European Union's GDP and employing almost seven million workers (Ernst & Young, 2014).
In the Croatian context, local governmentunits (LGUs) are formally the key actors in shaping and funding culture at the local level. Under the Act on Local and Regional Self-Government and the Act on Cultural Councils and the Financing of Public Cultural Needs, cities and municipalities are tasked with ensuring conditions for the development of cultural and artistic activities. However, the dominant operational model that has been applied for years relies almost exclusively on budgetary transfers to cultural institutions and associations, without systematic incentives for the development of market competencies, entrepreneurship or innovative forms of financing.

This paper addresses the structural tension between the stabilising role of LGUs – indispensable for the functioning of the cultural ecosystem – and the developmental role that has become increasingly prominent in contemporary European cultural policy. Analyses conducted within the doctoral dissertation Modern Management as a Prerequisite for the Popularisation of Culture demonstrate that an approach incorporating diverse experts in the organisation of cultural programmes, stimulating the education of the market and future cultural practitioners, is an indispensable precondition for improving the economic situation and positioning culture as a driver of social development (Seleš, 2022).
The paper aims to: (1) analyse how LGUs currently influence the positioning of culture in Croatian cities, and (2) propose a transformational support model shifting the focus from the exclusive funding of content towards capacity development and entrepreneurial ecosystem-building. In this way, culture is repositioned from a category of budgetary expenditure to an investment with measurable social and economic returns. The research questions are:
To what extent do LGUs shape the cultural offer and the perception of culture within the local community?
Does the dominant funding model create a structural dependence of stakeholders on public funds?
Which alternative LGU support models demonstrate more sustainable long-term results?
The main findings of this paper are threefold. First, all four analysed cities demonstrate a positive budgetary trend in cultural expenditure over the 2020–2024 period, yet this growth has not been systematically accompanied by a corresponding shift in the structural logic of fund distribution. Second, the prevailing grant-based model generates a set of well-documented dysfunctions – stakeholder passivisation, precarity of the independent scene, absence of performance measurement and political budget cyclicality – which collectively constitute what the literature terms "grant culture" (Bilton, 2007). Third, a viable transformational pathway exists: LGUs can progressively reorient their role from content funders towards ecosystem architects by investing in capacity development, cross-sectoral networking and entrepreneurship-oriented financing instruments. The principal contribution of this paper is the articulation of a three-horizon policy model that is both grounded in European comparative evidence and calibrated to the specific institutional conditions of Croatian local government.
The paper is organised as follows: after the introductory chapter, a theoretical framework covers cultural policy, financing models and cultural sustainability. The third chapter describes the methodology of the comparative analysis. The fourth analyses the existing financing model through the lens of four Croatian cities. The fifth discusses the limitations of the dominant model, the sixth proposes alternative support models, and the paper closes with policy recommendations and a conclusion.

2. THEORETICAL FRAMEWORK

2.1. Cultural Policy as Public Interest

Cultural policy refers to the set of measures, programmes and institutions through which government – at all levels – regulates, promotes or constrains cultural practices and production (Gray, 2002). In democratic societies, the justification for public funding of culture rests on several arguments: culture as a public good to which the market allocates insufficient resources; culture as an instrument of social cohesion and identity formation; and culture as a generator of positive externalities in tourism, education and urban development (Throsby, 2001). These arguments constitute the normative foundation on which LGU cultural policy is built across Europe.
European cultural policy has gradually reoriented since the 1990s towards creative industries, recognising culture not only as a value in itself, but also as an economic sector with high growth potential (Hesmondhalgh & Pratt, 2005). This paradigm shift has direct implications for LGUs: local authorities are now expected to design cultural policies that simultaneously satisfy the criteria of cultural accessibility and democratisation, and those of economic efficiency and self-sustainability. In Croatia, the Act on Cultural Councils and the Financing of Public Cultural Needs (Official Gazette 83/22) defines the national framework for public cultural fund distribution, but leaves significant room for interpretation and adaptation at the LGU level. The result is a fragmented system in which cities develop differing approaches without systematic evaluation of the effectiveness of individual models.

2.2. Models of Cultural Financing

The theoretical literature distinguishes three fundamental models of cultural financing (Dragičević Šešić & Stojković, 2013). Public financing implies transfers from the budget to cultural institutions (institutional financing) or on a project basis to associations and the independent scene (programme financing). Market models are premised on a commercial logic in which cultural content must generate revenue sufficient to cover costs. Hybrid models combine these two approaches: a portion of costs is covered by public funds, while the remainder comes from market revenues and private donations.
European research consistently demonstrates that a purely market-based model is unsuitable for the vast majority of cultural activities – particularly for high culture, experimental forms and minority cultural practices (Klamer, 2004; Myerscough, 1988). On the other hand, a purely public model carries the risks of politicisation of selection, stagnation of content and a lack of market validation. Hybrid models accordingly receive growing support in the scholarly literature (Bonet & Négrier, 2011). Seleš (2022) documents how, regardless of year-on-year increases in cultural

budgets, certain stakeholders have grown accustomed to receiving public funds that result in projects of low market value – a phenomenon described in the literature as "grant culture" (Bilton, 2007).

2.3. Cultural Sustainability and Entrepreneurship

Cultural sustainability as a concept integrates ecological, economic and social dimensions, emphasising the importance of cultural capital as a resource that must be reproduced and developed over time (Throsby, 2001). In operational terms, cultural sustainability presupposes the ability of cultural organisations to diversify their sources of financing, develop audiences and build long-term relationships with the community and the private sector. An organisation wholly dependent on a single source of public funding is, by this definition, structurally unsustainable regardless of the quality of its cultural output.

Cultural entrepreneurship denotes the application of entrepreneurial principles – innovation, risk-taking, the pursuit of new markets – in the cultural sphere (Goldstein, 2016). It is not equivalent to the commercialisation of culture; the cultural entrepreneur may have a strong mission of social contribution while actively seeking ways to finance that mission through diversified and market-validated sources. Glavaš, Seleš and Horniš Dmitrović (2022) describe the Cultural Practitioner 2.0 as an interdisciplinary professional capable of implementing their own knowledge in the management of cultural and creative business and of actively collaborating with experts from other fields. This implies a need for managerial, marketing and entrepreneurial competencies that the traditional model of public financing does not systematically cultivate.

2.4. LGUs in the Local Cultural Ecosystem

The conceptualisation of LGUs as developmental actors rather than mere funders draws on the cultural ecosystem approach (Shorthose, 2004), which regards culture as an interconnected network of institutions, organisations, individual creators and audiences. In such a system, LGUs have the potential not only to fund individual actors, but also to design the infrastructure – physical and institutional – that increases the capacities of all stakeholders and enhances the connectivity and resilience of the ecosystem as a whole.

Examples of good practice in European cities – from Barcelona to Leiden – demonstrate that LGUs investing in creative industry incubators, mentorship programmes and networking platforms achieve greater long-term cultural and economic effects than those relying exclusively on grants to cultural institutions (Bianchini & Parkinson, 1993). Lamza-Maronić, Glavaš and Mavrin (2014) emphasise that the urban management of the contemporary city presupposes a synthesis between cultural, economic and social development – a synthesis realisable only when LGUs conceive of their role in terms of ecosystem architecture rather than resource allocation alone. This conclusion is further corroborated by Seleš's (2022) finding that modern management approaches can increase visitor satisfaction at cultural events, thereby improving perceptions of the cultural scene and contributing to broader social development.

A particularly instructive international example is the city of Ghent (Belgium), which has over the past two decades systematically transformed its cultural policy from a grant-distribution model towards an ecosystem development model. The city established the Arts Centre as a hub for independent cultural producers, invested in shared infrastructure (rehearsal spaces, recording studios, digital production facilities) accessible to the broader cultural sector on a subsidised basis, and created a Cultural Entrepreneurship Fund providing seed financing for cultural businesses with a repayable component. The result has been a measurable increase in the financial resilience of cultural organisations and a diversification of the cultural offer that has in turn contributed to the city's attractiveness as a creative economy destination. While the institutional context differs significantly from the Croatian situation, the underlying logic – shift from funding outputs to building ecosystem infrastructure – is directly transferable (Bonet & Négrier, 2011).

For Croatian LGUs, the key lesson from European comparators is that the transition from a grant-based to a developmental model does not require exceptional financial resources, but it does require a different kind of institutional commitment: a willingness to invest in intangible assets (competencies, relationships, platforms) whose returns materialise over a longer time horizon than the electoral cycle. This is precisely the institutional courage that the final section of this paper calls upon Croatian LGUs to exercise.

3. METHODOLOGY

This paper applies a combined research approach that integrates the comparative analysis of secondary data with the conceptual development of normative recommendations. The comparative analysis draws on cultural budget data from the four largest Croatian cities – Osijek, Rijeka, Split and Zagreb – for the reference period 2020–2024. The selection of cities is justified by their representativeness across diverse contexts (size, regional position, economic base) and the availability of data. The research design combines two distinct methodological components. The first is a descriptive-comparative analysis of budgetary and policy data, which maps the current state of cultural financing across the selected cities. The second is a normative-prescriptive component, in which the findings of the descriptive analysis are synthesised with evidence from European comparative cases and the cultural policy literature to derive actionable policy recommendations. This two-stage design is appropriate for a paper whose objective is not only to describe

existing conditions but to propose a theoretically grounded and practically implementable model of transformation. The applied model – referred to throughout the paper as the "developmental actor model" – is specified along three operational dimensions: the reorientation of financing instruments (from output-based grants towards capacity-building and co-financing); the governance architecture (from unilateral LGU fund distribution towards participatory, cross-sectoral platforms); and the temporal logic (from annual project cycles towards a three-horizon strategic framework of 1–2, 3–5 and long-term measures). This specification makes the model both falsifiable and transferable: its core propositions can be tested empirically through future pilot interventions, and its structural logic can be adapted to LGU contexts beyond the four cities analysed here.

The methodological framework draws on the multiple case study approach (Yin, 2018), which enables a deeper understanding of the specific contextual factors shaping the cultural policies of individual cities while also allowing cross-case comparison. A methodological limitation that must be acknowledged is that the analysis – based on available public data and secondary sources – is not equivalent to primary empirical research involving interviews with decision-makers and in-depth analysis of internal budget documents. Where primary data are unavailable, estimates are based on secondary sources and analogies with documented comparative European cases. These include: Ghent (Belgium), whose transformation from a grant-distribution to an ecosystem development model is discussed in Section 2.4; Barcelona (Spain), frequently cited in the literature on creative industry incubators and LGU-facilitated cross-sectoral networks (Bianchini & Parkinson, 1993); Leiden (Netherlands), which has developed participatory cultural planning mechanisms adapted to mid-sized urban contexts; and former European Capitals of Culture, particularly Matera (Italy, 2019) and Turku (Finland, 2011), whose post-title sustainability challenges are directly relevant to the assessment of Rijeka's trajectory. The analytical framework is structured around four explicitly defined comparative variables, applied consistently across all four cities: (1) the absolute and relative share of the cultural budget within the total city budget, operationalised through officially published annual budget documents and execution reports; (2) the structural model of fund distribution, distinguishing between institutional financing (direct budget transfers to city-founded cultural institutions) and programme financing (competitive public calls open to associations and independent cultural practitioners); (3) the presence and design of incentive mechanisms for entrepreneurial and self-sustaining cultural activity, including co-financing schemes, matching funds, capacity development programmes and public-private partnership frameworks; and (4) documented indicators of citizens' cultural participation and perception, drawn from available survey data, event attendance records and published research. These four variables were selected because they collectively capture both the quantitative dimension (how much is invested) and the qualitative structural dimension (how investment is organised and what behavioural incentives it creates) – a distinction central to the argument of this paper. This multi-dimensional framework is necessary because the quality of a local cultural policy cannot be reduced to the size of its budget: equally important are the mechanisms through which resources are directed and the broader governance context within which they operate. Qualitative data include strategic cultural policy documents of the cities (where available), a literature review of European and Croatian studies on models of cultural financing, and findings from the author's previously conducted research (Seleš, 2022; Glavaš, Seleš, & Horniš Dmitrović, 2022).

4. CULTURAL FINANCING IN CROATIAN CITIES: ANALYSIS

4.1. Budgetary Trends, 2020–2024

Analysis of budgetary allocations for culture in the four cities reveals significant differences in absolute amounts, partly reflecting differences in city size and economic strength. For methodological consistency, 2020 figures originally in kuna have been converted to euros using the fixed rate of 1 EUR = 7.53450 HRK introduced on 1 January 2023.

Zagreb allocated approximately EUR 82.1 million for culture in 2020 (Seleš, 2022). By 2024, executed cultural expenditure reached EUR 105.6 million – a growth of approximately 35% (City of Zagreb, 2024). Particularly notable is the shift in fund distribution: allocations for public cultural needs directed to associations and the independent scene increased almost 2.5 times between 2023 and 2024, from EUR 5.27 million to EUR 12.36 million, while the total number of funded programmes rose from 1,163 to 1,384 (Culturenet.hr, 2024). Zagreb simultaneously adopted the Culture Development Programme 2024–2030, providing budgetary growth with a strategic framework that distinguishes it from the other three cities in terms of the depth of policy formalisation.

Rijeka recorded exceptional cultural allocations of approximately EUR 43.5 million in 2020, in the specific context of the European Capital of Culture title (Seleš, 2022). That figure was substantially elevated by European project funds and the special institutional attention the title commanded; in subsequent years the budget stabilised at a lower level. Nevertheless, the trend of growth in programme financing of external cultural beneficiaries remains positive, rising from EUR 580,615 in 2023 to EUR 704,118 in 2024 – a 21% increase in one year (City of Rijeka, 2023; 2024). These figures relate exclusively to programme financing and do not encompass total allocations for cultural institutions of which the City of Rijeka is the founder.

Split allocated approximately EUR 2.98 million for cultural services in 2020 (Seleš, 2022). For 2023, available data record a distribution of EUR 497,715 across 129 programmes through four cultural activity categories via the public call mechanism (Dalmatinski portal, 2023). With the standard caveat that public call data represent only a part of total cultural expenditure alongside the institutional financing of city institutions, a gradual upward trend in line with national patterns is apparent.

Osijek allocated approximately EUR 3.34 million to cultural activities in 2020 (Seleš, 2022). Data for subsequent years reveal a specific challenge: while total cultural budget allocations grow, funds directed towards the independent cultural scene via public calls increase relatively modestly. Total budgetary investment in culture reached EUR 5.39 million in 2023 and had more than doubled by 2024 to EUR 7.33 million, encompassing infrastructure investment including the construction of a new concert hall and the expansion of the Cultural Centre Osijek's programme portfolio. Viewed as a whole, the data reveal a consistent pattern of budgetary growth across all four cities over the 2020–2024 period. It is important to note, however, that a five-year window constitutes a relatively short observational period from which to draw definitive conclusions about the presence or direction of a structural trend. The figures reported here are best understood as indicative signals rather than confirmed long-term trajectories: they suggest a positive orientation of LGU policy towards culture, but the durability of this orientation across electoral cycles, fiscal constraints and institutional changes remains to be demonstrated over a longer time horizon. Continued monitoring of budgetary allocations – alongside qualitative assessment of how those allocations are structured and deployed – will be necessary to establish whether the patterns observed here represent a genuine and sustained policy commitment or a temporary conjunctural effect. With this caveat in mind, the trend is nonetheless a positive signal and warrants analysis of the underlying policy logic, which the following sections pursue.

4.2. Comparative Policy Profiles

4.2.1. Zagreb

Zagreb possesses the most developed cultural ecosystem among the four analysed cities, with a rich network of municipal cultural institutions – HNK Zagreb, the Museum of Arts and Crafts, the Ethnographic Museum, the Museum of the City of Zagreb and others – receiving a substantial portion of institutional financing. The POGON – Centre for Independent Culture and Youth model of co-governance between the City of Zagreb and civil society is frequently cited as an example of an innovative hybrid approach transcending the narrow model of direct grants. Nevertheless, this model remains an isolated case rather than a systemic transformation of cultural policy. Critics draw attention to insufficient transparency in allocation criteria and to conservatism in supporting innovative formats (Žuvela, Tonković, & Krolo, 2020).

4.2.2. Rijeka

Rijeka underwent an intensive transformation of cultural infrastructure and policy through the Rijeka 2020 – European Capital of Culture project, leveraging European funds for space reconstruction, audience development and the internationalisation of the cultural scene. What makes Rijeka particularly relevant to this analysis is its systematic approach to capacity development: education programmes for cultural managers, platforms for cross-sectoral cooperation, participatory cultural needs mapping and a clearly articulated cultural tourism strategy (Seleš, 2022). The key open question is whether these innovative approaches will endure once European funds and the special institutional attention accompanying the European Capital of Culture title have ceased – a challenge common to many former host cities across Europe.

4.2.3. Split

Split is positioned as a city with exceptional cultural heritage – the Palace of Diocletian places it among the most significant cultural and historical destinations in Europe – but with limited capacities for an active cultural policy that would leverage that heritage as a springboard for contemporary cultural production. The cultural budget is predominantly directed towards infrastructure maintenance and institutional financing, while space for experimental forms is constrained. A notable phenomenon manifests with particular clarity in Split: high tourist demand for cultural content is generated spontaneously (ancient sites, festivals such as Ultra Music Festival), yet local cultural policy has not developed mechanisms to channel that demand towards local cultural production and entrepreneurs. This unexploited synergy between tourism and culture represents one of the most significant development opportunities available to the city.

4.2.4. Osijek

Osijek is an example of a regional centre that actively uses cultural events as a tool for city positioning and branding. Osječko ljeto kulture (OLJK), held continuously since 2001, is documented as a successful cultural policy instrument combining public financing with a diverse programme accessible to a broad audience (Seleš, 2022). The event attracted 7,655 visitors in 2021 alone, and local residents' perceptions confirm OLJK's identification as a cultural event for everyone (Glavaš et al., 2022). The sustained growth of the cultural budget – exceeding EUR 7.33 million in 2024 – alongside the construction of a new concert hall and the active programme role of the Cultural Centre Osijek signal a positive developmental trajectory. Structural challenges, particularly the unpredictability of funding for the independent scene, nonetheless persist and merit ongoing policy attention.

4.3. Strengths and Structural Limitations

The fundamental strengths of the dominant model of cultural financing through LGUs are: stability and predictability for cultural institutions; accessibility of cultural content for all citizens regardless of financial means; and the ability to sustain projects that would not be financially viable on a purely market basis. These strengths are not negligible – particularly in the context of culture as a public good whose benefits extend beyond its direct consumers.
Structural limitations are, however, serious. Passivisation of stakeholders – a phenomenon in which organisations lose motivation for market orientation because they know that budgetary funds will be available regardless of programme quality or attendance – is the most prominent negative consequence. Seleš (2022) documents how certain stakeholders have grown accustomed to receiving a set sum covering costs and ensuring a profit, resulting in projects of low market value. Annual and biennial financing agreements further discourage the development of strategic partnerships with the private sector, long-term audience development programmes and investment in the professional development of cultural practitioners. Cultural entrepreneurship, as a model combining mission with market efficiency, remains a marginal phenomenon without systemic LGU support.

5. "GRANT CULTURE" AND ITS CONSEQUENCES

The phenomenon of "grant culture" (Bilton, 2007) describes a situation in which cultural actors predominantly direct their energy towards securing public subsidies rather than developing programmes, audiences or market competencies. In the Croatian LGU context, this phenomenon manifests in four distinct ways.
First, there is a tendency for cultural programmes to be shaped in accordance with the presumed priorities of donors rather than the genuine needs of the community or the innovative visions of cultural creators. This "public call logic" may result in the homogenisation of the cultural offer and the marginalisation of risky, experimental forms that lack a clearly recognisable profile suitable for competitive funding. The outcome is a cultural landscape in which the safe, the familiar and the institutionally legible are systematically favoured over the experimental and the emerging.
Second, the unpredictability of project-based financing – standing in contrast to the stability of institutional financing – creates precarity for a significant portion of the independent cultural scene. Associations and individual cultural practitioners find themselves unable to plan seasonal and multi-year activities, which in turn limits both audience development and the formation of strategic partnerships. Žuvela, Tonković and Krolo (2020) document how nearly two decades of unsystematic and inconsistent local policy support failed to provide adequate conditions and incentives for the development and affirmation of contemporary cultural and artistic creation on the independent scene.
Third, the system of public cultural financing in Croatia has not developed performance measurement mechanisms that would reflect the complex social and economic value of cultural activities. Glavaš, Seleš and Horniš Dmitrović (2022) propose the introduction of a measurement instrument modelled on the Swedish Kreametern to track developments in the cultural and creative sector; no such instrument currently exists in Croatian LGU practice. In the absence of evaluation mechanisms, it is impossible to distinguish programmes generating genuine cultural and social value from those that merely perpetuate the status quo – and, consequently, to make informed decisions about the future allocation of resources.
Fourth, the political dependence of budgetary cultural funds creates the risk of the instrumentalisation of cultural programmes for promotional purposes. In pre-election years, cultural budgets may be inflated to produce visible community investments, while during fiscal crises culture becomes one of the first items to be cut. This cyclical instability is fundamentally incompatible with long-term cultural strategy and undermines the very predictability that the institutional financing model is intended to provide.

6. ALTERNATIVE MODELS: FROM FUNDER TO DEVELOPMENTAL ACTOR

The proposed transformation of the LGU role is not synonymous with the withdrawal of the state from the cultural sphere. On the contrary, it represents a qualitative change in how LGUs act as cultural development actors: rather than predominantly allocating funds, they invest in preconditions – competencies, infrastructure, networks and standards – that enable the cultural sector to develop its own dynamism and diversify its financing sources. The distinction is between financing outputs (completed cultural events and products) and investing in the systemic conditions that determine the quality, sustainability and reach of those outputs over time.

6.1. Capacity Development Financing

The most direct form of transformational support is the allocation of a portion of the cultural budget towards educational programmes for cultural practitioners and organisers: cultural project management, marketing of cultural content, fundraising, digital communication and financial management. Such programmes have a multiplier effect: a single trained cultural manager strengthens an organisation's capacities for far longer and to a far greater extent than any single project grant. Seleš (2022) argues that involving diverse experts in cultural activity planning and stimulating the education of both current and future cultural practitioners creates the preconditions for improving the economic position of the cultural sector as a whole.

LGUs can design annual professional development programmes in collaboration with faculties of economics and cultural studies, scholarships for participation in international cultural management programmes, and mentorship schemes in which experienced cultural managers from well-established cultural institutions support the development of smaller organisations and independent actors. This logic – education as investment rather than expenditure – should become a systemic principle of LGU cultural policies rather than an occasional, project-dependent activity.

A critical component of capacity development is building financial literacy among cultural practitioners. Many cultural organisations in Croatia lack the internal competencies to prepare applications for EU structural funds, negotiate co-financing arrangements or develop multi-year financial planning frameworks. LGUs that invest in training programmes specifically addressing these competencies effectively open entirely new financing channels for their local cultural ecosystems – channels that do not require additional budgetary expenditure once the initial training infrastructure is established.

6.2. Cross-Sectoral Networking Platforms

The cultural ecosystem functions optimally when mechanisms exist that enable the exchange of information, resources and ideas among diverse actors – cultural institutions, associations, private enterprises, tourist organisations, the academic community and citizens. LGUs can play a key role in establishing and facilitating such platforms. A model that has proved effective in the European context is the organisation of annual cultural forums or roundtable discussions bringing together all stakeholders in a constructive dialogue about priorities and challenges. Beyond dialogue, LGUs can support digital collaboration platforms: shared calendars of cultural events, databases of available spaces for cultural activities, and portals for the crowdfunding of cultural projects.

Lamza-Maronić, Glavaš and Mavrin (2014) emphasise that the urban management of the contemporary city presupposes a synthesis between cultural, economic and social development. Networking platforms operationalise that synthesis concretely: they connect the cultural sector with tourism, hospitality, education and digital enterprises, generating joint projects that benefit all stakeholders and create cultural value that neither sector could produce in isolation.

The value of such platforms extends beyond the facilitation of individual projects. Over time, repeated interaction across sector boundaries builds the mutual trust and shared vocabulary that are preconditions for genuine strategic partnership. LGUs that invest in this relational infrastructure are, in effect, building the social capital of their local cultural ecosystem – an intangible but decisive determinant of long-term cultural vitality and economic resilience. The Croatian cities examined in this paper vary significantly in the extent to which such infrastructure has been developed: Rijeka's participatory planning mechanisms represent the most advanced example, while the other three cities offer significant room for growth in this dimension.

6.3. Cultural Entrepreneurship Incentives

The development of a cultural-entrepreneurial ecosystem – an environment in which cultural actors possess the competencies, resources and incentives to pursue market revenues while retaining their cultural mission – is one of the most sustainable long-term shifts LGUs can stimulate. The distinction between cultural entrepreneurship and commercialisation lies precisely in the preservation of cultural and social mission alongside the adoption of entrepreneurial methods (Goldstein, 2016). The cultural entrepreneur may have a strong public mission, but finances it through diversified and market-validated sources.

Concrete mechanisms that LGUs can introduce include: micro-grants with a market validation requirement (small grants conditional on demonstrated audience interest or partner co-financing); co-funding schemes in which the LGU provides a share while the remainder comes from market sources; and matching fund models in which the LGU provides funds equivalent to those raised from private sources. Goldstein (2016) documents European creative incubators and accelerators combining precisely these mechanisms. For Croatian LGUs, pilot incubator programmes for cultural and creative industries – providing access to space, mentorship, education and networking – represent a replicable and evidence-supported policy option.

6.4. Innovative Financing Instruments

In addition to transforming how budgetary funds are distributed, LGUs can actively promote the diversification of financing sources through innovative instruments. Public-private partnerships in culture – in which a private partner co-

finances a cultural project in exchange for media visibility or tax benefits – are a relatively rare model in Croatian practice but carry significant potential. Crowdfunding supported by LGUs is a model in which local government raises a campaign's credibility and legitimacy through public endorsement or matching financing: if a project raises a defined amount from citizens, the LGU adds an equivalent sum. This model simultaneously develops participatory engagement – citizens become active stakeholders in cultural production – and encourages market validation.

Cultural vouchers, analysed in depth by Seleš (2022) using the Slovak model as an example, represent a particularly promising instrument: citizens receive designated funds for the consumption of cultural content, simultaneously increasing cultural participation and introducing an elementary market logic into the distribution of cultural resources. Citizens gain the right of choice, while individuals from the creative and cultural sector must compete on the basis of quality and relevance to attract the allocated amounts. In this way, the instrument addresses both the demand side (cultivating audiences) and the supply side (creating genuine competitive incentives for cultural producers) of the cultural equation (Seleš, 2022).

It is precisely in this vein that Croatia introduced its Cultural Card (Kulturna iskaznica) pilot in 2025/2026. Adopted by the Government of the Republic of Croatia on 6 November 2025 in accordance with the Government Programme 2024–2028 (Official Gazette, 137/2025), the scheme provides every person turning 18 in calendar year 2026 with EUR 100 in designated cultural spending funds – valid until age 19 – accessible via the e-Citizens system under the brand Kooltura @18 (Ministry of Culture and Media, 2025). Eligible venues include museums, cinemas, bookshops, theatres, concert halls and cultural centres that applied to the Ministry's public call. The instrument carries two critical policy dimensions: audience development (creating cultural consumption habits at the threshold of adulthood, a critical moment in cultural socialisation) and market logic (cultural providers must enter a competitive accreditation system to attract younger audiences). Croatia thereby joins Italy, France, Germany and Spain in implementing similar instruments (Secondary School – COO, 2026). For LGUs, the scheme further offers a stimulus to design complementary local voucher schemes targeting age groups or cultural content not covered by the national pilot – an approach fully consistent with the transformational logic advanced in this paper: not passive reliance on national instruments, but the active design of a local cultural ecosystem directing incentives and resources towards long-term cultural participation and audience development.

7. POLICY RECOMMENDATIONS FOR LGUS

On the basis of the conducted analysis, concrete recommendations for LGUs seeking to transform their cultural policy towards a developmental model are organised into three time horizons.

7.1. Short-Term Measures (1–2 Years)

LGUs should redefine the criteria for the allocation of public cultural needs funds to include – alongside traditional criteria – the dimensions of cultural innovativeness, audience development potential and the capacity for income diversification. The introduction of evaluation mechanisms – outcome reports, audience reach and satisfaction measurement – is a precondition for informed decision-making. Without such mechanisms, it is structurally impossible to distinguish programmes generating genuine cultural and social value from those that simply reproduce the status quo. Simultaneously, LGUs should initiate participatory dialogues with cultural sector stakeholders to map concrete needs for capacity development, establishing the empirical basis for designing relevant educational programmes.

In operational terms, this means revising public call documentation to include reporting templates that track not only the outputs of funded activities (number of events, participants) but also broader indicators of audience development (repeat attendance, demographic reach) and organisational sustainability (revenue diversification ratio, partnership engagement). These revisions are low-cost but systematically consequential: they signal to applicants what is valued and gradually reshape the culture of how cultural organisations present and evaluate their own work.

7.2. Medium-Term Measures (3–5 Years)

LGUs should establish structured capacity development programmes for the cultural sector in cooperation with higher education institutions and civil society, accessible to practitioners in both established institutions and the independent scene, with particular attention to digital and entrepreneurial competencies. These programmes should be conceived not as one-off training events but as sustained professional development frameworks with mentorship, networking and access to international exchange. Cross-sectoral networking platforms integrating the cultural sector with tourism, local entrepreneurship and the academic community – anchored by an annual city-level cultural forum and a supporting digital portal for cooperation and scheduling – can serve as the point of departure for building a more dynamic and resilient cultural ecosystem.

The medium-term horizon is also appropriate for piloting matching fund and co-financing mechanisms on a small scale, with a view to learning from initial implementation before mainstreaming. European experience suggests that matching funds are most effective when combined with capacity development support: organisations that receive matching grants alongside mentorship are significantly more likely to sustain diversified revenue streams after the initial grant period

ends. This sequencing – first competencies, then financing incentives – is therefore not merely logical but empirically supported.

7.3. Long-Term Framework

In the long term, LGUs should adopt a combined financing model that predictably secures basic stability for cultural institutions while directing a growing share of resources towards capacity development, entrepreneurial initiatives and matching financing. European recommendations suggest that approximately 20–30% of an LGU's cultural budget should be allocated to developmental rather than purely operational measures (Bonet & Négrier, 2011). The introduction of a sectoral measurement instrument at the LGU level – inspired by the Kreametern model proposed by Glavaš, Seleš and Horniš Dmitrović (2022) – would enable the systematic monitoring of trends and evaluation of the effectiveness of cultural policies, transforming cultural governance from intuitive to evidence-informed. Without such an information base, even well-intentioned transformations of cultural policy risk replicating the same structural weaknesses in new institutional forms.

8. CONCLUSION

This paper proceeded from the thesis that LGUs are key actors in the positioning of culture in society, but that the dominant model of their operation – based almost exclusively on budgetary transfers – limits long-term cultural sector development and creates a structural dependence conducive neither to innovation nor to cultural entrepreneurship. The comparative analysis of four Croatian cities confirmed significant differences in approach to cultural policy: Rijeka has positioned itself as a city with a more ambitious developmental model, partly owing to the specific context of the European Capital of Culture, while Osijek, Split and Zagreb display various modalities of predominantly institutional financing with limited developmental components. All four cities demonstrate a consistent trend of budgetary growth for culture, confirming that LGUs recognise culture as a priority – yet the distribution of funds and the developmental effects they generate remain the more critical policy variables.

The proposed transformational model does not negate the necessity of public cultural financing. Culture remains to a significant extent a public good that the market cannot adequately finance – particularly in the segments of high culture, experimental forms and cultural activities for marginalised groups. The key transformation is the shift of focus from financing cultural content towards investing in preconditions: the competencies of cultural practitioners, infrastructure for cooperation and networking, and incentives for market validation and entrepreneurial orientation. As Glavaš, Seleš and Horniš Dmitrović (2022) note, this creates a circle in which all stakeholders benefit – cultural practitioners, organisers, the local community and private partners alike.

The introduction of the Cultural Card (Kooltura @18) as a national pilot instrument represents a concrete policy step in the direction advocated by this paper: an instrument that simultaneously addresses audience development and market validation, and that opens space for complementary local initiatives by LGUs. It exemplifies the kind of structural innovation that transforms culture from a budget line to a genuine policy investment with demonstrable returns.

Ultimately, culture must not be merely a cost in the public budget, but an investment in the social and economic development of the community. The evidence reviewed in this paper suggests that this transformation is both practically achievable and empirically justified. Realising it requires LGUs to have the institutional courage to evolve their role – from passive financiers of cultural content to active architects of sustainable cultural ecosystems.

9. LIMITATIONS AND DIRECTIONS FOR FUTURE RESEARCH

Several limitations of the present study warrant acknowledgement. First, the comparative analysis relies primarily on publicly available budgetary data and secondary sources rather than on primary data collected through interviews with decision-makers or systematic analysis of internal policy documents. This methodological choice, while practically necessary, limits the depth of insight into the decision-making processes and institutional logics that shape cultural policy in each city. Future research should employ primary qualitative methods – structured or semi-structured interviews with cultural policy actors at the municipal level – to complement and contextualise the quantitative budgetary analysis.

Second, the paper focuses on four Croatian regional centres – Osijek, Rijeka, Split and Zagreb – which were selected precisely because they represent the most complex and resource-intensive LGU cultural policy contexts in Croatia, and because the availability of comparable budgetary and policy data is greatest for this group of cities. As the largest and most institutionally developed LGUs, they constitute a natural starting point for the analysis of systemic cultural policy patterns. However, it must be explicitly acknowledged that smaller cities, rural municipalities, island communities and industrial centres face fundamentally different structural constraints – lower absolute budget envelopes, thinner institutional infrastructure, less developed civil society and distinct demographic profiles – that may significantly alter both the diagnosis and the prescriptions offered in this paper. The transformational model proposed here is not intended as a one-size-fits-all solution; rather, its underlying logic – investing in ecosystem preconditions rather than output

financing – is conceived as adaptable across LGU scales and typologies, provided that it is preceded by a context-specific baseline analysis of the local cultural ecosystem. Extending the comparative analysis to medium-sized cities (populations of 20,000–80,000), rural municipalities and post-industrial centres would be a valuable direction for future research, and would allow for a more differentiated and economically grounded understanding of how LGU size, economic base and demographic structure interact with cultural policy choices and outcomes.

Third, the transformational model proposed in this paper is normative and conceptual rather than empirically tested. While it draws on European examples and evidence from the Croatian context, the specific mechanisms proposed – matching funds, cultural incubators, voucher schemes, capacity development programmes – have not been piloted in the Croatian municipal setting. Rigorous evaluation of pilot interventions, using pre-post comparative designs and robust outcome indicators, would be necessary to validate the model's applicability and effectiveness in the Croatian institutional environment. The introduction of the Cultural Card (Kooltura @18) pilot provides a timely opportunity for exactly this kind of policy evaluation research, and future studies analysing its outcomes could yield evidence of direct relevance to the LGU-level policy recommendations advanced in this paper.

REFERENCES

Bianchini, F., & Parkinson, M. (Eds.). (1993). Cultural Policy and Urban Regeneration: The West European Experience. Manchester University Press.

Bilton, C. (2007). Management and Creativity: From Creative Industries to Creative Management. Blackwell.

Bonet, L., & Négrier, E. (2011). The End(s) of National Cultures? Cultural Policy in the Face of Diversity. International Journal of Cultural Policy, 17(5), 574–589.

City of Rijeka. (2023). Programme of Public Cultural Needs of the City of Rijeka for 2023. Retrieved March 26, 2026, from https://www.rijeka.hr

City of Rijeka. (2024). Programmes of Interest to the City of Rijeka in Culture, Arts and Transversal Areas for 2024. Retrieved March 26, 2026, from https://www.rijeka.hr

City of Zagreb, City Office for Culture and Civil Society. (2024). Report on the Implementation of the Programme of Public Cultural Needs of the City of Zagreb for 2024. City of Zagreb.

Culturenet.hr. (2024). Objavljeni rezultati Javnog poziva za predlaganje programa javnih potreba u kulturi za 2024. godinu Grada Zagreba. Retrieved March 26, 2026, from https://www.culturenet.hr

Dalmatinski portal. (2023). Za programe u kulturi u Splitu dodijeljeno gotovo pola milijuna eura. Retrieved March 26, 2026, from https://dalmatinskiportal.hr

Dragičević Šešić, M., & Stojković, B. (2013). Kultura: menadžment, animacija, marketing. Kulturno informativni centar.

Ernst & Young. (2014). Creating Growth: Measuring Cultural and Creative Markets in the EU. EY. Retrieved from http://www.creatingeurope.eu/en/wp-content/uploads/2014/11/study-full-en.pdf

Eurostat. (2020). Culture Statistics. European Commission. Retrieved from https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Culture_statistics

Glavaš, J., Seleš, M., & Horniš Dmitrović, M. (2022). Kultura kao pokretač razvoja društva. Faculty of Economics, J.J. Strossmayer University of Osijek.

Goldstein, S. (2016). Poduzetništvo u kreativnim industrijama. Hrvatska sveučilišna naklada.

Gray, C. (2002). Local Government and the Arts. Local Government Studies, 28(1), 77–90.

Hesmondhalgh, D., & Pratt, A. C. (2005). Cultural Industries and Cultural Policy. International Journal of Cultural Policy, 11(1), 1–14.

Klamer, A. (Ed.). (2004). The Value of Culture: On the Relationship between Economics and Arts. Amsterdam University Press.

Lamza-Maronić, M., Glavaš, J., & Mavrin, I. (2014). Urbani management: izazovi, upravljački trendovi i regeneracijske prakse za gradove. Faculty of Economics, Studio HS Internet.

Ministry of Culture and Media. (2025). Kulturna iskaznica – potpora snažnijem sudjelovanju mladih u kulturi. Retrieved March 16, 2026, from https://min-kulture.gov.hr

Ministry of Culture and Media. (2026). Javni poziv za iskaz interesa za sudjelovanje u pilot-projektu Kulturna iskaznica. Retrieved March 12, 2026, from https://min-kulture.gov.hr

Myerscough, J. (1988). The Economic Importance of the Arts in Britain. Policy Studies Institute.

Official Gazette. (2025). Odluka o uvođenju Kulturne iskaznice, No. 137/2025. Retrieved March 10, 2026, from https://narodne-novine.nn.hr

Secondary School – Centre for Education and Upbringing. (2026). Kulturna iskaznica za učenike. Retrieved March 20, 2026, from https://ss-czoio.hr/kulturna-iskaznica-za-ucenike/

Seleš, M. (2022). Suvremeno upravljanje kao preduvjet popularizacije kulture [Doctoral dissertation]. J.J. Strossmayer University of Osijek.

Seleš, M., Glavaš, J., & Grgić, I. (2025). Event management: teorija i praksa. Faculty of Economics, University of Osijek.

Shorthose, J. (2004). Micro-bohemia: Local Urban Cultural Policy and the Creative Economy. European Journal of Cultural Policy, 10(2), 165–177.

Throsby, D. (2001). Economics and Culture. Cambridge University Press.

Tillväxtverket. (2018). Kreametern – analysrapport. Retrieved from https://tillvaxtverket.se

Yin, R. K. (2018). Case Study Research and Design (6th ed.). SAGE.

Žuvela, A., Tonković, Ž., & Krolo, K. (2020). Smjernice za uspostavu sudioničkog upravljanja na primjeru centra za suvremenu kulturu, umjetnost i mlade Zadar. City of Zadar.

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BAYESIAN STATISTICS IN MARKETING

Abstract: Every decision in marketing, whether strategic, tactical, or operational in nature, should be based on a previously conducted analysis or research, with collected data processed using appropriate statistical methods. Accordingly, this paper presents two fundamental statistical approaches: the frequentist and the Bayesian approach. While the frequentist approach is based on the measurable frequency of events, Bayesian inference, among other features, enables the incorporation of prior information into the analysis process. Starting from the limitations of frequentist statistics, the focus of the paper is placed on Bayesian inference and its key advantages. Special attention is devoted to the analysis of the application of the Bayesian approach in marketing, through the review of selected studies in which it has been used to address various marketing-related problems.

Keywords: Bayesian Approach, Frequentist Approach, Marketing

1. INTRODUCTION

In contemporary market conditions, where even the smallest change in the environment can cause significant difficulties in business operations, special attention must be paid to the decision-making process. This is particularly evident in the field of marketing, given the increasingly intense competition and the growing demands of consumers, whose behavior is often difficult to predict. Marketing managers are increasingly faced with complex situations that require an analytical approach and consideration of a large number of interrelated factors. In this context, making high-quality decisions should be based on previously conducted detailed analyses, i.e., research. In addition to collecting relevant and reliable data, the quality of decisions largely depends on the choice of an appropriate statistical approach to data processing.

Although it still represents one of the commonly used approaches, frequentist inference has certain limitations that may reduce its applicability in complex marketing problems. As a potential alternative, the Bayesian approach is attracting increasing attention and is already being widely applied in marketing research. In this regard, the paper first explains frequentist inference, highlighting its main shortcomings. It then presents the fundamentals of Bayesian inference and

its key advantages. Special attention is devoted to reviewing studies in the field of marketing in which the Bayesian approach has been successfully applied.

2. LIMITATIONS OF THE FREQUENTIST APPROACH

From the perspective of the frequentist approach, probability is interpreted as the long-run frequency of a "repeatable" event, that is, as a measurable frequency of occurrence determined on the basis of repeated experiments (Vallverdú, 2008, p. 5). Since uncertainty regarding parameters is of an epistemic nature, frequentist inference does not yield probabilistic statements about the parameters of a statistical process, which can be illustrated by the example of confidence intervals (Wagenmakers et al., 2008, p. 2). A frequentist 95% confidence interval for the normal mean μ equal to [-0.5, 1.0] does not imply that there is a 95% probability that μ lies within this interval; rather, it means that in a long sequence of repeated applications of the same confidence interval construction procedure on different datasets, in 95% of cases the true value of μ would be captured by the corresponding confidence interval.

In the literature, two main frequentist approaches are typically distinguished – Fisher's approach based on the p-value, and the approach based on the significance level (α-level), formulated by Neyman and Pearson. Although there are important conceptual differences between these approaches, in contemporary research practice they are often combined, so that the p-value is simultaneously interpreted both as a measure of evidence and as a rate of repeatable error (Wagenmakers et al., 2008, pp. 2-3). With regard to Fisher's approach, i.e., significance testing, the general strategy includes the following steps (Kotzen, 2011, p. 5):

- selecting the hypothesis H_0, referred to as the null hypothesis, and examining whether there are grounds for its rejection;
- determining all possible outcomes of the experiment and assigning a likelihood to each outcome under the assumption that H_0 is true;
- after observing the outcome, calculating the probability that this outcome, or one at least as extreme, would occur by summing the probabilities of all outcomes that are at least as extreme as the observed one (including the observed outcome itself);
- using this sum (the p-value) as a guideline for rejecting H_0; in other words, if the p-value $\leq \alpha$, the result is considered statistically significant at level α and H_0 may be rejected at that significance level, whereby a smaller α implies a "stronger" rejection of the null hypothesis.

Both Fisher's procedure and the Neyman–Pearson procedure (which, unlike Fisher's, is strictly frequentist, as it requires knowledge of the procedure's behavior in long-run repeated sampling situations) face numerous theoretical and practical problems; among the most prominent are the following (Wagenmakers et al., 2008, pp. 3-8):

- frequentist inference is generally not based solely on the actually observed data – the procedure is chosen in advance, and the validity of experimental evidence is evaluated according to how that procedure would behave in a long sequence of repeated experiments;
- frequentist inference depends on data that were never observed – the p-value represents the probability, under the assumption that the null hypothesis is true, of obtaining data at least as extreme as those actually observed, meaning that it is partially determined by data that never occurred;
- frequentist inference depends on the intention behind data collection – since p-values are defined relative to the sample space, changes in that space (e.g., experimental design or sample size) can significantly affect the p-value;
- frequentist inference does not prescribe which estimator is the best – as it is not derived from a set of simple axioms describing rational behavior, a single statistical problem may have multiple frequentist solutions, and it is not always clear which one is optimal;
- frequentist inference does not formally quantify statistical evidence – the interpretation of p-values as indicators of the strength of evidence against the null hypothesis, originating from Fisher's tradition and associating specific p-value ranges with levels of evidence (e.g., 0.1, 0.05, and 0.01), relies on informal and heuristic guidelines; additionally, it has been noted that, for equal p-values, studies with small samples may provide stronger evidence against the null hypothesis than studies with large samples (e.g., from a rational perspective, $p = 0.05$ based on only 10 observations may appear more convincing than $p = 0.05$ based on 1000 observations);
- frequentist inference is not applicable to "non-nested" models – since p-values require a clearly defined H_0, they are not suitable for testing non-nested hypotheses (which represent competing theoretical explanations), as they do not allow for their adequate interpretation.

Given the aforementioned limitations of frequentist inference, the Bayesian approach is often highlighted as an alternative. However, despite these limitations, the frequentist approach remains widely used in numerous empirical studies.

3. ADVANTAGES OF THE BAYESIAN APPROACH

In Bayesian statistics, named after the priest Thomas Bayes (whose theorem describes a method for updating probabilities based on data and prior knowledge), unlike in the frequentist framework, parameters and hypotheses are treated as probability distributions, while data are considered fixed (Fornacon-Wood et al., 2022, p. 1077). Probability distributions summarize the current state of knowledge about a parameter or hypothesis and can be updated as new data become available by applying Bayes' theorem, as shown in the following equation (Fornacon-Wood et al., 2022, p. 1077):

$$p(\theta|Data) = \frac{p(Data|\theta) \cdot p(\theta)}{p(Data)} \qquad (1)$$

One of the key differences between frequentist and Bayesian inference is the introduction of the prior, which can be defined based on expert beliefs, historical data, or a combination of both – the prior probability of the parameter θ in the equation is denoted as p(θ) (Fornacon-Wood et al., 2022, p. 1077). In this context, Data refers to the observed data (sample), p(Data|θ) represents the likelihood, i.e., the probability of the observed data given parameter θ, while p(Data) denotes the marginal probability of the data and serves as a normalization constant. The goal of Bayesian inference is to determine the posterior distribution p(θ|Data), i.e., the conditional probability of parameter θ after observing the data (University of Utah, n.d.). The process is carried out in three steps (Gelman et al., 2025, p. 3):

- specifying a full probability model – defining the joint probability distribution for all observed and unobserved quantities within the problem; the model should be consistent with existing knowledge about the underlying scientific problem and the data collection process;
- conditioning on observed data – computing and interpreting the corresponding posterior distribution;
- evaluating model fit and implications of the posterior distribution – assessing how well the model fits the data, whether the main conclusions are reasonable, and the extent to which results depend on the assumptions made in the first step; based on the findings, the model may be modified or extended, after which the process is repeated through all three steps.

The application of Bayesian statistics to parameter estimation and hypothesis testing offers several advantages over the frequentist approach; among the most notable are (Wagenmakers et al., 2008, pp. 11–21):

- coherence – Bayesian inference is prescriptive and does not require ad hoc adjustments to correct procedures; once a model is specified, there is a unique way to obtain the appropriate result;
- automatic parsimony – the Bayesian approach favors models that capture the replicable structure of the data while ignoring idiosyncratic noise; such models, unlike overly complex or overly simple ones, provide the best predictions for new data from the same source;
- applicability to non-nested models – since Bayesian hypothesis testing is based on marginal likelihoods, it does not make a fundamental distinction between nested and non-nested models, allowing for application in a much broader range of situations;
- flexibility – Bayesian inference allows for flexible application of relatively complex statistical techniques, including hierarchical and nonlinear models;
- marginalization – Bayesian statistics enables focusing on relevant quantities by integrating out so-called nuisance parameters, thereby obtaining marginal posterior distributions of parameters of interest;
- validity – Bayesian inference produces results closely aligned with what researchers are actually interested in; by assigning probabilities to hypotheses, it is consistent with intuitive scientific reasoning;
- testable subjectivity – in the Bayesian framework, subjectivity is not hidden; through explicitly specified priors that are open to scrutiny and criticism, it becomes transparent and formally assessable in terms of robustness;
- ability to gather evidence in favor of the null hypothesis – unlike p-values, which can only lead to rejection of the null hypothesis, the Bayesian approach allows for evidence to accumulate in its favor and enables quantitative comparison of competing hypotheses via marginal likelihoods;
- monitoring evidence during data collection – Bayesian inference allows evidence to be tracked as data accumulate, without the need for corrections due to "optional stopping," since stopping rules are irrelevant for result interpretation;
- incorporation of prior knowledge – Bayesian inference enables the inclusion of prior knowledge through priors, which are not only useful but necessary for rational inference; differences in conclusions arising from different priors reflect scientific uncertainty rather than a weakness of the method.

Based on the previously analyzed advantages of Bayesian inference, it can be observed that this approach has wide application across various fields, including economics. In particular, marketing stands out as an area in which the application of the Bayesian approach can make a significant contribution to understanding market phenomena and supporting decision-making.

4. APPLICATION OF THE BAYESIAN APPROACH IN MARKETING

There is a substantial body of research in economics in which the Bayesian approach has been applied. Błażejowski et al. (2016) review some of these studies, focusing on topics related to economic growth. In their own research, the same authors also analyze economic growth using Bayesian methods. The popularity of Bayesian methods in macroeconomic forecasting stems from their ability to efficiently handle a large number of parameters and, through the appropriate specification of prior distributions, to effectively address model uncertainty and specification issues in a macroeconomic context. Similarly, in the field of financial analysis, research objectives related to forecasting and modeling risks associated with financial assets naturally align with the Bayesian framework (Martin et al., 2024).

Bayesian statistical methods represent an important analytical framework in marketing, as they offer an integrated approach to statistical inference and decision-making applicable to both theoretical and empirical analyses (Rossi and Allenby, 2003). Building on this perspective, Rossi et al. (2005) explain the application of Bayesian methods in marketing through the way marketing problems are statistically modeled, highlighting three interrelated components: within-unit behavior, across-unit behavior, and action. The term "unit" refers to the lowest level of aggregation explicitly included in the model, determined by the nature of the problem and data availability (in many cases, this is the consumer, although other levels of aggregation are also possible). The first component refers to the conditional likelihood function describing behavior at the unit level, conditioned on unit-specific parameters that capture heterogeneity across units; the second component concerns the distribution of these parameters across the population of units; the third component represents the decision problem as the ultimate objective of the modeling process, often involving the specification of a profit function, where the optimal action is determined based on the model and the information contained in the data. In this context, the Bayesian approach enables a unified and coherent treatment of all three components of the marketing problem.

In contemporary marketing literature, the Bayesian approach has been applied across a wide range of areas. These include the analysis of consumer choice behavior, demand and customer satisfaction analysis, dynamic pricing, evaluation of advertising effectiveness, and recommendation systems (Martin et al., 2024).

For example, Posch et al. (2022) proposed a novel approach for forecasting menu item sales in restaurants and canteens based on two Bayesian generalized additive models. Their analysis used two datasets obtained from the POS systems of a restaurant and a canteen. The performance of the proposed approach was thoroughly evaluated and compared with other forecasting methods, with results indicating that it provides the most accurate and robust point forecasts overall. In addition, for one of the datasets, the prediction intervals were noticeably more precise than those obtained using competing methods.

By constructing a dynamic game model based on Bayesian updating of information, Fan and Bao (2025) analyzed optimal advertising strategies of retailers in the presence of asymmetric information about product quality. The results showed that the choice of advertising strategy significantly affects the mechanism by which consumers update their beliefs, as well as the efficiency of market transactions. Among the four considered advertising strategies (full disclosure, exaggerated, downplayed, and no disclosure), full disclosure was found to be the optimal strategy for retailers.

Danaher et al. (2020) analyzed data on the exposure of 4,000 consumers to three media channels (email, catalogs, and paid search) and their purchases in both physical and online stores of three apparel retail brands, using a variational Bayesian approach. Their findings suggest that email, and sometimes catalogs, negatively affect competing brands, that paid search affects only the focal brand, and that catalogs often have a positive effect on competing brands, but only among multichannel consumers.

The Bayesian approach can also be applied in the context of A/B testing, primarily due to the ease of interpreting results. In this regard, Kamalbasha and Eugster (2020) presented three experimental scenarios: testing websites where visitors can purchase only a single product, testing websites where visitors can choose among multiple products, and an aggregate scenario. For each scenario, a Bayesian model formulation and corresponding decision-making procedures based on sampling from estimated posterior distributions were presented.

5. CONCLUSION

Faced with numerous market challenges, most often driven by consumer behavior and competitive dynamics, marketing managers frequently find themselves in situations that require making important business decisions on an almost daily basis. In order to improve their effectiveness and ensure a more efficient decision-making process, it is essential, among other things, to pay careful attention to the selection of appropriate statistical data analysis methods, as they form the foundation upon which business decisions are made.

The frequentist approach, as one of the most traditionally used methods in statistical analysis, is based on the frequency of event occurrence. Although widely applied, this approach is characterized by certain limitations. In particular, the issue of interpreting p-values as one of the key indicators of frequentist inference stands out. Since p-values rely on informal and heuristic guidelines, their misuse or uncritical application may call into question the validity of research results and, consequently, the quality of the decisions made. As an alternative to the frequentist approach, Bayesian inference is gaining increasing application, as it enables the incorporation of prior information into the analysis process. The Bayesian approach can substantially overcome the limitations of frequentist methods, offering advantages in terms of coherence, flexibility, and interpretative clarity of results. The application of Bayesian methods facilitates decision-making in marketing, as analytical results are presented in a form that aligns more closely with the way decision-makers think. The growing number of scientific studies applying Bayesian methods to solve marketing-related problems – such as sales forecasting, optimization of advertising strategies, A/B testing, and other relevant challenges – further confirms the importance and applicability of this approach.

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REFERENCES

Błażejowski, M., Gazda, J., & Kwiatkowski, J. (2016). Bayesian Model Averaging in the Studies on Economic Growth in the EU Regions – Application of the gretl BMA package. *Economics and Sociology*, 9(4), pp. 168-175.10.14254/2071-789X.2016/9-4/10

Danaher, P.J., Danaher, T.S., Smith, M.S., & Loaiza-Maya, R. (2020). Advertising effectiveness for multiple retailer-brands in a multimedia and multichannel environment. *Journal of Marketing Research*, 57(3), pp. 445-467. https://doi.org/10.1177/0022243720910104

Fan, X., & Bao, C. (2025). Advertising Strategies for Online Retailers Based on Bayesian Persuasion. *Procedia Computer Science*, 266, pp. 415-422. https://doi.org/10.1016/j.procs.2025.08.053

Fornacon-Wood, I., Mistry, H., Johnson-Hart, C., Faivre-Finn, C., O'Connor, J.P., & Price, G.J. (2022). Understanding the differences between Bayesian and frequentist statistics. *International journal of radiation oncology, biology, physics*, 112(5), pp. 1076-1082. https://doi.org/10.1016/j.ijrobp.2021.12.011

Gelman, A., Carlin, J.B., Stern, H.S., Dunson, D.B., Vehtari, A. & Rubin, D.B. (2021). *Bayesian Data Analysis 3rd*. https://sites.stat.columbia.edu/gelman/book/BDA3.pdf

Kamalbasha, S., & Eugster, M.J. (2020). Bayesian A/B testing for business decisions. In International Data Science Conference (pp. 50-57). Wiesbaden: Springer Fachmedien Wiesbaden.

Kotzen, M. (2011). *The Bayesian and Frequentist Approaches to Inference*. https://matthewkotzen.net/s/bayesfreqweb.pdf

Martin, G.M., Frazier, D.T., Maneesoonthorn, W., Loaiza-Maya, R., Huber, F., Koop, G., Maheu, J., Nibbering, D. & Panagiotelis, A. (2024). Bayesian forecasting in economics and finance: A modern review. *International Journal of Forecasting*, 40(2), 811-839. https://doi.org/10.1016/j.ijforecast.2023.05.002

Posch, K., Truden, C., Hungerländer, P., & Pilz, J. (2022). A Bayesian approach for predicting food and beverage sales in staff canteens and restaurants. *International Journal of Forecasting*, 38(1), pp. 321-338. https://doi.org/10.1016/j.ijforecast.2021.06.001

Rossi, P.E., & Allenby, G.M. (2003). Bayesian statistics and marketing. *Marketing Science*, 22(3), pp. 304-328.

Rossi, P.E., Allenby, G.M., & McCulloch, R. (2005). *Bayesian Statistics and Marketing*. John Wiley & Sons.

Vallverdú, J. (2008). The false dilemma: Bayesian vs. frequentist. arXiv preprint arXiv:0804.0486v1.

Wagenmakers, E.J., Lee, M., Lodewyckx, T., & Iverson, G.J. (2008). Bayesian versus frequentist inference. In Bayesian evaluation of informative hypotheses (pp. 181-207). New York, NY: Springer New York.

University of Utah, n.d. Bayes. https://my.eng.utah.edu/~cs5961/Resources/bayes.pdf

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THE IMPACT OF GLOBAL INSTABILITY ON INTERNATIONAL TRADE

Abstract:
From 2020 to the present, international trade has demonstrated a high level of volatility in terms of both its volume and direction. The positive effects of free trade agreements (CEFTA, ASEAN, USMCA, MERCOSUR, etc.) and the higher degree of globalization that characterized international trade resulted in increased levels of exchange and the liberalization of international markets at the beginning of the 21st century. However, since 2020, international trade flows have successively faced a series of instabilities, starting with COVID-19 and extending to wars in the Middle East, as well as new protectionist measures introduced by the United States primarily aimed at reducing the trade deficit with China. U.S. tariff revenues reached 287 billion dollars in 2025; this 192% increase compared to the previous year clearly illustrates the significance of these barriers for global trade, particularly considering that such protectionist measures are almost always followed by countermeasures. Health crises and war conflicts during this period have led to the closure of ports, waterways, airports, and airspace. Political crises have resulted in violations of WTO principles (e.g. the principles of non-discrimination and national treatment), as well as the formation and strengthening of global blocs (BRICS, the new "Board of Peace," etc.). All these instabilities negatively affect the free movement of goods and services, resulting in a decline in trade activities and higher procurement costs for final products, as well as for energy and other resources. The objective of this paper is to determine the ways in which instability affects the volume of international trade activities, with particular reference to how these instabilities have influenced Serbia's trade exchange with its international partners. The primary data sources which will be consulted for this research include reports from organizations such as the UN, OECD, and Deloitte.

Keywords: International trade, protectionism, instability, Republic of Serbia.

INTRODUCTION

International trade in the third decade of the 21st century is characterized by a high degree of complexity, interdependence, and exposure to global economic and geopolitical shocks. The expansion of global value chains, liberalization of trade flows under the influence of the World Trade Organization (WTO), and the proliferation of regional trade agreements have significantly contributed to the growth of both merchandise and services trade, which together amount to tens of trillions of US dollars annually (Curran & Eckhardt, 2021). At the same time, the global

trading system has become increasingly vulnerable to disruptions arising from protectionist policies, unilateral trade measures, and geopolitical tensions among major economic powers. The re-emergence of tariff-based protectionism, particularly through large-scale unilateral tariff regimes, has had significant implications for global trade flows, supply chain stability, and the predictability of international business environments. In addition to trade policy shifts, global conflicts and regional instabilities have further intensified uncertainty in international markets. Energy-related disruptions, particularly in strategically important transit routes, have demonstrated the high sensitivity of global supply chains to geopolitical risks. These events have affected not only commodity markets such as oil and gas, but also industrial production, transportation, food security, and emerging sectors such as semiconductors and artificial intelligence infrastructure.

The objective of this paper is to analyze the structure and dynamics of international trade in the third decade of the 21st century, with a particular focus on the volume and composition of global trade in goods and services, as well as the impact of major global instabilities on international trade flows. The paper also examines the consequences of protectionist trade policies and geopolitical conflicts on global economic relations, highlighting their effects on both developed and developing economies.

1. INTERNATIONAL TRADE IN THE THIRD DECADE OF THE 21ST CENTURY – VOLUME AND STRUCTURE

International trade in the 21st century encompasses global trade in goods and services worth trillions of dollars. One of the most significant factors behind the growth in the volume of international trade is the reduction and elimination of tariffs, and especially quotas, under the influence of the World Trade Organization, as well as multilateral foreign trade agreements such as CEFTA (members: Serbia, Bosnia and Herzegovina, Montenegro, North Macedonia, Albania, and Moldova), ASEAN (Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam), USMCA (the United States, Mexico, and Canada), MERCOSUR (Argentina, Brazil, Paraguay, Uruguay, and Bolivia), etc. WTO data indicate that in 2025, global trade in goods and commercial services increased to 34.65 trillion US dollars, representing a 7% increase compared to 2024. International trade in goods increased by 6%, while services grew by 8%. The share of services in international trade in 2025 reached 27.6%, which is the highest recorded share of services since 2005. Total exports of goods in 2025 amounted to 26.3 trillion dollars, while the top 10 exporting countries accounted for 49.6% of the total volume of international trade in goods. China ranked first with a share of 14.4% of total global merchandise exports, followed by the United States in second place with 8.3%, and Germany in third place with 6.7%. The combined share of China, the United States, and Germany in total global merchandise exports in 2025 amounted to as much as 29%. The largest importers in 2025 were the United States with a 13.2% share of total global imports, followed by China with 9.7%, while Germany ranked third with a 5.8% share of total global merchandise imports. Total exports of goods from China in 2025 amounted to 3.7 trillion dollars, from the United States 2.1 trillion, while Germany exported 1.7 trillion dollars; it should be noted that in 2025, compared to 2024, China recorded a growth in merchandise exports of 5.5%, while the United States and Germany grew at rates of 6% and 5.2%, respectively. With regard to CEFTA countries, Serbia in 2025 recorded merchandise exports worth 37 billion dollars, placing it 66th in the world by export volume; Bosnia and Herzegovina recorded 9.8 billion, placing it 106th; Montenegro 0.6 billion, placing it 161st; North Macedonia 9 billion, placing it 109th; Albania 4.3 billion, placing it 129th; and Moldova 3.7 billion, placing it 133rd. In 2025, compared to 2024, Serbia achieved a significant increase in merchandise exports of 18.1%, while Serbian exports account for only 0.14% of total global merchandise exports (World Trade Organisation, 2026).

The World Trade Organization has classified total exports of goods into three main categories: “manufactures,” “agricultural products,” and “fuels and mining products.” With regard to “manufactures,” the European Union ranks first in terms of exports, with total exports amounting to 5.5 trillion dollars (of which 2.2 trillion to non-EU countries) in 2024, followed by China with exports of 3.2 trillion dollars. In third place is the United States with 1.2 trillion, followed by South Korea with 592 billion dollars and Japan with exports of 583 billion dollars. With regard to “agricultural products,” the European Union ranks first in terms of exports, with total exports amounting to 861 billion dollars (of which 276 billion to non-EU countries), also in 2024. The United States ranked second with exports of 199 billion dollars, followed by Brazil with 155 billion, then China with 99 billion, and Canada with 85 billion dollars. With regard to “fuels and mining products,” the European Union ranks first in terms of exports, with total exports amounting to 621 billion dollars (of which 203 billion to non-EU countries) in 2024. The United States ranked second with 376 billion dollars, followed by the United Arab Emirates with exports valued at 307 billion, then Russia with 272 billion, and Australia with 229 billion dollars of exports. With regard to clothing as a subcategory of exports, it can be concluded that in 2024 the European Union ranked first in terms of export value, with exports amounting to 166 billion dollars (of which 43 billion to non-EU countries). China ranked second with 165 billion dollars, followed by Bangladesh with 38 billion dollars, then Vietnam with 34 billion, and Turkey with 18 billion dollars in clothing exports. With regard to automotive products as a subcategory of exports, the European Union ranked first in terms of export value, with 803 billion dollars (of which 298 billion to non-EU countries). China ranked second with 191 billion dollars of exports,

followed by Mexico with 166 billion, then Japan with 150 billion, and the United States with 149 billion dollars in exports of automotive products (World Trade Organisation, 2026).

Trade in services increased by 8% in 2025 compared to 2024 and currently amounts to over 9.5 trillion dollars. The growth of transport services slowed and amounted to 2% in 2025 compared to 2024, while exports of travel services amounted to 1.89 trillion dollars, with an 8% increase in 2025. Exports of other services, which include a wide range of services such as financial and professional services, increased by 10% in 2025 and today account for more than 60% of global trade in services. Trade in services is highly concentrated, as the top 10 exporters and importers of services accounted for 56.5% and 54% of total trade, respectively (World Trade Organisation, 2026). With regard to exports of services, the United States ranks first with 1.2 trillion dollars in service exports, followed by the United Kingdom with 721 billion dollars, and Ireland in third place with service exports valued at 565 billion dollars. With regard to imports of services, the United States ranks first with imports of 869 billion dollars, followed by China with 620 billion dollars, and Germany in third place with 588 billion dollars of service imports in 2025. Some of the most significant trends in global trade in services include an 11% increase in trade in tourism services in the European Union, a 15% increase in Irish exports of computer services, and a 20% increase in Indian exports of business services. When analyzing exports of transport services in 2025, the European Union ranks first in terms of export value with total exports amounting to 560 billion dollars (of which 265 billion to non-EU countries), followed by Singapore with 135 billion dollars, China in third place with 122 billion dollars, then the United States with 104 billion, and the United Arab Emirates with 75 billion dollars in exports of transport services. When analyzing exports of tourism services in 2025, the European Union ranks first with total exports amounting to 565 billion dollars (of which 231 billion to non-EU countries), followed by the United States with 213 billion dollars, the United Kingdom in third place with 92 billion dollars, then the United Arab Emirates with 75 billion dollars and Japan with 62 billion dollars in exports of tourism services. When analyzing exports of financial services, the European Union ranks first with exports amounting to 277 billion dollars (of which 121 billion to non-EU countries), followed by the United States with 209 billion dollars, Singapore in third place with 55 billion dollars, then Hong Kong with 32 billion, and Switzerland with 29 billion dollars in exports of financial services in 2025. In the coming years, a continuation of the trend of increasing the share of service exports in the overall structure of global exports is expected. The countries of the European Union, in terms of the volume of intra-EU trade and exports to third countries, will remain leaders in most categories together with the United States and China.

2. GLOBAL INSTABILITIES – SIGNIFICANCE AND IMPACT ON INTERNATIONAL TRADE

2.1. US Protectionist Tariffs – Impact on Global Trade

One of the most prominent instabilities that has affected virtually the entire global trade system relates to protectionist unilateral import barriers in the form of US tariffs during Donald Trump's second term (from January 20th 2025). From the very beginning of the administration's work, a large number of import tariffs were introduced. As of April 2nd 2025, tariffs were imposed at 49% on goods from Cambodia, 46% on goods from Vietnam, 36% on goods from Thailand, 37% on goods from Bangladesh, 34% on goods from China (this rate at one point rose to 125% before later falling to 10%), 32% on goods from Taiwan, 29% on goods from Pakistan, 25% on goods from Mexico, etc. In this "initial" wave, tariffs were also imposed on goods from "ally" countries, such as a 20% tariff on all goods imported from the European Union, 31% on goods from Switzerland and Liechtenstein, and 10% on goods from the United Kingdom (Congressional Research Service, 2026). The introduction of such unilateral barriers de facto undermines the principles of foreign trade liberalization and the objectives of the World Trade Organization, of which the United States is a full member (unlike Serbia, which still has observer status). The aim of US tariffs, which are described as "reciprocal," is the elimination of trade deficits with all countries covered by the tariffs. In this regard, a tariff rate formula was developed as the ratio of the US trade deficit with a given country to total US imports from that country; the result is multiplied by 0.5 to obtain the final tariff rate that was implemented. For example, in 2024, the total US trade deficit with China amounted to 295 billion US dollars, while the total volume of bilateral trade between the two countries amounted to 438 billion; when the ratio of 68% is multiplied by 0.5, the final ad valorem tariff rate of 34% is obtained. With regard to Serbia and the region, tariffs on imports of Serbian goods into the United States at the beginning of April 2025 amounted to 37%, before being reduced to 35% on August 7th 2025. Such a tariff rate was calculated taking into account the deficit that the United States records with Serbia, which in 2024 amounted to 70 million US dollars. When the rate for Serbia is compared with the rates imposed on countries in the region, it is clear that Serbia fared worse in this regard. The tariff rate for goods from Bosnia and Herzegovina was 35%, for countries such as North Macedonia, Montenegro, and Albania it was 10%, while for goods from Croatia and Slovenia the universal EU rate of 20% was applied (this rate was reduced to 15% from August 7th 2025).

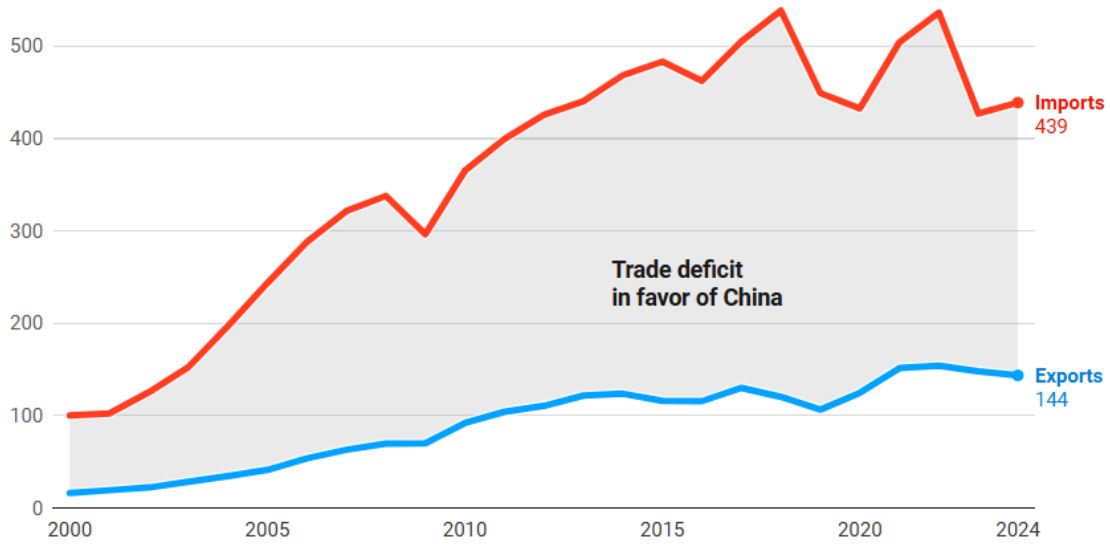


Chart 1: Representation of the US merchandise trade deficit with China as one of the leading causes of the imposition of protectionist tariffs in April 2025 (in billions of US dollars).
Source: (US Census Bureau, 2026).

Some estimates show that the effective tariff rate (the average rate applied to all goods imported into the United States) was increased from 2.5% to as much as 27% in the period from January to April 2025. An effective rate of 27% represents the highest such rate in more than a century. Following measures by the US Supreme Court, the effective rate was reduced to 13.7% as of the beginning of 2026. Goods affected by US tariffs included aluminum and steel with tariffs of up to 50% (including aluminum derivatives such as beer and beverage cans), copper with an effective rate of 50% (also including copper derivatives), agricultural products such as coffee (especially from Brazil and Colombia), nuts, seafood (most affected were China, India, and Vietnam), olive oil (most affected were European countries). In addition to these, tariffs also covered automotive parts (especially from China, Mexico, and Canada), solar panels and components (with rates exceeding 100% in some cases), wood products (significantly affecting Canada and China), and others. With regard to goods from Serbia, the most affected were the defense industry, the steel industry, and automotive parts industry (such as the "Fiat Panda" produced in Kragujevac). The largest export category from Serbia to the United States is the service sector, particularly information technology services, whose exports from Serbia to the US amounted to 1.7 billion euros in 2024. This sector was not affected by tariffs imposed by the United States (Congressional Research Service, 2026).

The response of foreign trade partners to the introduction of US tariffs in early April 2025 varied in scope. Canada introduced reciprocal tariffs projected to exceed 20 billion dollars by the end of 2025; these tariffs mainly covered steel, aluminum and automobiles (including automotive parts). The European Union adopted a comprehensive package of measures that included additional tariffs ranging from 4% to 30% on a wide range of US products. Mexico, in response to the introduction of tariffs, considered tariffs ranging from 5% to 20% on US goods but initially managed to negotiate a 90-day delay of tariffs on Mexican goods exported to the United States. China responded with additional tariffs ranging from 10% to 15% on goods such as automobiles, agricultural machinery, coal, and natural gas. In mid-May 2025, these rates were reduced following bilateral agreements between the two countries (Government of Canada, 2026).

US tariffs initially led to an increase in imports in the first quarter of 2025 compared to the first quarter of 2026; this increase amounted to around 25% and was a consequence of increased imports in anticipation of the announced tariffs. In other words, importers attempted to secure certain quantities of goods before the tariffs came into force (OECD, 2025). An increase in imports was also recorded in the period January–July 2026 compared to the period January–July 2025; this increase amounted to around 10% (UN trade and development, 2026).

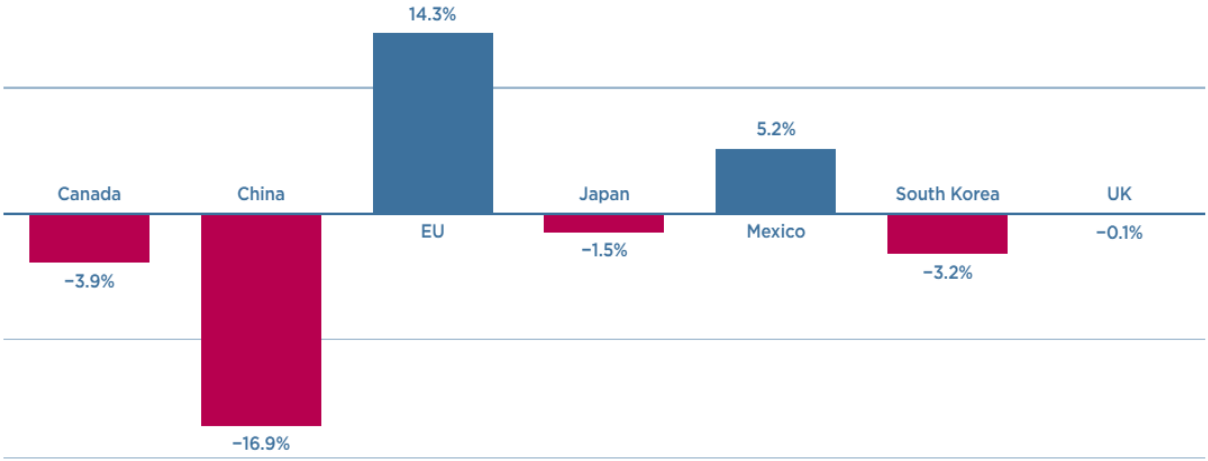


Chart 2: The increase/decrease in imports of US goods with some of the most important foreign trading partners.
Source: (US International Trade Commission, 2026).

When observing changes in US imports by individual trading partners, it can be concluded that imports from the European Union and Mexico in the period January–July 2025 increased compared to the same period in 2024 by 14.3% and 5.2%, respectively. On the other hand, imports from China, Canada, South Korea, and Japan decreased by 16.9%, 3.9%, 3.2%, and 1.5%, respectively. Imports from the United Kingdom slightly decreased.

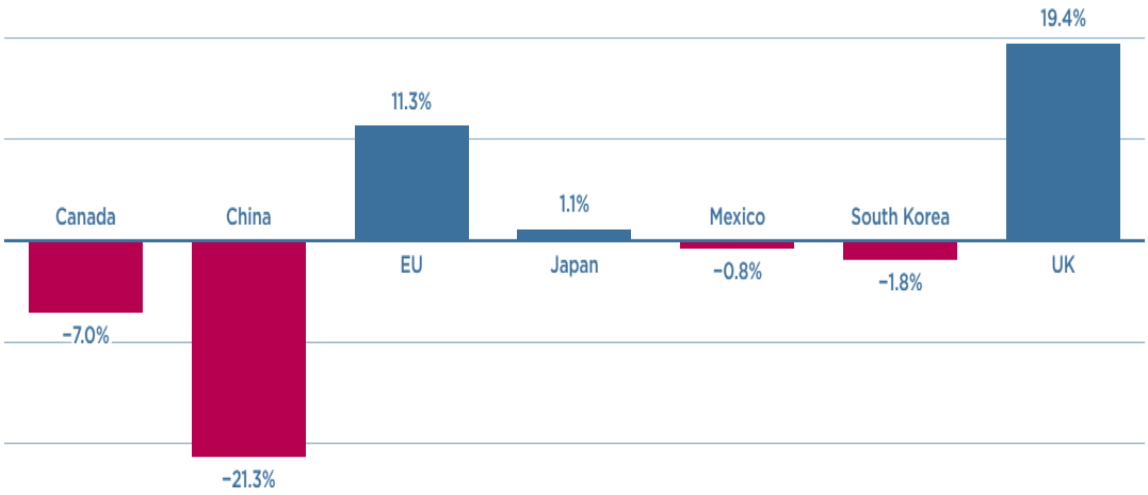


Chart 3: The increase/decrease in US merchandise exports with some of the most important foreign trade partners.
Source: (US International Trade Commission, 2026).

When observing changes in US exports by individual trading partners, it can be concluded that exports to the United Kingdom, the European Union, and Japan recorded an increase in the period January–July 2025 compared to the same period in 2024 of 19.4%, 11.3%, and 1.1%, respectively. On the other hand, exports from the United States to China, Canada, South Korea, and Mexico recorded a decline of 21.3%, 7.0%, 1.8%, and 0.8%, respectively. The effects of tariffs reflect their initial intention; from the presented data, it can be concluded that the main reason for the introduction of protectionist unilateral tariffs was the reduction of the merchandise trade deficit with China. The deficit with China is not the only reason for the introduction of such measures; namely, although nominal Gross Domestic Product is higher in the United States than in China, around 30 trillion compared to 20 trillion US dollars, the Gross Domestic Product of the two countries adjusted for purchasing power parity (PPP) is higher in China than in the United States (China's GDP PPP is between 1.34 and 1.37 times larger than that of the United States).

The epilogue of US protectionist tariffs occurred on February 20th 2026, when the Supreme Court of the United States declared the imposed tariffs unconstitutional. In its ruling, the Supreme Court stated that the administration cannot impose tariffs using the International Emergency Economic Powers Act (IEEPA) of 1977. Such and similar powers belong to the US Congress. With regard to the consequences of US tariffs, it should be emphasized that such measures, which violate the fundamental principles of the World Trade Organization, such as the principle of non-discrimination, as well as other principles such as that tariffs should only be introduced in cases where the domestic economy is

endangered and all other measures have been exhausted, directly affect trust and the business environment of international trade. These measures create an environment of uncertainty, panic, and forced countermeasures, which further disrupts trade relations between foreign trade partners. It should also be noted that the burden of such measures is also borne by consumers in the countries that introduced them; for example, consumers in the United States became less able to access certain technological products from China such as mobile phones (e.g. Huawei, Xiaomi, Redmi, Realme) and other devices after the introduction of tariffs (US Congress, 2026). These and other products, prior to the introduction of tariffs, had significantly lower prices compared to domestic American brands and represented a "good deal" for consumers. After the tariffs, US consumers were deprived of many products that either became completely unavailable or uncompetitive following the introduction of tariffs.

2.2. Global Conflicts and Their Implications for Foreign Trade Relations

The beginning of 2026 brought multiple challenges and pressures on foreign trade transactions caused by conflicts between allied countries (e.g., the United States and Denmark) and rival countries (e.g., the United States and Iran). In January 2026, the US administration expressed interest in the annexation of Greenland, citing national security and growing military competition in the Arctic against Russia and China. This was followed by a clear condemnation from the European Union and other countries, accompanied by mass boycotts of American products in Denmark. In this regard, an application called "Made O' Meter" was created, allowing Danish consumers to identify US products on the shelves of retail chains. The founder of the application, Ian Rosenfeldt, reports that in the first three days of the crisis more than 30,000 downloads of the application on consumers' mobile phones were recorded. In addition to this, other similar applications were developed, such as "UdenUSA" (NonUSA), with the same purpose (Quiroz-Gutierrez, 2026). Some applications also have the ability, when they identify that a scanned product originates from the United States, to suggest a Danish or European alternative to that product, based on artificial intelligence. Thus, although imports from the United States account for about 1% of Denmark's total food imports, the boycott of products represents a direct result of tense foreign policy conflicts. After most European countries condemned the US position regarding Greenland, the United States threatened tariffs of 10% on goods from Denmark, Norway, Sweden, France, Germany, the United Kingdom, the Netherlands, and Finland. Since the European Union was actively preparing countermeasures in the form of tariffs, the entire rhetoric created risks for trade relations between the United States and the European Union worth 1.5 trillion dollars. Many experts in international relations believe that US intentions are based on American dependence on the supply of rare earth minerals from China, and that the United States, by seeking control over Greenland, is attempting to reduce that dependence. Regardless of how the conflict was caused, the consequences of the conflict and the introduction of US tariffs of 10% (planned for February 1st 2026) would most strongly affect Germany, since this country exports goods to the United States worth over 153 billion dollars. The German automotive industry would be the most affected, as it is already struggling with crises caused by cheaper cars from China. After Germany, the United Kingdom and France are also targeted, with exports to the United States worth 66 and 65 billion dollars, respectively.

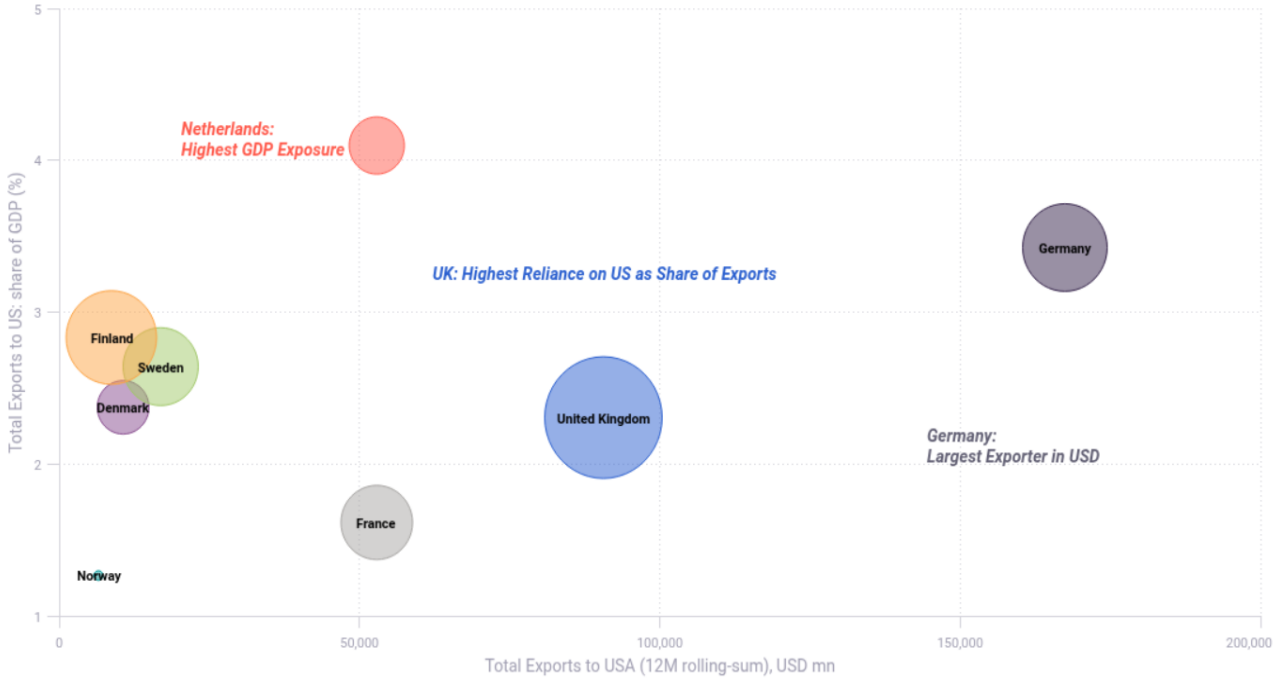


Chart 4: The relative importance of the exports of the "NATO-8" countries with the USA in absolute terms and as a percentage of GDP.
Source: (US International Trade Commission, 2026).

The introduction of additional 10% tariffs would, in absolute terms, cause the greatest damage to Germany, the United Kingdom, and France. However, when looking at the percentage that merchandise exports to the United States represent in the GDP of individual countries, it is clear that in this sense the most vulnerable country would be the Netherlands, followed by Germany and Finland. It should also be noted that these tariffs would carry additional weight for the United Kingdom, since its exports to the United States account for the largest share of total exports compared to all other "NATO-8" countries. The introduction of additional 10% tariffs would certainly lead to a reduction in the value of exports from "NATO-8" countries to the United States; it is possible that part of these exports would be redirected to their partners within the EU or to other markets. It should be noted that part of the burden would also fall on US consumers, since the United States is dependent on imports from "NATO-8" countries in categories such as transport equipment, which accounts for 32% of total US imports in this category from these countries, pharmaceuticals and medical products with 21%, chemicals and chemical products with 13%, vehicles with 11.5%, and food with an 11% share of total US imports. When considering all import categories from these eight countries to the United States, the US imports on average 9.34% of all products in all categories from these countries ("NATO-8"). The initial plan of the US administration was to introduce 10% tariffs on goods from the "NATO-8" countries, with the possibility of further increasing these tariffs to 25% in June 2026 if these countries did not align with US interests regarding Greenland. The World Economic Forum in Davos held on January 21st 2026 brought relief in this regard; following the forum, the US administration abandoned these tariffs (Deloitte, 2026).

Shortly after the Greenland crisis, international political and trade relations entered a new crisis caused by the US–Iran war, which began on February 28th 2026 and spread to almost the entire Middle East region. Immediately after the outbreak of the war, a large number of flights across the Middle East were canceled, with the total number of canceled flights estimated at 23,000, while those flights that were successfully operated became significantly more expensive due to costs caused by kerosene shortages and increased security risks. Countries that completely closed their airspace to traffic included Iran, Iraq, Kuwait, and Syria, while Israel, Bahrain, the United Arab Emirates, and Qatar imposed serious restrictions on air traffic. A vast number of logistical problems emerged almost immediately; on March 2nd 2026 the Strait of Hormuz, through which nearly 20% of global oil supply previously passed before the outbreak of the conflict, was completely blocked. A few days later, the price of oil on the world market exceeded 100 dollars per barrel (159 liters), reaching a peak of 119 dollars at one point. Before the closure, up to 14.22 million barrels of crude oil passed through the strait daily on average. In terms of exports, the most affected were Saudi Arabia, which exports 5.29 million barrels per day (37.2% of total exports), Iraq with 3.24 million barrels (22.8%), the United Arab Emirates with 1.83 million barrels (12.9%), Kuwait with 1.43 million barrels (10.1%), and Qatar with 630,000 barrels (4.4%) per day. On the import side, the most affected were China with total imports of 5.35 million barrels per day (37.7% of total oil imports), India with 2.09 million barrels per day, South Korea with 1.7 million barrels (12%), and Japan with 1.55 million barrels (10.9%). The European Union and the United States were not significantly affected by the crisis, since the EU imports only 530,000 barrels per day, which accounts for just 3.8% of its imports, while the United States imports around 360,000 barrels of crude oil per day, which represents only 2.5% of its total crude oil imports.

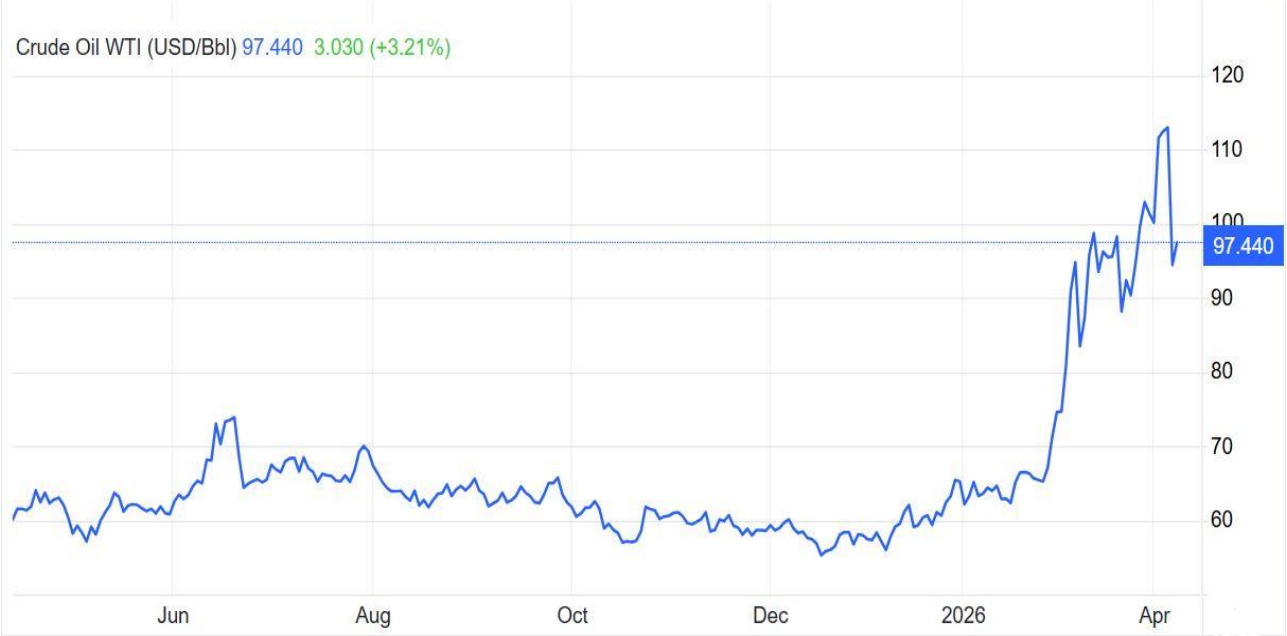


Chart 5: The movement trend of the exchange in price of crude oil and the impact of closing the Strait of Hormuz on it.
Source: (Trading economics, 2026).

From Chart 5, it can be concluded that the US–Iran war had a radical impact on the movement of crude oil market prices. Prior to the outbreak of the war, oil prices ranged around 60 (up to 70) dollars per barrel, while after the outbreak of the conflict the price per barrel exceeded 100 US dollars for the first time since the "Covid-19" crisis. The current price stands at 97.44 dollars per barrel. The crisis also affected the rise in prices of diesel, gasoline, and LPG in Serbia; at the beginning of April, the price per liter of diesel reached 217 dinars, gasoline 191 dinars, and LPG 105 dinars, marking the highest fuel price increase in Serbia since the "Covid-19" crisis.

In addition to oil and gas, the blockade of the canal could also significantly affect the export and price of construction materials, especially steel, aluminum, and copper. The research company "Linesight" states in its report that "Gulf countries produce about 9% of the global aluminum supply, mostly for export, while their production depends on imports of bauxite and alumina." The report also concludes that "the disruption of gas supplies caused the shutdown of the only aluminum smelter in Qatar, which completely ceased operations the day after the blockade of the canal, while the aluminum smelter in Bahrain halted new deliveries." Cement as a construction material is also affected due to rising production costs caused by higher energy costs and higher transportation costs. Cement production is energy-intensive, while cement itself is heavy to transport. Copper is also significantly affected, as half of the sulfur required for the production of sulfuric acid necessary for copper ore processing comes from Gulf countries. In other words, although Gulf countries do not produce copper, disruptions in prices and quantities are possible due to sulfur shortages, which arise as a byproduct of oil and gas production. The closure of the canal has also affected food supply in Gulf countries; the United Arab Emirates imports as much as 90% of its food, a large share of which comes through the Strait of Hormuz. However, due to their economic power, Gulf countries have the ability to use alternative routes in the form of air transport for food procurement. Qatar, as one of the Gulf countries, already has experience with the blockade from 2017, and therefore faced this blockade more prepared than other Gulf countries. Food production could also be affected by a reduction in the quantities of nitrogen fertilizers. Namely, one-third of key raw materials for the production of nitrogen fertilizers passes through this channel. Experts warn that a large part of the world's population depends on synthetic fertilizers and that a disruption in the supply chain could cause turbulence in the food market and consequently lead to higher food prices. The semiconductor industry is also affected, as it is an energy-intensive industry. Large chip factories consume extremely large amounts of energy, so a longer-term disruption in energy supply can affect the supply of microchips and processors. The development and use of artificial intelligence is also affected, as data centers that power AI models rely on stable and relatively affordable energy supply. Any disruption in the functioning of the canal increases the operational costs of data centers. Energy is not the only issue that may arise for artificial intelligence due to the blockade; among the materials affected by the closure of the canal is helium, which is a key element in the production of the aforementioned chips. The shortage of this gas affects the operation of AI data centers through the chips that depend on it. In other words, although at first glance the blockade of the Strait of Hormuz appears to threaten the supply of certain energy sources, its impact would be felt across almost all industries, from construction and food production to semiconductors and the AI industry, which in its rapid growth consumes enormous amounts of energy. The conflict between the United States and Iran also caused a significant decline in stock prices, especially in the IT sector, as well as a drop in almost all major stock indices such as the S&P 500, which fell by 4.63% in the first quarter of 2026, the NASDAQ index, which fell by 7.11% in the first quarter, and the Dow Jones index, which fell by 3.58% in the first quarter of 2026 (Guerra & Kohen, 2026). The greatest cost of geopolitical and geoeconomic conflicts is borne precisely by end consumers and investors through higher prices of basic goods and low investment returns. These are only some examples of numerous global obstacles and conflicts which, due to their frequency and duration, have become more of a rule than an exception in the world of contemporary international business (Nuševa, Marić, Vukmirović, & Macura, 2023).

CONCLUSION

The analysis of international trade in the third decade of the 21st century shows that global trade has reached unprecedented levels in terms of both volume and structural complexity. Trade in goods and services continues to expand, with services increasingly accounting for a larger share of global exchanges, while leading economies such as the European Union, the United States, and China maintain dominant positions in both exports and imports. However, despite the overall growth and integration of global markets, the international trading system remains highly vulnerable to external shocks. The findings of this paper show that protectionist policies, particularly large-scale unilateral tariff measures, can significantly distort trade flows, alter import and export patterns, and create short-term trade reorientation effects driven by anticipation and uncertainty. Although such measures may be introduced with the intention of reducing trade deficits or strengthening domestic industries, their broader impact often includes increased market volatility and reduced predictability in international economic relations.

In addition to trade policy disruptions, geopolitical conflicts have proven to be a major source of instability in global markets. Energy supply shocks, particularly those created by closures of strategic transit routes, have wide-ranging consequences that extend far beyond the energy sector, influencing transportation costs, industrial production, food supply chains, and high-technology industries such as semiconductors and artificial intelligence infrastructure. These

disruptions further highlight the interconnectedness of modern global supply systems. The empirical evidence presented in this paper suggests that the costs of global instability are ultimately distributed across multiple actors, with end consumers and investors often bearing a significant share through higher prices, increased uncertainty, and lower investment returns. At the same time, global trade continues to adjust dynamically, with supply chains adapting and rerouting in response to new constraints and risks.

Overall, international trade in the contemporary period can be characterized by a dual tendency: continued expansion and integration on one hand, and rising exposure to political, economic, and geopolitical risks on the other. As a result, instability has become not an exception but regular part of the global trading system.

REFERENCE

Congressional Research Service. (2026). *Presidential 2025 Tariff Actions: Timeline and Status.* Washington: Congressional Research Service.

Curran, L., & Eckhardt, J. (2021). The Structure of International Trade, Global Value Chains and Trade Wars in the 21st Century. *Research Handbook on Trade Wars*, 1-25.

Deloitte. (2026, 04 10). *US administration withdraws announcement of 10% additional tariffs on several EU countries and the UK over Greenland.* Retrieved from Deloitte: https://www.deloitte.com/at/de/services/tax/blogs/2026/breaking-news-us-administration-withdraws-announcement-of-additional-tariffs-eu-countries.html

Government of Canada. (2026, 04 05). *Complete list of U.S. products subject to counter tariffs*. Retrieved from Government of Canada: https://www.canada.ca/en/department-finance/programs/international-trade-finance-policy/canadas-response-us-tariffs/complete-list-us-products-subject-to-counter-tariffs.html

Guerra, M., & Kohen, D. (2026, 04 10). *Iran, Oil and the U.S. Economy*. Retrieved from morganstanley.com: https://www.morganstanley.com/insights/articles/iran-war-oil-shock-stock-market-impacts

Nuševa, D., Marić, R., Vukmirović, G., & Macura, N. (2023). The impact of geopolitical turbulences on global logistics activities. *Strategic Management and Decision Support Systems in Strategic Management* (str. 553-559). Subotica: Facluty of Economics in Subotica, University of Novi Sad. DOI: 10.46541/978-86-7233-416-6_70.

OECD. (2025). *Finding the right balance in uncertain times.* Paris: OECD.

Quiroz-Gutierrez, M. (2026, 04 09). *A Danish app that helps consumers boycott U.S. products increased users by 1,400% as Trump resurrected the Greenland issue at Davos*. Retrieved from Fortune.com: https://fortune.com/2026/01/23/us-consumer-product-boycott-app-greenland-denmark-madeometer-donald-trump-world-economic-forum-davos/

Trading economics. (2026, 04 09). *Crude Oil*. Retrieved from tradingeconomics.com: https://tradingeconomics.com/commodity/crude-oil

UN trade and development. (2026, 04 06). *Tariff dashboard - tracking the evolution of US tariffs*. Retrieved from UN trade and developement: https://unctad.org/topic/trade-analysis/tariffs/tariff-dashboard

US Census Bureau. (2026, 04 04). *Trade in goods with China*. Retrieved from US Census Bureau: https://www.census.gov/foreign-trade/balance/c5700.html

US Congress. (2026, 04 08). *U.S. Restrictions on Huawei Technologies: National Security, Foreign Policy, and Economic Interests*. Retrieved from Congress.gov: https://www.congress.gov/crs-product/R47012

US International Trade Commission. (2026, 04 06). *Import and Export Data*. Retrieved from US International Trade Commission: https://www.usitc.gov/data/index.htm#tariff-and-trade-datasets

World Trade Organisation. (2026, 04 02). *World Trade Statistics - Key insights and trends in 2025*. Retrieved from World Trade Organisation: https://www.wto.org/english/res_e/statis_e/world_trade_statistics_e.htm

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THE IMPACT OF GLOBAL INSTABILITY ON ELECTRONIC COMMERCE LOGISTICS AND FULFILLMENT MODELS

Abstract: Global instability represents one of the key characteristics of the contemporary business environment, as it has a comprehensive impact on business operations and leads to significant changes in operating conditions. This instability manifests through economic crises, increased uncertainty, geopolitical conflicts and tensions, as well as frequent disruptions in global supply chains, which further complicate the planning and execution of business activities. Under such circumstances, electronic commerce stands out as a sector that is particularly exposed to these negative effects due to its strong dependence on logistics systems. The aim of this paper is to analyze the impact of global instability on logistics processes in electronic commerce, as well as on fulfillment models. The study is based on an analysis of contemporary academic literature in the fields of logistics and electronic commerce, as well as industry reports. The results indicate the growing importance of flexible and digitally supported logistics solutions, whose implementation becomes one of the key factors in maintaining competitiveness under conditions of increased uncertainty. Particular importance is placed on improved inventory management and the application of modern information technologies in the planning and coordination of logistics activities.

Keywords: Instability; Electronic commerce; Logistics; Supply chain; Fulfillment models

1. INTRODUCTION

The contemporary business environment today is anything but stable. The past few years have clearly demonstrated how quickly global flows can be disrupted and how deeply connected modern economies truly are. During and after the pandemic, geopolitical tensions have continued to intensify, making uncertainty an almost everyday framework of business operations. According to a World Bank report (2026), the global economy is facing increasing risks alongside slowed growth, which further complicates the functioning of international trade and supply chains.

In such circumstances, electronic commerce becomes particularly sensitive to environmental changes, because although it appears to rely primarily on online platforms, its core still depends on physical processes, especially logistics. Disruptions in supply chains, delivery delays, rapidly increasing costs, and nearly unmanageable inventory planning have become a reality that companies face on a daily basis. At the same time, these challenges are no longer temporary,

but represent a structural feature of the modern business environment, requiring companies to rethink traditional approaches to logistics and operations.

The aim of this paper is to analyze how global instability affects logistics processes in electronic commerce, as well as order fulfillment models. The focus is on examining supply chain disruptions, inventory management, and cost pressures, as well as the ways in which companies respond to these challenges and adapt their logistics strategies. In this context, the paper is structured as follows: the next section discusses the concept of global instability and the characteristics of the modern business environment; this is followed by an analysis of electronic commerce logistics and order fulfillment model; subsequently, the effects of instability and potential company responses are examined; and finally, key observations and conclusions are presented.

2. GLOBAL INSTABILITY AND THE CONTEMPORARY BUSINESS ENVIRONMENT

In recent years, the global business environment has no longer been characterized by stability, but rather by a series of consecutive disruptions that have significantly altered the functioning of international trade. The COVID-19 pandemic represents one of the most significant shocks of the 21st century, causing border closures, production interruptions, and disruptions in global supply chains. Although not the first major disturbance, it intensified existing vulnerabilities and marked the beginning of a period of prolonged instability, followed by events such as the Russia-Ukraine War, the energy crisis in Europe, and disruptions in key maritime routes, including the Suez Canal blockage and subsequent issues in the Red Sea. These events indicate that disruptions in the global economy and business are no longer exceptions, but rather a part of contemporary business operations. According to estimates by World Bank (2026), global economic growth has slowed approximately 2-3% annually.

Under such conditions, global instability is not reflected solely through macroeconomic indicators, but also through concrete operational challenges faced by companies. The rerouting of shipping lines, increasingly frequent delivery delays, insufficient container availability, and sharp increases in transportation costs have become the new reality. Data from United Nations Conference on Trade and Development (2024) indicate that container shipping prices in global maritime transport have, on certain routes, increased by more than three times compared to the same period in the previous year. The same source highlights that rising transportation cost have a direct impact on product prices; consequently, companies face more complex inventory management, higher operational costs, and reduced delivery reliability.

These disruptions have revealed the limitations of traditional approaches, which for decades were based on maximizing efficiency and minimizing costs. For example, models such as Just-in-Time, which rely on low inventory levels and fast, efficient delivery, have proven to be highly vulnerable to supply chain disruptions. As a result, an increasing number of companies are shifting their focus from efficiency toward resilience. According to analyses by the World Economic Forum (2026), more than 70% of companies have identified the need to enhance supply chain flexibility, while a growing number of firms are working on supplier diversification as a strategy to reduce dependence on individual markets. In addition, digitalization and the application of advanced technologies are becoming key tools for adapting to new business conditions. Companies are increasingly investing in real-time tracking systems, data analytics, and the automation of logistics processes. According to data from the Organization for Economic Co-operation and Development (2025), supply chain automation can reduce operational costs by up to 20%. However, even with the implementation of advanced technologies, global instability and its effects on business cannot be eliminated - only mitigated.

The importance of these changes is particularly evident in logistics, which represents on of the most sensitive functions in modern business operations. Logistics is directly affected by all the mentioned disruptions, as it depends on the functioning of transportation costs can lead to a 1-2% rise in import prices globally. This impact is even more pronounced in electronic commerce, where speed and delivery reliability are key determinants of competitiveness. Therefore, understanding the nature of global instability and its impact on the business environment serves as a foundation for further analysis of logistics processes and order fulfillment models in electronic commerce.

Consequently, resilience is no longer viewed as a complementary objective, but as a core requirement for maintaining business continuity in an increasingly volatile global environment.

3. LOGISTICS IN ELECTRONIC COMMERCE AND FULFILLMENT MODELS

The development of electronic commerce has led to significant changes in the organization of logistics processes, as well as in consumer expectations. Unlike traditional retail, where goods are distributed in large quantities to brick-and-

mortar stores, electronic commerce involves large numbers of individual orders that need to be delivered to end customers. This business model increases the complexity of logistics operations and imposes the need for greater speed, flexibility and reliability of delivery.

When it comes to the need for greater speed, according to the DHL report (2025), more than 70% of consumers state that delivery speed is one of the key factors influencing their online purchasing decisions, and more than 50% want delivery to be faster. Shipment tracking also has a significant impact. Under such conditions, logistics processes become one of the key elements of competitive advantage.

3.1. Electronic Commerce logistics

Logistics in electronic commerce include a series of interconnected operational processes that enable the fulfillment of online orders. Unlike traditional logistics systems, where goods are distributed to predefined retail locations, electronic commerce introduces a shift, not only must it respond to a large number of individual customer demands, but this response often needs to occur in real time.

This shift increases operational complexity, as logistics systems must handle fragmented order structures, higher frequency of shipments, and stricter delivery deadlines, all while maintaining efficiency and cost control. This major transformation creates the need for a different approach to warehouse organization, a higher level of automation, and more intensive use of information technologies throughout the entire logistics system of a company. According to reports, digitalization and automation represent key factors in improving the efficiency of electronic commerce logistics, as they enable companies to process orders faster and manage their resources more effectively.

As previously mentioned, there is a strong pressure on delivery speed in electronic commerce. Deliveries that previously took several days are now increasingly expected within 24 hours, and more recently, same day delivery is becoming common, especially in developed countries. According to Statista report (2023), more than 40% of customers expect delivery within two days, while an increasing number of customers are willing to pay for express delivery options. Slightly different findings are presented by McKinsey & Company in their report (2023) indicating that as many as 90% of customers expect delivery within 2-3 days, mostly free of charge. These expectations further complicate the organization of logistics precesses and require continuous optimization of warehousing and distribution operations.

A particular challenge is last-mile delivery, which refers to the final stage of delivering products to the end customer. This segment is considered the most expensive and, at the same time, the most complex part of the entire delivery process. According to Lim & Jin (2018), last-mile delivery costs can account for up to 50% of total logistics costs in electronic commerce, a finding also supported by McKinsey (2023), which highlights this segment as one of the main sources of operational inefficiency.

Due to these challenges, companies are increasingly exploring alternative delivery solutions, such as micro-fulfillment centers, urban distribution hubs, and decentralized delivery networks, in order to improve efficiency and reduce delivery times.

The growth of electronic commerce additionally burdens logistics systems through the continuous increase in shipment volumes. According to the Pitney Bowes report (2024), the global number of parcel shipments exceed 160 billion annually, with constant year-over-year growth. More recent estimates suggest that this trend will continue, with the number of shipments expected to surpass 200 billion globally (Pitney Bowes, 2024) in coming years, further increasing pressure on logistics infrastructure and distribution capacities. Such growth dynamics require continuous improvement of logistics processes, particularly in warehousing, sorting and last mile delivery.

The complexity of delivery is not the only challenge companies face today. A specific feature of electronic commerce logistics is the exceptionally high level of product returns. Compared to traditional retail, where returns are less frequent, online sales experience significantly higher return rates. In certain sectors, such as the fashion industry, return rates can exceed 30%, which further complicates already complex logistics processes and increases transport costs (Statista, 2023). High return rates significantly complicate logistics processes, as they require the development of efficient reserve logistics systems, including product inspection, repackaging, and reintegration into inventory, which further increases operational costs and general complexity.

The way companies respond to all these challenges largely depends on the choice of order fulfillment model. Different approaches to organizing logistics processes determine the level of efficiency and the ability to adapt to modern market conditions. For this reason, the following section will analyze the main order fulfillment models in electronic commerce and their key characteristics.

3.2. Order Fulfillment Models in Electronic Commerce

Order fulfillment models in electronic commerce refer to the ways in which companies organize the storage, processing and delivery of products to end customers. The selection of an appropriate model represents one of the key strategic decisions, as it directly affect costs, delivery speed, flexibility and overall customer experience. It is important to emphasize that there is no universal solution, instead, companies choose models in accordance with their specific needs.

One possible approach is the in-house fulfillment model, in which a company independently manages warehousing, inventory and distribution. The biggest advantage of this model lies in the higher level of control, however, it requires significant investments, which can be a limitation, especially for smaller companies. As domestic (Serbian) authors point out, efficient management of logistics processes represents the basis of competitiveness in modern distribution systems (Lovreta, 2011).

On the other hand, an increasing number of companies choosing logistics outsourcing, i.e., engaging third-party logistics providers (3PL). In this model, an external company takes over part of the entire process of storage, order processing, and delivery. According to OECD analyses (2025), logistics outsourcing enables companies to focus on their core activities, while logistics providers ensure greater efficiency and flexibility in fulfillment operations. A specific model that has gained importance with the development of digital platforms is dropshipping. In this case, the company does not hold its own inventory, instead, orders are directly forwarded to the supplier, who delivers the products to the end consumer. This model significantly reduces initial business cost and eliminates the need for warehousing, but at the same time introduces challenges related to quality control and delivery time.

In addition to the before mentioned models, the omnichannel approach is becoming increasingly important. This approach involves the integration of online and offline sales channels. Within this model, companies combine different fulfillment methods, such as home delivery, in-store pickup (clock & collect), or shipping from nearest warehouse. Such an approach enables greater flexibility and better resource utilization, but requires a high level of coordination and system integration.

According to DHL report (2025), flexible delivery options and the possibility of choosing the method of product collection significantly influence customer satisfaction and loyalty. In practice, many companies use a combination of different fulfillment models in order to optimize costs and improve service quality. The choice of an appropriate model depends on numerous factors, including company size, their budget and product type, while customer expectations also play a crucial role in decision-making process. The ability to adapt these models is becoming key success factor, which will be further discussed in the following section.

4. THE IMPACT OF GLOBAL INSTABILITY ON LOGISTICS

Unlike the previous chapters, which examined general trends and characteristics of logistics, this section focuses on the concrete consequences that global disruptions have on the functioning of logistics systems. These impacts are most clearly observed through supply chain disruptions, challenges in inventory management, and rising logistics costs. In addition, global instability not only disrupts operational processes but also fundamentally reshapes strategic decision-making in logistics, forcing companies to reconsider traditional models and adopt more resilient and adaptive approaches.

4.1. Supply Chain Disruptions and Transportation Challenges

In conditions of global instability, disruptions in supply chains are most evident in the reduced predictability of transportation costs. Instead of stable and pre-defined routes, as was previously the case, companies are now facing frequent changes in planned transportation routes. In practice, this means that logistics plans are increasingly losing reliability, and companies and their partners are forced to find alternative solutions in a short period of time. Additionally, frequent changes in transportation routes make coordination between different stages of the logistics process more difficult.

Moreover, increased congestion in ports, delays at border crossing, and shortages of transport capacity further intensify these challenges, leading to longer delivery times and decreased service reliability. As a result, companies are increasingly exposed to operational risks that can directly affect customer satisfaction and overall business performance.

In addition to these challenges, recent disruptions in key maritime corridors have further intensified transport uncertainty. For example, due to security risks in the Red Sea, a significant share of global shipping traffic has been redirected around the Cape of Good Hope, increasing transit times by 10 to 15 days on average and significantly raising

transport costs. Furthermore, global container shipping volatility remains a major issue, making long-term logistics planning increasingly difficult for companies operating in international markets.

In such conditions, logistics systems are transforming and shifting from static planning to dynamic management, where decisions regarding routes, delivery times, and transport modes are made in real time. This approach largely relies on modern IT solutions such as ERP (Enterprise Resource Planning), WMS (Warehouse Management System), and TMS (Transport Management System). The integration of these technologies enables greater visibility across the supply chain, allowing companies to monitor disruptions, anticipate potential risks, and respond more effectively to unexpected changes.

4.2. Inventory Management

Changes in transportation flows, and overall reduced reliability of deliveries, directly affect the way companies manage their inventories. In conditions where delivery times are unpredictable, companies are forced to adjust their inventory management strategies in order to ensure business continuity.

Since companies need to maintain higher inventory levels to mitigate the risk of delays or supply disruptions, issues arise such as increased storage costs and greater capital engagement. Higher inventory levels also lead to space management challenges, increased risk of inventory obsolescence, and reduced business flexibility. These problems, are especially pronounced in electronic commerce, where inventory turnover is crucial for efficiency. As a solution, companies are shifting from centralized warehousing to a decentralized approach. In decentralized systems, goods are positioned closer to end customers to reduce delivery times. However, decentralization also introduces additional complexity in inventory coordination and control, requiring more advanced planning systems and higher levels of synchronization across different locations. Companies must carefully balance the trade-off between service speed and cost efficiency in order to optimize their overall logistics performance.

Furthermore, the growing importance of real-time data analytics allows firms to better forecast demand patterns, reduce uncertainty, and improve inventory allocation decisions, thereby minimizing the negative effects of instability.

4.3. Cost Pressures

The result of all these changes is that costs have become unstable and difficult to predict. When standard routes and planned flows become unreliable, companies are forced to choose more expensive options, significantly increasing overall logistics costs. Additional pressure on costs arises from multiple locations, a higher number of warehouses, and greater coordination requirements are just some of the factors contributing to rising costs. Cost pressures are particularly evident in last-mile delivery phase, where companies must meet customer expectations for faster delivery in order to remain competitive.

In addition, increasing labor costs, higher fuel prices and the need for investment in digital infrastructure further amplify financial pressures on logistics operations. These factors make cost management significantly more complex, specially in highly competitive markets.

A significant challenge is long-term cost planning, as fluctuations in transportation and logistics service prices make it difficult to create reliable financial plans. In recent years, this uncertainty has been further intensified. Geopolitical tensions and sanctions, especially regarding Europe's supply of oil and gas, have led to increased price volatility, directly affecting transportation and distribution costs. Additionally, disruptions in key transport routes, such as the blockage of the Suez Canal or issues in maritime routes through the Red Sea, have resulted in longer transport routes and increased operational costs. In such situations, logistics companies are often forced to use alternative routes, which are longer and more expensive, further complicating cost control.

Moreover, fluctuations in fuel prices have had a direct and immediate impact on transportation costs, particularly in road and maritime transport. Since fuel represents a significant share of logistics expenses, even small increases in fuel prices can affect overall cost structures. Consequently, companies are increasingly focusing on cost optimization strategies, including route optimization, strategic partnerships, and the use of advanced technologies, in order to mitigate the negative financial impact of global instability and maintain long-term sustainability.

Another important factor contributing to cost pressures is the growing need for investment in technological infrastructure, including automation systems, tracking technologies, and data analytics tools. While these investments improve efficiency in the long run, they represent an additional financial burden in the short term, especially for smaller companies. In this context, managing logistics cost is no longer limited to cost reduction, but increasingly involves balancing short-term financial constrains with long-term strategic investments. This shift highlights the growing importance of adaptability and resource allocation decisions, which directly influence the ability of companies to respond to instability and maintain competitiveness.

These challenges further emphasize the need for companies to continuously adapt their order fulfillment models and strategies, which will be analyzed in the following section.

5. ADAPTATION OF ORDER FULFILLMENT MODEL TO GLOBAL INSTABILITY

Disruptions in transportation, unpredictability of delivery times, and rising costs force companies to continuously reassess how they organize their logistics processes, with flexibility and adaptability emerging as key factors for survival. In real-world conditions, this means that companies increasingly rely on combined fulfillment models rather than a single approach. Such hybrid models often integrate in-house logistics capabilities with outsourced services, allowing companies to balance control, cost efficiency and responsiveness in highly volatile market conditions. Recent research shows that electronic commerce continues to grow, with global market value increasing from approximately $4.25 trillion in 2020 to as much as $7 trillion in 2025, further intensifying pressure on logistics and operational models (Vučenović, Macura, & Pavličević, 2026). This rapid expansion of electronic commerce not only increases the volume of orders but also raises customer expectations in terms of delivery speed, service quality, placing additional strain on existing fulfillment systems.

For example, when order volumes increase, part of the activities is outsourced to logistics providers, ensuring continuity of delivery without overburdening internal resources. According to a DHL report (2025), flexible delivery options and adaptability of logistics systems are among the key factors influencing customer satisfaction in electronic commerce, further confirming the importance of such approaches. In this context, third-party logistics (3PL) providers play a crucial role by offering scalable solutions that enable companies to quickly adjust their operational capacity in response to fluctuating demand.

Companies are increasingly relying on modern IT solutions, such as ERP (Enterprise Resource Planning), WMS (Warehouse Management System) and TMS (Transportation Management System), which enable real-time tracking of goods flows and faster operational decision-making. Thanks to these systems, companies can respond promptly to disruption, reroute goods, adjust delivery paths and optimize inventory allocation, thereby reducing the negative impact of instability on business operations. Furthermore, the adoption of advanced technologies such as artificial intelligence, predictive analytics, and automation enhances decision-making processes and enables more accurate demand forecasting, which is essential in uncertain environments.

Adapting order fulfillment models is not a one-time decision, but a continuous process. Companies that successfully integrate flexibility, digitalization, and cooperation with logistics partners have a greater ability to maintain operational stability and preserve their competitive position, even in conditions of pronounced global instability. Ultimately, those companies that proactively invest in resilient and adaptive fulfillment strategies are better positioned to not only withstand external shocks but also leverage them as opportunities for long-term growth and competitive advantage.

6. CONSLUSION

The analysis of the impact of global instability on logistics processes and order fulfillment models in electronic commerce shows that contemporary business conditions are increasingly characterized by uncertainty and constant change. In such an environment, traditional and rigid fulfillment models are no longer sufficient. Companies are increasingly shifting toward more flexible and adaptive approaches that enable faster responses to changes and better management of uncertainty. The use of hybrid fulfillment models, integration of different distribution channels and collaboration with logistics service providers have become essential elements of modern logistics strategies.

At the same time, digitalization plays a central role in enabling these adjustments. The application of advanced IT systems and data-driven decision-making allows companies to monitor operations in real time, optimize logistics processes, and respond more effectively to disruptions. These capabilities are becoming a key determinant of competitiveness in the electronic commerce sector. Overall, the ability to continuously adapt order fulfillment models, rather than rely on a single optimal solution, emerges as a critical success factor. Companies that successfully combine flexibility, technological support, and strategic coordination of logistics activities are better positioned to maintain stability and achieve long-term growth in conditions of global instability.

REFERENCES

DHL. (2025). DHL e-commerce trends report 2025. DHL, Bonn.

Lim, S. F. W., Jin, X., & Srai, J. S. (2018). Consumer-driven e-commerce: A literature review, design framework, and research agenda on last-mile logistics models. International Journal of Physical Distribution & Logistics Management, 48(3), 308–332. https://doi.org/10.1108/IJPDLM-02-2017-0081

Lovreta, S. (2011). Trgovinski menadžment. Ekonomski fakultet, Beograd.

McKinsey & Company. (2023). Parcel delivery: The future of last-mile logistics. McKinsey & Company, New York.

OECD. (2025). Supply chain resilience review. OECD Publishing, Paris.

Pitney Bowes. (2024). Parcel shipping index 2024. Pitney Bowes, Stamford.

Statista. (2023). E-commerce delivery expectations statistics. Statista.

United Nations Conference on Trade and Development. (2024). Review of maritime transport 2024. United Nations, Geneva.

Vučenović, S., Macura, N., & Pavličević, M. (2026). Promene u elektronskoj trgovini – odraz primene veštačke inteligencije i karakteristika savremenog potrošača. U Zbornik radova XXX međunarodne konferencije Informacione tehnologije (IT). Univerzitet Crne Gore, Podgorica.

World Bank. (2026). Global economic prospects. World Bank, Washington, DC.

World Economic Forum. (2026). Global risks report 2026. World Economic Forum, Geneva.

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MEASURING MARKETING OUTCOMES OF CUSTOMER EXPERIENCE: VALIDATION OF THE SCALE

Abstract:
Background: Customer experience has emerged as one of the most important constructs in contemporary marketing, as organizations increasingly compete through the quality of interactions and experiences delivered across the customer journey. While the literature has extensively examined the conceptual foundations, dimensions, and strategic relevance of customer experience, considerably less attention has been devoted to the development of validated instruments capable of measuring its downstream marketing consequences. In particular, there remains a need for a psychometrically sound scale that captures the core marketing outcomes associated with customer experience in an integrated and methodologically rigorous manner.
Purpose: The main objective of this study was to develop and validate the Marketing Outcomes of Customer Experience (MOCE) scale. The proposed instrument was designed to measure three key dimensions widely recognized in the marketing literature as major consequences of customer experience: Customer Satisfaction, Behavioural Loyalty Intentions, and Word ofMouth. By focusing on these three constructs, the study sought to provide a reliable and valid framework for assessing how customer experience is reflected in evaluative, relational, and communicative customer responses.
Methods: The empirical analysis was conducted on a sample of 702 respondents. The MOCE instrument was formed by integrating three existing scales into a unified measurement framework. The psychometric evaluation of the instrument included reliability analysis and factor analysis. Sampling adequacy was assessed using the Kaiser–Meyer–Olkin (KMO) measure, while Bartlett's test of sphericity was used to determine whether the correlation matrices were suitable for factor analysis. Internal consistency was examined using Cronbach's alpha coefficient, and the dimensional structure of the instrument was assessed through principal component analysis.
Findings: The results confirmed the satisfactory psychometric properties of the MOCE scale, with, with , The overall reliability of the MOCE instrument reached 0.966, indicating excellent internal consistency across the three constructs.
Implications: The study contributes to the customer experience literature by extending the measurement focus from customer experience itself to its key marketing outcomes. The validated MOCE scale offers a useful framework for future empirical research and provides practitioners with a diagnostic instrument for evaluating whether customer experience strategies generate favorable outcomes in terms of satisfaction, loyalty-related intentions, and positive word-of-mouth. Future research should test the scale in different industries, populations, and national contexts to

further examine its generalizability and robustness.
Keywords: *customer experience; marketing outcomes; customer satisfaction; behavioural loyalty intentions; word-of-mouth; scale validation; psychometric validation; factor analysis*

1. INTRODUCTION

In increasingly competitive markets, organizations have shifted from product-centric and transaction-oriented approaches toward experience-driven strategies, recognizing customer experience (CX) as a critical source of differentiation and long-term value creation (De Keyser et al., 2020; Lemon & Verhoef, 2016; Verhoef et al., 2009). Rather than being confined to a single encounter, CX reflects the customer's holistic perception of interactions with a firm across the entire customer journey and integrates cognitive, emotional, sensory, behavioral, and social responses (Brakus et al., 2009; Schmitt, 1999). As such, CX has emerged as one of the most important concepts in contemporary marketing theory and practice. However, while the literature has substantially advanced the conceptualization of CX, its relationship with measurable marketing outcomes remains insufficiently theorized and empirically operationalized.

The strategic relevance of CX lies in its capacity to influence consequential downstream outcomes. Prior research consistently suggests that favorable customer experiences contribute to customer satisfaction, strengthen behavioral loyalty intentions, and encourage positive word of mouth, whereas poor experiences may weaken relationships and increase switching tendencies (Klaus et al., 2013; Zeithaml et al., 1996). These outcomes are not merely attitudinal reactions but represent marketing-relevant consequences through which experience translates into organizational performance. In the broader marketing literature, such outcomes are often treated as indicators of marketing productivity and market-based asset development, as they shape retention, advocacy, and the long-term value of customer relationships (Rust et al., 2004). Consequently, understanding and measuring the marketing outcomes of CX is essential for both scholarly advancement and managerial decision-making.

Despite the growing body of CX research, measurement remains a persistent challenge. Existing studies have produced influential measures of related constructs, including brand experience (Brakus et al., 2009) and customer experience quality, particularly through the EXQ framework (Klaus et al., 2013), that was validated for the Serbian banking context (Ćelić et al., 2025). More recent work has also expanded the conceptual language of the field by clarifying the role of touchpoints, context, and experiential qualities in the formation of CX (De Keyser et al., 2020). Nevertheless, much of the literature remains focused on measuring customer experience itself rather than developing a validated instrument that captures its downstream marketing outcomes in an integrated manner. In empirical studies, customer satisfaction, loyalty, and word of mouth are often measured separately, inconsistently operationalized, or treated as loosely connected consequences. This fragmentation limits comparability across studies and constrains the accumulation of coherent knowledge regarding how CX generates value in the marketplace.

This limitation is particularly important because existing measures frequently focus on isolated touchpoints, conflate customer experience with customer satisfaction, or fail to capture the multidimensional and process-oriented nature of experience as it unfolds over time (Kranzbühler et al., 2018; McColl-Kennedy et al., 2019; Ponsignon et al., 2021). As a result, there is still no sufficiently robust and psychometrically validated scale that systematically measures the key marketing outcomes arising from customer experience. The absence of such an instrument creates both theoretical and practical difficulties. From a theoretical standpoint, it weakens construct clarity and hampers cumulative research on the mechanisms through which CX affects marketplace behavior. From a managerial standpoint, it limits firms' ability to assess the return on investments in experience design and to identify which experiential effects have the strongest implications for commercially relevant outcomes.

Scale development and validation have long been regarded as foundational contributions to marketing science because they enable abstract constructs to be measured with rigor, reliability, and empirical precision (DeVellis, 2016). Valid measurement is especially important in areas such as customer experience, where conceptual breadth often exceeds methodological precision. Without carefully developed and validated scales, empirical findings may be unstable, constructs may overlap, and managerial recommendations may rest on weak operational foundations. Accordingly, the development of a scale that captures the marketing outcomes of customer experience responds to a significant gap in the literature and addresses an important methodological need.

The present study seeks to address this gap by developing and validating a multi-item scale designed to measure the marketing outcomes of customer experience. The conceptual foundation of the study draws on service-dominant logic, which emphasizes value co-creation through interactions between customers and firms (Vargo & Lusch, 2004). The resulting scale is evaluated through standard psychometric criteria, including reliability, convergent validity, discriminant validity, and nomological validity.

The contributions of this study are significant not only for research purposes, as they extend customer experience research by shifting attention from measuring CX itself to rigorously assessing its marketing consequences.

Furthermore, it provides a psychometrically validated instrument to support future empirical research across diverse contexts and industries. More significantly, it offers practitioners a diagnostic tool for evaluating the effectiveness of experience-oriented strategies in producing meaningful relational and behavioral outcomes. By developing a reliable and valid scale for measuring the marketing outcomes of customer experience, this research aims to strengthen both the conceptual and empirical foundations of CX scholarship.

2. MARKETING OUTCOMES OF CUSTOMER EXPERIENCE

Customer experience (CX) is increasingly recognized as a strategic driver of firm performance because its effects extend beyond immediate service evaluations and shape a range of important marketing outcomes. In marketing literature, such outcomes are typically understood as customer-level consequences that reflect the effectiveness of a firm's market-facing activities and contribute to long-term organizational value creation (Rust et al., 2004; Srivastava et al., 1998). Among the most frequently examined and managerially relevant consequences of customer experience are customer satisfaction, behavioral loyalty intentions, and word of mouth. These outcomes are particularly important because they capture affective evaluation, relational continuity, and advocacy behavior, respectively, thereby providing a comprehensive view of how customer experience translates into marketplace value.

Customer experience is inherently multidimensional, encompassing customers' cognitive, emotional, sensorial, behavioral, and relational responses to interactions with a firm across the customer journey (Lemon & Verhoef, 2016; Verhoef et al., 2009). Because these responses shape how customers interpret and evaluate their interactions with the firm, favorable experiences are expected to produce more positive judgments and behavioral tendencies. In this sense, customer satisfaction, behavioral loyalty intentions, and word of mouth can be viewed as key marketing outcomes through which the consequences of customer experience become visible and measurable.

2.1. Customer Satisfaction

Customer satisfaction (SAT) is one of the most established constructs in marketing and consumer behavior research. It is generally defined as a customer's evaluative judgment regarding whether a product, service, or overall experience meets or exceeds expectations (Oliver, 1997). Although satisfaction and customer experience are closely related, they are conceptually distinct. Customer experience reflects the broader, multidimensional process of interacting with a firm, whereas satisfaction represents a post-consumption evaluative outcome of that process. In other words, satisfaction is not equivalent to experiencing itself but rather one of its most important consequences.

The link between customer experience and customer satisfaction is well grounded in prior literature. Positive experiences across touchpoints tend to reduce perceived effort, enhance emotional engagement, and strengthen perceptions of value, all of which contribute to higher satisfaction levels (Klaus et al., 2013; Lemon & Verhoef, 2016). When customers perceive that their interactions with a company are coherent, convenient, and emotionally positive, they are more likely to evaluate the relationship favorably. Conversely, fragmented, frustrating, or inconsistent experiences tend to reduce satisfaction, even when the core service outcome is acceptable.

Customer satisfaction is particularly important because it often serves as an immediate and central indicator of customer response. It captures whether the firm's experience has been positively appraised and whether it has meaningfully met customers' expectations. Furthermore, satisfaction has repeatedly been shown to influence subsequent relational and behavioral outcomes, making it a crucial mechanism by which customer experience generates broader marketing effects. For this reason, satisfaction is widely treated as one of the primary outcomes of customer experience.

2.2. Behavioral Loyalty Intentions

Behavioral loyalty intentions (BLI) refer to a customer's stated willingness to continue the relationship with a firm through future purchases, repurchases, or continued use. Unlike attitudinal loyalty, which reflects emotional attachment or psychological commitment, behavioral loyalty intentions focus on the likelihood of engaging in future behaviors that signal relationship continuity (Zeithaml et al., 1996). In service and relationship marketing contexts, these intentions often include repurchase intention, intention to remain with the provider, and resistance to switching.

Customer experience is expected to play an important role in shaping behavioral loyalty intentions because customers are more likely to remain loyal to firms that consistently provide positive, memorable, and value-enhancing experiences. Experiences that are easy, personalized, trustworthy, and emotionally satisfying strengthen the customer's inclination to continue the relationship, while negative experiences increase dissatisfaction, uncertainty, and switching propensity (Klaus et al., 2013; Verhoef et al., 2009). Thus, behavioral loyalty intentions may be understood as a forward-looking manifestation of customers' responses to prior experiences.

The relevance of behavioral loyalty intentions as a marketing outcome lies in their strong association with customer retention and revenue stability. Retaining existing customers is often more cost-effective than acquiring new ones, and firms that successfully translate positive experiences into loyalty intentions are better positioned to generate repeat business and long-term customer value. Moreover, behavioral loyalty intentions are particularly useful in empirical research because they reflect not only customers' current evaluation of the firm but also their anticipated future conduct. Accordingly, they represent a vital outcome variable in studies examining the performance implications of customer experience.

2.3 Word of Mouth

Word of mouth (WOM) refers to informal interpersonal communication in which customers share opinions, experiences, and recommendations about firms, products, or services with other individuals. It is widely regarded as one of the most influential marketing outcomes because it extends the impact of the customer experience beyond the focal customer, affecting the perceptions and decisions of others (Anderson, 1998). Positive WOM can strengthen brand reputation and attract new customers, while negative WOM may damage trust and discourage potential buyers.

The relationship between customer experience and WOM is conceptually intuitive and empirically supported. Customers who have highly positive experiences are more likely to share those experiences with others, especially when the experience is emotionally engaging, distinctive, or exceeds expectations. Such communication may take the form of recommendations, praise, or positive online reviews. In contrast, unfavorable experiences can also trigger WOM, often in the form of complaints or warnings to others. This makes WOM a particularly sensitive and socially diffused outcome of customer experience.

WOM is especially important as a marketing outcome because it reflects advocacy rather than mere evaluation. While satisfaction indicates that a customer has positively assessed an experience, WOM suggests that the customer is willing to externalize that evaluation and communicate it to others. This makes WOM strategically significant, as it contributes to customer acquisition, social proof, and the amplification of brand perceptions in both offline and digital environments. In sectors characterized by high competition and low differentiation, positive WOM generated by superior customer experience may become a particularly valuable source of competitive advantage.

2.4. The instrument for assessing Marketing Outcomes Customer Experience (MOCE) scale

Taken together, customer satisfaction, behavioral loyalty intentions, and word of mouth represent three complementary dimensions of the marketing outcomes of customer experience. Customer satisfaction captures the evaluative response to the experience; behavioral loyalty intentions reflect the relational and future-oriented consequences of that evaluation; and word of mouth represents the communicative and advocacy-based extension of customer response. Examining these three constructs jointly enables a more comprehensive understanding of how customer experience creates value for firms.

Their inclusion is also theoretically justified because they capture distinct but interconnected consequences of experience. A favorable customer experience is expected to enhance satisfaction, thereby strengthening loyalty intentions and increasing the likelihood of positive WOM. At the same time, customer experience may also exert direct effects on loyalty-related and advocacy-related outcomes, especially when customers perceive the experience as particularly memorable or distinctive. Therefore, these three constructs provide a robust foundation for assessing the marketing outcomes of customer experience and are appropriate dimensions for scale development and validation.

3. THE RESULTS OF EVALUATING THE VALIDITY AND RELIABILITY OF THE MOCE INSTRUMENT

The scale instrument comprises 17 items that assess attitudes towards the marketing outcomes of customer experience, resulting in the development of a hypothesis to be tested:

H_0: The MOCE scale instrument can be used to identify and measure the attitudes of respondents from the Republic of Serbia regarding the marketing outcomes of customer experience.

The empirical study was conducted to test the MOCE scale in the Serbian banking sector. All respondents were users of banking services in Serbia, including both individuals and legal entities. The empirical analysis was based on a sample of 702 respondents. The sample profile indicates that 61.3% of the participants were male and 38.7% were female. The most represented age category was 25 to 34 years of age, comprising 44.4% of the respondents. In terms of education,

nearly half of the sample (49.1%) held a university degree. Furthermore, the regional structure of the sample reveals a strong predominance of respondents from Vojvodina, who accounted for 83.5% of the total sample.

The present study combined three existing scales into a unified instrument intended to operationalize the Marketing Outcomes of Customer Experience (MOCE). The Customer Satisfaction items were measured using a seven-point Likert scale anchored from 1 ("strongly disagree") to 7 ("strongly agree"). In contrast, the items measuring Behavioural Loyalty Intentions and Word of Mouth were assessed using a seven-point Likert-type frequency scale ranging from 1 ("never") to 7 ("frequently"). To reduce the potential for response bias associated with item sequencing, all items were randomized within the questionnaire. The preliminary evaluation of the instrument indicated satisfactory face validity, suggesting that the items appropriately reflected the constructs they were intended to measure. Consistent with prior research (Klaus, 2014), the dimensions were subsequently labeled according to their substantive content. Thus, the first dimension, consisting of five items, was designated as Customer Satisfaction (SAT); the second dimension, consisting of five items, as Behavioural Loyalty Intentions (BLI); and the third dimension, consisting of seven items, as Word of Mouth (WOM). The psychometric characteristics of the instruments were evaluated by applying Principal Component Analysis (CPA). The analyses were conducted at the individual level.

This research aimed to evaluate the unidimensionality of each MOCE subscale. To achieve this, a one-component factor analysis was conducted on the items within each subscale. By applying the criterion of having eigenvalues greater than 1 along with the "Scree plot" criterion, a single factor was extracted for every subscale, confirming their unidimensional nature. Additionally, an analysis of the entire sample was conducted to assess the instrument's reliability. The results for the specified dimensions indicated high reliability, aligning with prior research.

3.1. The validity of the subscale Customer Satisfaction

Prior to factor extraction, the adequacy of the dataset for factor analysis was assessed using the Kaiser–Meyer–Olkin (KMO) measure and Bartlett's test of sphericity. The KMO value of 0.881 indicates satisfactory sampling adequacy according to Kaiser's criteria. The reliability of the scale was further examined using Cronbach's alpha, which reached 0.921 (Table 4), confirming a high degree of internal consistency among the items. Furthermore, Bartlett's test of sphericity was statistically significant ($\chi^2 = 2218.512$, $df = 10$, $p < 0.001$), demonstrating that the correlation matrix was not an identity matrix and that the variables were sufficiently intercorrelated. Therefore, the results support the appropriateness of applying factor analysis to the data.

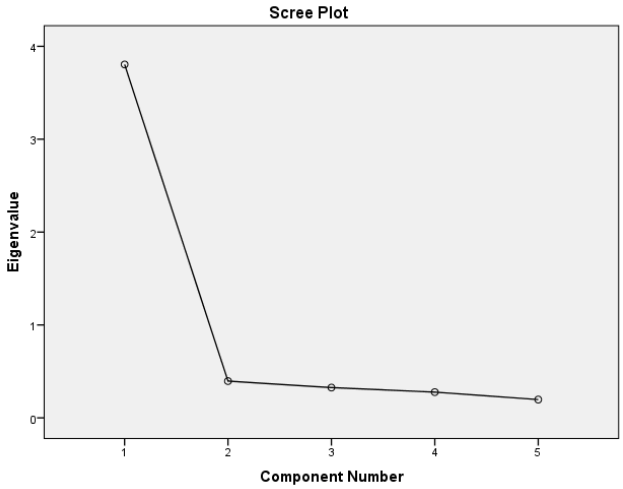
Table 1: Values of component saturations for the first principal component determined by the items of the subscale Customer Satisfaction

Customer Satisfaction	Factor loadings
SAT 4 - I feel satisfied that XYZ produces the best results that can be achieved for me	0.893
SAT 5 - The extent to which XYZ has produced the best possible outcome is satisfying	0.885
SAT 1 - My feelings towards XYZ are very positive	0.875
SAT 2 - I feel good about coming to XYZ for the offerings I am looking for	0.855
SAT 3 - Overall, I am satisfied with XYZ and the service they provide	0.853

Source: autors, 2026.

Table 1 presents the factor loadings of the items belonging to the Customer Satisfaction subscale on the first principal component. The results indicate that all five items load strongly on a single component, with factor loadings ranging from 0.853 to 0.893. These high loadings suggest that the items share a substantial proportion of common variance and consistently reflect the same underlying construct. Among the items, SAT 4 ("I feel satisfied that XYZ produces the best results that can be achieved for me") showed the highest loading (0.893), indicating that it has the strongest association with the extracted component. The relatively narrow range of loadings further indicates that all items contribute meaningfully and in a balanced manner to the measurement of the construct. Overall, the findings support the unidimensionality of the Customer Satisfaction subscale, as all items exhibit high, satisfactory loadings on the first principal component. This suggests that the subscale has a clear internal structure and that the included items are appropriate indicators of customer satisfaction.

The Customer Satisfaction subscale may be regarded as unidimensional, indicating that it measures a single underlying construct and demonstrates a satisfactory degree of homogeneity. This conclusion is supported by the proportion of variance explained by the first principal component, which accounted for 76.098% of the total variance, with an eigenvalue of $\lambda = 3.805$ (Table 4; see also the scree plot in Figure 1).



Picture 1: Scree Plot of the components on the items of the Customer Satisfaction subscale
Source: autors, 2026

3.2. The validity of subscale Behaviour Loyalty Intentions

The suitability of the data for factor analysis was examined using the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity. The KMO value of 0.890 indicates a high level of sampling adequacy, in line with Kaiser's recommended criteria. The reliability of the subscale was assessed using Cronbach's alpha, which was 0.939 (Table 4), indicating excellent internal consistency and confirming the measure's reliability. In addition, Bartlett's test of sphericity was statistically significant ($\chi^2 = 2702.686$, df = 10, $p < 0.001$), indicating that the correlation matrix was appropriate for factor analysis. Taken together, these results confirm that the necessary assumptions for applying factor analysis were satisfied.

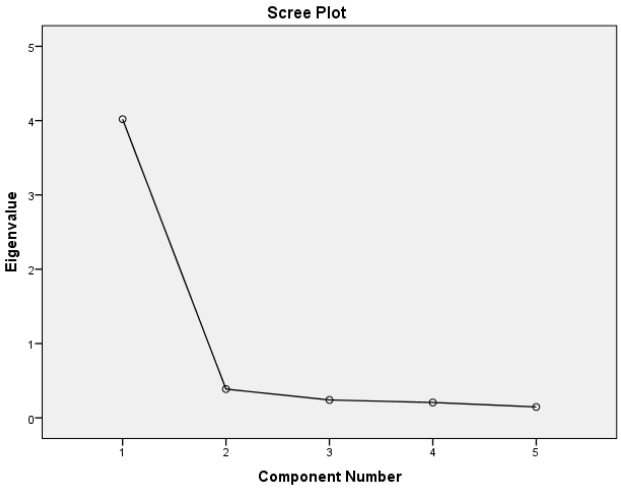
Table 2: Values of component saturations for the first principal component determined by the items of the subscale Behaviour Loyalty Intentions

Behaviour Loyalty Intentions	Factor loadings
BLI 2 - How likely are you to recommend XYZ to someone who seeks your advice	0.929
BLI 4 - How likely are you to consider XYZ the first choice to buy – services	0.911
BLI 3 - How likely are you to encourage friends and relatives to use XYZ	0.900
BLI 1 - How likely are you to say positive things about XYZ to other people	0.898
BLI 5 - How likely are you to use XYZ more in the next few years	0.843

Source: autors, 2026.

Table 2 reports the factor loadings of the Behavioural Loyalty Intentions items on the first principal component. All items exhibited high loadings, ranging from 0.843 to 0.929, indicating a strong association with the extracted factor. The highest loading was observed for BLI 2 ("How likely are you to recommend XYZ to someone who seeks your advice"), with a value of 0.929, suggesting that this item has the strongest association with the underlying factor. These findings demonstrate that all items contribute substantially to the underlying construct and confirm the coherence of the Behavioural Loyalty Intentions subscale. The uniformly high loadings support the conclusion that the subscale is unidimensional and psychometrically appropriate for measuring behavioural loyalty intentions.

The results indicate that the Behavioural Loyalty Intentions subscale is unidimensional, suggesting that it measures a single underlying construct and demonstrates internal homogeneity. This conclusion is supported by the first principal component, which explained 80.38% of the total variance and had an eigenvalue of $\lambda = 4.019$ (Table 4; see also the scree plot in Figure 2).



Picture 2: Scree Plot of the components on the items of the Behaviour Loyalty Intentions subscale
Source: autors, 2026

3.3. The validity of the subscale Word of Mouth

Prior to factor extraction, the adequacy of the dataset was assessed using the Kaiser–Meyer–Olkin (KMO) measure and Bartlett's test of sphericity. The KMO value of 0.934 suggests excellent sampling adequacy according to Kaiser's interpretation. The internal consistency of the subscale was evaluated using Cronbach's alpha, which reached 0.960 (Table 4), indicating a very high level of reliability. Furthermore, Bartlett's test of sphericity was statistically significant ($\chi^2 = 4862.880$, df = 21, $p < 0.001$), confirming that the variables were sufficiently intercorrelated to justify factor analysis. Therefore, the results support the appropriateness of applying factor analysis to the data.

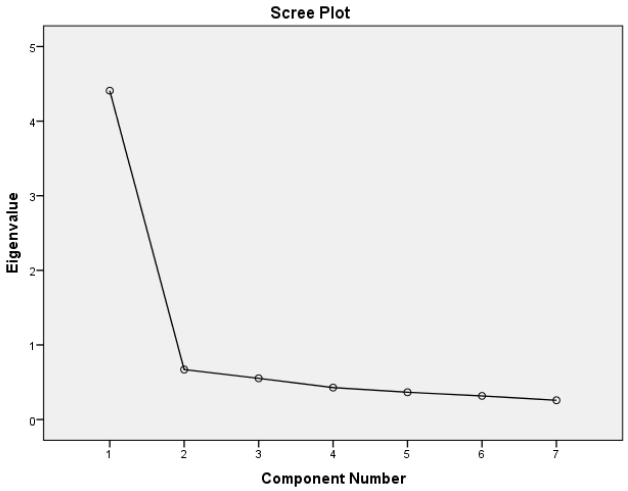
Table 3: Values of component saturations for the first principal component determined by the items of the subscale Word of Mouth

Word of Mouth	Factor Loadings
WOM 7 - How often have you recommended XYZ to close personal friends	0.947
WOM 6 – How often have you recommended XYZ to acquaintances	0.946
WOM 5 - How often have you spoke positively of XYZ to others	0.924
WOM 4 - How often have you recommended XYZ to family members	0.891
WOM 2 - How often have you made sure that others know that you do business with XYZ	0.871
WOM 3 - How often have you Spoke positively about XYZ employee(s) to others	0.867
WOM 1 - How often have you mentioned to others that you do business with XYZ	0.847

Source: autors, 2026.

Table 3 presents the factor loadings of the items comprising the Word of Mouth subscale on the first principal component. The results indicate that all seven items load strongly on a single component, with factor loadings ranging from 0.847 to 0.947. These high loadings suggest that the items share a substantial proportion of common variance and consistently reflect the same underlying construct, namely word-of-mouth behavior. The highest loadings were observed for WOM 7 ("How often have you recommended XYZ to close personal friends") and WOM 6 ("How often have you recommended XYZ to acquaintances"), with values of 0.947 and 0.946, respectively. These findings indicate that recommendations made to personal and social contacts are the strongest indicators of the latent word of mouth construct. Overall, the results support the unidimensionality of the Word-of-Mouth subscale. The consistently high factor loadings indicate that all items contribute meaningfully to the measurement of the same latent dimension and provide evidence of the subscale's internal coherence and construct validity.

The Word of Mouth subscale can be regarded as unidimensional, indicating that it captures a single measurement domain and exhibits a high degree of internal homogeneity. This conclusion is supported by the first principal component, which accounted for 80.965% of the total variance, with an eigenvalue of $\lambda = 5.668$ (Table 4; Figure 3).



Picture 3: Scree Plot of the components on the items of the Word of Mouth subscale
Source: autors, 2026

The internal consistency of the questionnaire items was assessed using Cronbach's alpha coefficient on a sample of 702 respondents. The overall reliability of the MOCE scale was 0.966 (Table 4, Instrument MOCE), indicating excellent internal consistency across the three constructs. The results support the instrument's reliability and suggest a satisfactory level of construct validity. Therefore, the questionnaire can be considered suitable for measuring respondents' attitudes toward the marketing outcomes of customer experience, the research hypothesis:

H_0: The MOCE scale instrument can be used to identify and measure the attitudes of respondents from the Republic of Serbia regarding the marketing outcomes of customer experience is supported.

Table 4: The reliability and variance extracted for the MOCE instrument's subscales

Subscale	Crombach's alpha	%	Λ
Customer Satisfaction	.921	76.098	3.805
Behaviour Loyalty Intentions	.939	80.380	4.019
Word of Mouth	.960	80.965	5.668
Instrument MOCE	.966		

* Λ - the characteristic root of the first principal component; % - variance extracted

Source: autors, 2026.

4. CONCLUDING REMARKS

This study provided validation of the Marketing Outcomes of Customer Experience (MOCE) scale by integrating three outcome dimensions: Customer Satisfaction, Behavioural Loyalty Intentions, and Word of Mouth for the Serbian context. The results indicate that the proposed instrument demonstrates satisfactory psychometric properties. All three subscales showed high internal consistency, statistically significant Bartlett's test values, and strong factor loadings, confirming their reliability, validity, and unidimensionality. In addition, the overall reliability of the MOCE scale was very high, supporting its suitability for empirical applications.

The findings contribute to the customer experience literature by providing a structured instrument for measuring its key marketing outcomes. While prior research has primarily focused on the conceptualization and measurement of customer experience itself, this study extends the field by offering a validated scale that captures its downstream consequences in terms of satisfaction, loyalty-related intentions, and word of mouth behaviour. In this respect, the MOCE scale provides a useful framework for both academic research and managerial assessment.

From a practical perspective, the instrument may assist organizations in evaluating the effectiveness of customer experience strategies and in identifying whether customer interactions translate into favorable marketing outcomes. At the same time, the study is subject to certain limitations, particularly regarding the sample's regional concentration. Future research should therefore test the scale in other industries, populations, and national contexts to further examine its generalizability and robustness.

Most importantly, the results suggest that the MOCE scale represents a reliable and valid instrument for measuring the marketing outcomes of customer experience and provides a useful basis for further theoretical and empirical development in this area.

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REFERENCES

Anderson, E. W. (1998). Customer Satisfaction and Word of Mouth. Journal of Service Research, 1(1), 5–17. https://doi.org/10.1177/109467059800100102

Brakus, J. J., Schmitt, B. H., & Zarantonello, L. (2009). Brand Experience: What is It? How is it Measured? Does it Affect Loyalty? Journal of Marketing, 73(3), 52–68. https://doi.org/10.1509/jmkg.73.3.052

Ćelić, Đ., Džinić, T., Petrov, V., & Drašković, Z. (2025). Measuring Customer Experience Quality in Banking Services in Serbia: Validation of the EXQ Scale. University of Novi Sad, Faculty of Economics. https://sm.ef.uns.ac.rs/index.php/proceedings/article/view/447

De Keyser, A., Verleye, K., N. Lemon, K., L. Keiningham, T., & Klaus, P. (2020). Moving the Customer Experience Field Forward: Introducing the Touchpoints, Context, Qualities (TCQ) Nomenclature. Journal of Service Research, 23(4), 433–455. https://doi.org/10.1177/1094670520928390

DeVellis, R. F. (2016). Scale development: Theory and applications (Fourth edition). SAGE Publications, Inc.

Klaus, P. (2014). Measuring Customer Experience: How to Develop and Execute the Most Profitable Customer Experience Strategies: Palgrave Macmillan. https://www.amazon.com/Measuring-Customer-Experience-Profitable-Strategies/dp/1137375450

Klaus, P., Gorgoglione, M., Buonamassa, D., Panniello, U., & Nguyen, B. (2013). Are you providing the "right" customer experience? The case of Banca Popolare di Bari. International Journal of Bank Marketing, 31(7), 506–528. (world). https://doi.org/10.1108/IJBM-02-2013-0019

Kranzbühler, A.-M., Kleijnen, M. H. P., Morgan, R. E., & Teerling, M. (2018). The Multilevel Nature of Customer Experience Research: An Integrative Review and Research Agenda. International Journal of Management Reviews, 20(2), 433–456. https://doi.org/10.1111/ijmr.12140

Lemon, K. N., & Verhoef, P. C. (2016). Understanding Customer Experience Throughout the Customer Journey. Journal of Marketing, 80(6), 69–96. https://doi.org/10.1509/jm.15.0420

McColl-Kennedy, J. R., Zaki, M., Lemon, K. N., Urmetzer, F., & Neely, A. (2019). Gaining Customer Experience Insights That Matter. Journal of Service Research, 22(1), 8–26. https://doi.org/10.1177/1094670518812182

Oliver, R. L. (1997). Satisfaction: A behavioral perspective on the consumer. McGraw-Hill.

Ponsignon, F., Lunardo, R., & Michrafy, M. (2021). Why Are International Visitors More Satisfied with the Tourism Experience? The Role of Hedonic Value, Escapism, and Psychic Distance. Journal of Travel Research, 60(8), 1771–1786. https://doi.org/10.1177/0047287520961175

Rust, R. T., Lemon, K. N., & Zeithaml, V. A. (2004). Return on Marketing: Using Customer Equity to Focus Marketing Strategy. Journal of Marketing, 68(1), 109–127. https://doi.org/10.1509/jmkg.68.1.109.24030

Schmitt, B. (1999). Experiential Marketing. Journal of Marketing Management, 15(1–3), 53–67. https://doi.org/10.1362/026725799784870496

Srivastava, R. K., Shervani, T. A., & Fahey, L. (1998). Market-Based Assets and Shareholder Value: A Framework for Analysis. Journal of Marketing, 62(1), 2–18. https://doi.org/10.1177/002224299806200102

Vargo, S. L., & Lusch, R. F. (2004). Evolving to a New Dominant Logic for Marketing. Journal of Marketing, 68(1), 1–17. https://doi.org/10.1509/jmkg.68.1.1.24036

Verhoef, P. C., Lemon, K. N., Parasuraman, A., Roggeveen, A., Tsiros, M., & Schlesinger, L. A. (2009). Customer Experience Creation: Determinants, Dynamics and Management Strategies. Journal of Retailing, Enhancing the Retail Customer Experience, 85(1), 31–41. https://doi.org/10.1016/j.jretai.2008.11.001

Zeithaml, V. A., Berry, L. L., & Parasuraman, A. (1996). The Behavioral Consequences of Service Quality. *Journal of Marketing*, *60*(2), 31–46. https://doi.org/10.1177/002224299606000203

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BRIDGING THE GAP BETWEEN SUSTAINABILITY EDUCATION AND PRACTICE IN TOURISM

Abstract: This study explores sustainability perceptions among future professionals, focusing on the role of work experience. Based on a sample of 241 students, the results reveal that those with prior work experience report significantly higher levels of perceived sustainability development and organizational responsibility. These findings suggest that practical exposure enhances sustainability understanding beyond formal education, indicating a potential gap between educational content and real-world practice. The study contributes by distinguishing between different dimensions of sustainability perceptions and by positioning these findings as a basis for future qualitative research. In particular, further studies are needed to explore how sustainability is understood and implemented by tourism professionals and whether a gap exists between the expectations of future professionals and actual industry practices.

Keywords: sustainability perceptions, tourism, students, higher education

1. INTRODUCTION

The hospitality industry is undergoing in the last decades a deep sustainability transformation driven by environmental urgency, growing regulatory frameworks, and a shift in consumer consciousness and exigence. As a resource-intensive sector, hotels are increasingly pressured to align their operations with sustainable development goals while maintaining service excellence (Bagheri et al., 2023; Ek Styvén et al., 2022). Consequently, corporate sustainability strategies (CSS) have moved from the periphery to the core of hotel management. However, the successful implementation of these strategies depends on a workforce that possesses not only theoretical knowledge but also the practical competencies required to navigate the complexities of daily operations.

Despite the growing emphasis on sustainability within tourism and hospitality higher education, a persistent concern remains: which can be conceptualized as the "education-industry gap". Several studies suggest that while academic programs provide a solid conceptual foundation, they may fall short in preparing future professionals for the pragmatic and interdisciplinary challenges of the corporate world (Mínguez et al., 2021; Scott & Willison, 2021). This mismatch often results in a friction between students' idealized expectations and the operational realities of the sector (Hall, 2011).

In this context, understanding the perceptions of future professionals is crucial. Their vision of how sustainability is integrated into the industry and how roles are distributed within organizations will shape the future of the sector. Emerging research suggests that practical exposure through work experience may contribute to differences in these perceptions (Jackson & Tomlinson, 2022; Bennett, et al., 2023). Work experience allows students to move beyond

classroom theory, fostering a more nuanced and realistic understanding of sustainable practices and organizational responsibilities (Garavan et al., 2023).

Building upon previous research that identified key sustainability competencies through industry leader interviews (Guerra-Lombardi et al., 2025), this study adopts a quantitative approach to analyze the perceptions of 241 future professionals. Specifically, the research focuses on how work experience influences these perceptions and what this reveals about the current state of tourism education. To address this objective, the study is guided by the following research questions:

- RQ1. Are there significant differences in sustainability perceptions between future professionals with and without work experience in the tourism sector?
- RQ2. How does work experience contribute to identifying a potential gap between sustainability education and practice in tourism?

By addressing these questions, this paper contributes to the literature on sustainable tourism management and human resources by identifying how practical engagement shapes the professional mindset of the next generation of hospitality leaders.

2. LITERATURE REVIEW

2.1. The foundation of Sustainability perceptions

The successful operationalization of corporate sustainability strategies (CSS) in the hospitality industry relies heavily on the competencies, perceptions, and readiness of its workforce. While theoretical models of sustainability are widely taught in academic settings, understanding how these concepts translate into real-world operations requires an industry-aligned perspective. The conceptual foundation and the constructs evaluated in this quantitative study are rooted in previous research that identifies a critical need to assess how future professionals understand sustainability implementation and organizational responsibilities. Building upon these industry-driven insights, this study examines two core dimensions: the systemic integration of sustainability in the sector and the distribution of organizational roles.

2.2. Perceived sustainability integration in the Hospitality industry

Current trends underscore sustainability not merely as an ethical obligation but as a fundamental strategic priority within the tourism and hospitality sector. The integration of sustainability into hotel operations encompasses a complex range of initiatives, from environmental resource management to corporate sustainable governance (CSG) (Guerra-Lombardi et al., 2024; Bagheri et al., 2023). However, the conceptualization of these practices goes beyond structural changes; it deeply relies on how professionals perceive the authenticity and effectiveness of these efforts.

As sustainable business practices gain strength, a critical challenge emerges regarding the distinction between genuine commitment and superficial marketing tactics, commonly referred to as greenwashing (Floričić et al., 2024). Consumers and emerging professionals alike are increasingly demanding transparency and the tangible application of government regulations to ensure compliance (Rana et al., 2023). Consequently, assessing how future professionals interpret the macro-level implementation of these strategies is essential. In this study, this dimension is conceptualized as Perceived Sustainability Integration (PSI). This construct captures the respondents' overall assessment of the extent to which sustainability is genuinely recognized as a systemic and operational phenomenon within the tourism industry, contrasting authentic corporate commitment with mere compliance or greenwashing.

2.3. Organizational Sustainability Role Perceptions

The effective execution of sustainable strategies is intrinsically linked to human resource management and the active participation of employees across all organizational levels. The literature extensively highlights the significance of green human resource management (GHRM) in driving organizational performance and ensuring that sustainability values are actually internalized in daily operations (Tanova & Bayighomog, 2022; Hong et al., 2024).

However, achieving sustainability goals is not only the responsibility of top management; it requires a collaborative framework. Abbas et al. (2023) emphasize the mechanisms through which employee behavior at the operational level contributes to environmental and social sustainability in hotels. Furthermore, future professionals and young entrepreneurs play a pivotal role as catalysts for innovation and environmental awareness (Salvatore et al., 2021). The synergy between different organizational levels, ranging from executive decision-makers to operational staff, greatly influences the success of green initiatives (Song et al., 2021; Silva et al., 2025). To measure this understanding, this study introduces the construct of Organizational Sustainability Role Perceptions (OSRP). This variable reflects the

respondents' comprehension of how responsibility for sustainability is distributed across the corporate hierarchy and the perceived need of cross-level collaboration to achieve environmental objectives.

2.4. The Education–Industry Gap and the Role of Work Experience

A central debate in contemporary tourism literature concerns the alignment between academic readiness and the actual practical competencies demanded by the industry. While educational institutions strive to prepare students with sustainability knowledge, a growing body of research questions whether theoretical programs adequately train graduates for the complex realities of hotel operations (Mínguez et al., 2021; Scott & Willison, 2021). Hall (2011) notes that emerging professionals often face friction upon entering the workforce, as there is frequently a gap between their idealized academic expectations and the pragmatic, efficiency-driven approaches adopted by local specialists.
Practical exposure and active engagement in the workforce are posited as crucial factors in bridging this gap. Experiential learning and direct involvement in organizational environments significantly enhance an individual's contemporary social skills and green competencies (Garavan et al., 2023; Ivasciuc & Ispas, 2023). It is hypothesized that students with prior work experience in the tourism sector possess a more nuanced, critical, and realistic understanding of both corporate sustainability implementation (PSI) and the practical distribution of organizational roles (OSRP). By analyzing the differences based on work experience, this study aims to clarify the nature of the education-industry gap, providing actionable insights into how practical exposure shapes the sustainability competencies of the future hospitality workforce.

3. METHODOLOGY

The first part is devoted to sample characteristics and research procedure, and the second part depicts the variables used in the research, explaining the procedure of measuring respondents' perceptions on analyzed constructs.

3.1. Sampling and Research Procedure

The sample consists of students enrolled at faculties of economics, business, and tourism. In cases where tourism was not explicitly included in the faculty title, the curriculum was carefully reviewed to ensure the presence of courses related to tourism and sustainability, confirming the relevance of respondents to the research context. The sample is predominantly composed of undergraduate students, with a smaller representation of master's and doctoral levels (Table 1). Geographically, the sample is regionally grounded but also internationally diverse. In addition to participants from Serbia and neighboring countries, respondents come from a wide range of European and non-European countries. Such diversification can be largely attributed to the presence of Erasmus and other international mobility programs, which contribute to a more heterogeneous student population and enrich the cross-cultural perspective of the study.

Table 1: Sample structure

	Number of respondents	%
Gender		
Male	65	27.0%
Female	173	71.8%
Other	3	1.2%
State		
Serbia	105	43.6%
Croatia	74	30.7%
Spain	28	11.6%
Other countries	34	14.1%
Level of study		
Bachelor	184	76.3%
Master	49	20.3%
PhD	8	3.3%

Source: Authors' research

A questionnaire survey was conducted to obtain the data required for this study, as part of a broader research project. The questionnaire consisted of several sections, including statements measured on a seven-point Likert scale, as well as questions capturing the demographic characteristics of respondents. Data were collected using a convenience sampling approach among students who had previously attended courses in tourism or related fields. In cases where tourism was not explicitly part of the program title, the curriculum was reviewed to ensure the inclusion of subjects related to tourism management and sustainability, as familiarity with the fundamentals of tourism management was considered a prerequisite for participation. The majority of respondents (over 80%) actively attended classes, indicating a satisfactory

level of engagement with the subject matter. Data collection was carried out during the winter semester of the 2025/2026 academic year. Participation was voluntary and anonymous, and respondents were informed about the purpose of the study in advance.

3.3. Measures

To ensure the reliability and validity of the measurement model, the constructs were operationalized using multi-item scales. The items were developed based on a comprehensive review of existing literature. All items were measured using a 7-point Likert scale ranging from 1 ("strongly disagree") to 7 ("strongly agree"). The adequacy of the data for factor analysis was confirmed by the results of the exploratory factor analysis (EFA), indicating satisfactory sampling adequacy and factorability (KMO = 0.789; Bartlett's test of sphericity = 663.652; df = 45; $p < 0.001$), as presented in Table 2. Perceived Sustainability Integration ($\alpha = 0.770$) and Organizational Sustainability Role Perceptions ($\alpha = 0.740$) constructs demonstrate acceptable internal consistency, indicating satisfactory reliability and consistent measurement of the underlying concepts.

- **Perceived Sustainability Integration (PSI)** - This construct was measured using five items designed to assess respondents' overarching perceptions of how sustainability is systemically prioritized, regulated, and authentically implemented in the tourism sector, contrasting genuine efforts with greenwashing. The theoretical foundation for these items draws upon recent literature on corporate sustainable governance and greenwashing in hospitality (Bagheri et al., 2023; Floričić et al., 2024; Guerra-Lombardi et al., 2024). Example items include: "Hotels in my country are genuinely committed to sustainability rather than engaging in greenwashing" and "Government regulations play an essential role in ensuring sustainability in tourism."

- **Organizational Sustainability Role Perceptions (OSRP)** - To evaluate how participants perceive the distribution of responsibility for sustainability across different organizational hierarchies, this construct was measured using five items. The formulation of these items was guided by literature emphasizing green human resource management (GHRM) and cross-level collaboration for sustainability goals (Song et al., 2021; Tanova & Bayighomog, 2022; Abbas et al., 2023). Example items include: "Future professionals in tourism will play a key role in driving sustainability efforts" and "Sustainability initiatives in a hotel are more effective when there is collaboration between different organizational levels (e.g., management, operations, and staff)."

Table 2. Exploratory factor analysis, and Cronbach's Alpha

		Factor loadings	
Perceived Sustainability Integration (PSI) Cronbach's Alpha= 0.770			
1	Sustainability is a priority in the tourism industry in my country.	.819	
2	Hotels in my country are genuinely committed to sustainability rather than engaging in greenwashing.	.829	
3	Government regulations play an essential role in ensuring sustainability in tourism.	.517	
4	Sustainability is a key priority in the hotel industry around the world.	.623	
5	Hotels in my country are implementing specific sustainability practices and plans.	.728	
Organizational Sustainability Role Perceptions (OSRP) Cronbach's Alpha= 0.740			
6	Future professionals in tourism will play a key role in driving sustainability efforts.		.762
7	Employees in operational roles can have a significant impact on a hotel's sustainability goals.		.675
8	The ability to influence sustainability practices depends on the position held within a company.		.653
9	Top managers play the most critical role in ensuring the success of sustainability initiatives in a hotel.		.636
10	Sustainability initiatives in a hotel are more effective when there is collaboration between different organizational levels (e.g., management, operations, and staff).		.705

Source: Authors' research

4. Results and Discussion

Table 3 presents descriptive statistics and correlation coefficients among the research variables. The mean values indicate that respondents generally report moderately high perceptions of sustainability integration in the tourism sector (PSI: M = 4.52), while perceptions of organizational sustainability roles are even more pronounced (OSRP: M = 5.49). This suggests that, although sustainability is recognized as important, students particularly emphasize the role of individuals and organizational actors in driving sustainability efforts.

The correlation analysis reveals a positive and statistically significant relationship between PSI and OSRP ($r = .381$, $p < 0.01$), indicating that higher perceptions of sustainability integration are associated with stronger beliefs in the

importance of organizational roles and responsibilities for sustainability. This finding supports the notion that systemic sustainability practices and individual role perceptions are interrelated and mutually reinforcing.

Regarding control variables, work experience in tourism shows a positive and significant correlation with both PSI ($r = .190$, $p < 0.01$) and OSRP ($r = .201$, $p < 0.01$), suggesting that practical exposure to the industry contributes to more developed sustainability perceptions. In addition, level of studies is positively related to OSRP ($r = .174$, $p < 0.01$) and moderately associated with work experience ($r = .369$, $p < 0.01$), indicating that more advanced students and those with greater experience tend to demonstrate a higher awareness of sustainability roles within organizations.

Gender does not show significant relationships with the main constructs, implying that sustainability perceptions are relatively consistent across male and female respondents. However, a weak negative association between gender and level of studies ($r = -.154$, $p < 0.05$) suggests minor structural differences within the sample, which do not substantially affect the main findings.

Table 3. Descriptive statistics and correlation matrix

	Mean	SD	1	2	3	4	5
1. PSI	4.5228	.99659	1	.381**	.190**	-.038	.116
2. OSRP	5.4880	.88481	.381**	1	.201**	-.078	.174**
3. Work Experience			.190**	.201**	1	-.064	.369**
4. Gender			-.038	-.078	-.064	1	-.154*
5. Level of Studies			.116	.174**	.369**	-.154*	1

Notes: SD – standard deviation

**. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed).

Source: Authors' research

Given the observed associations, further analysis was conducted using an independent samples t-test to examine whether significant differences exist between students with and without work experience. The findings indicate statistically significant differences between the two groups for both examined constructs. Specifically, students with work experience report significantly higher levels of PSI compared to those without experience. This suggests that practical exposure to the tourism industry enhances students' understanding of how sustainability is implemented in real-world contexts. Similarly, significant differences are observed for organizational sustainability role perceptions OSRP, with students who have work experience demonstrating stronger beliefs in the importance of individual and collective roles in achieving sustainability within organizations.

Table 4: Independent Samples t-test Comparing Students With and Without Work Experience

Variable	Group	n	M	SD	t	p
PSI	With work experience	99	4.7495	1.03701	2.997	.003
	Without work experience	142	4.3648	.93908	2.944	.004
OSRP	With work experience	99	5.7010	.82974	3.180	.002
	Without work experience	142	5.3394	.89442	3.223	.001

Source: Authors' research

The findings indicate that PSI is positively associated with OSRP. This suggests that students who perceive sustainability as more systematically embedded in the tourism sector are also more likely to recognize the importance of shared responsibility across different organizational levels. This result is consistent with previous research emphasizing that sustainability in hospitality is not limited to formal strategies or regulatory compliance, but also depends on authentic implementation, employee involvement, and cross-level organizational collaboration (Tanova & Bayighomog, 2022; Garavan et al., 2023; Ivasciuc & Ispas, 2023; Hong et al., 2024).

Furthermore, students with work experience in tourism reported significantly higher levels of both PSI and OSRP. This finding supports the argument that practical exposure to the tourism industry helps bridge the education–industry gap by enabling students to better understand how sustainability is operationalized in real organizational contexts. While classroom-based learning provides an important conceptual foundation, work experience appears to contribute to a more realistic and practice-oriented understanding of sustainability challenges and responsibilities in hospitality. These results are in line with studies emphasizing the importance of experiential learning, green competencies, and industry-based exposure in preparing future tourism professionals (Garavan et al., 2023; Ivasciuc & Ispas, 2023). Accordingly, the findings point to the need for a stronger integration of practical learning opportunities into sustainability education, including internships, fieldwork, industry-based projects, and closer cooperation with hotels and tourism organizations.

5. CONCLUSION

This research aimed to examine how students enrolled in tourism and related fields perceive sustainability integration in the tourism sector, as well as the role of different organizational actors in implementing sustainable practices. Particular attention was given to differences between students with and without work experience in tourism. The findings indicate that students generally recognize the importance of sustainability; however, those with work experience in tourism demonstrate higher levels of both perceived sustainability integration and organizational sustainability role perceptions. These results suggest that practical exposure represents an important factor contributing to a more developed, realistic, and nuanced understanding of sustainability in the tourism sector. Although this research does not directly measure the education–practice gap, it provides preliminary evidence of such a gap by showing that work experience is associated with more developed sustainability perceptions.

5.1. Theoretical Implications

This study contributes to the literature by extending the understanding of the relationship between education, work experience, and sustainability-related perceptions among future tourism professionals. Existing theoretical perspectives often emphasize the role of formal education in developing sustainability knowledge and attitudes. However, the findings of this study suggest that formal education, although essential, may not be sufficient to fully shape students' understanding of how sustainability is implemented in real organizational contexts.

The results contribute to the literature on the education–industry gap by showing that work experience may play an important role in bridging the distance between classroom-based knowledge and industry realities. Students with experience in tourism do not only demonstrate higher awareness of sustainability, but also show a more developed understanding of the fact that sustainability depends on coordinated action across different organizational levels, from top management to operational employees. In this respect, the study moves the theoretical discussion beyond the understanding of sustainability as a primarily educational or normative concept, and toward the view of sustainability as an experience-based and organizationally embedded phenomenon.

Furthermore, the study contributes to the operationalization of two related but distinct dimensions of students' sustainability perceptions: perceived sustainability integration and organizational sustainability role perceptions. The positive relationship between these constructs suggests that students who perceive sustainability as more strategically and systemically integrated in tourism are also more likely to recognize the importance of shared responsibility and cross-level collaboration within organizations. This finding may serve as a basis for developing future theoretical models that link sustainability education, experiential learning, and professional competence development in tourism.

5.2. Practical Implications

The practical implications of this study are particularly relevant for higher education institutions, tourism study programs, and tourism and hospitality organizations. The findings show that students with work experience in tourism report more developed sustainability-related perceptions than students without such experience. Given that a considerable share of students may complete their studies without substantial practical exposure to the industry, these findings raise an important question: how can higher education compensate for the lack of direct work experience and support students in developing a more realistic understanding of sustainability during their studies?

From the perspective of higher education, the results indicate that special attention should be paid to the integration of sustainability topics with experiential and problem-based learning. Sustainability should not be treated only as theoretical content within course curricula, but as a practical and organizational issue that students need to understand through direct or simulated exposure to real industry challenges. Therefore, tourism programs could strengthen internships, fieldwork, industry-based projects, case study analysis, guest lectures by industry professionals, and research-practice projects focused on sustainable business practices.

For students without prior work experience, universities could implement structured learning activities that imitate or approximate industry experience. These may include simulations of managerial decision-making, analysis of real examples of sustainable and unsustainable practices in hotels, problem-solving tasks based on industry cases, mini-consulting projects with local tourism organizations, and practice-oriented assignments focused specifically on sustainability challenges. Such activities could effectively reduce the gap between students who have work experience and those who do not, by helping all students become more aware of how sustainability is implemented in practice.

The findings are also relevant for tourism and hospitality organizations. If work experience contributes to stronger sustainability awareness, organizations should recognize internships, traineeships, and student engagement programs as important mechanisms for developing future employees capable of supporting sustainable business transformation. Cooperation between universities and industry should therefore not be limited to recruitment or formal internship placement. Instead, it should be designed as a learning partnership aimed at developing sustainability-related competencies among future professionals.

From the perspective of curriculum development, the findings also suggest that not all forms of work experience should be treated as equally relevant. Experience in hotels, travel agencies, public tourism organizations, hospitality operations, or sustainability-related projects may shape students' perceptions in different ways. Therefore, study programs should move beyond the simple inclusion of practical experience and pay closer attention to its quality, duration, intensity, content, and relevance to sustainability. In this sense, practical learning should be intentionally designed, monitored, and connected to clearly defined sustainability learning outcomes.

5.3. Future Research Directions

This study provides a starting point for further research on the role of experiential learning in the development of sustainability competencies among tourism students. Although the findings indicate significant differences between students with and without work experience, the study does not explain which specific types of experience contribute most strongly to sustainability-related perceptions. Future research should therefore examine not only whether students have work experience, but also the quality, duration, relevance, intensity, and sustainability-related content of that experience.

Future studies could also investigate how different forms of experiential learning influence broader higher education outcomes, such as professional competence development, employability, work readiness, critical thinking, entrepreneurial orientation, and students' ability to address sustainability challenges in real business environments. A mixed-methods approach would be particularly useful, combining quantitative analysis with interviews involving students, teachers, and representatives of the tourism and hospitality industry. This would provide deeper insight into how students understand the relationship between formal education, practical experience, and sustainability.

Given that the sample included students from different countries, future research could also examine the role of national and institutional contexts in the development of sustainability competencies. It would be particularly valuable to analyze the extent to which different education systems, curricula, and university–industry cooperation models support student participation in practical activities that strengthen sustainability awareness. In this way, future research could provide a more comprehensive understanding of how contextual factors shape the relationship between education, work experience, and sustainability perceptions in tourism.

REFERENCES

Abbas, Z., Smaliukienė, R., Zamečnik, R., Kalsoom, G., & Cera, E. (2023). How does green HRM influence environmental and social sustainability in hotels? *Problems and Perspectives in Management*, 21(1), 253–263. https://doi.org/10.21511/ppm.21(1).2023.22

Bagheri, M., Baum, T., Mobasheri, A. A., & Nikbakht, A. (2023). Identifying and ranking employer brand improvement strategies in post-COVID 19 tourism and hospitality. *Tourism and Hospitality Research*, 23(3), 391–405. https://doi.org/10.1177/14673584221112607

Bennett, D., Knight, E., & Li, I. (2023). The impact of pre-entry work experience on university students' perceived employability. *Journal of Further and Higher Education*, 47(8), 1140-1154. https://doi.org/10.1080/0309877X.2023.2220286

Ek Styvén, M., Näppä, A., Mariani, M., & Nataraajan, R. (2022). Employee perceptions of employers' creativity and innovation: Implications for employer attractiveness and branding in tourism and hospitality. *Journal of Business Research,* 141, 290–298. https://doi.org/10.1016/j.jbusres.2021.12.038

Floričić, T. (2020). Sustainable Solutions in the Hospitality Industry and Competitiveness Context of "Green Hotels". *Civil Engineering Journal,* 6(6), Article 6. https://doi.org/10.28991/cej-2020-03091532

Garavan, T., Ullah, I., O'Brien, F., Darcy, C., Wisetsri, W., Afshan, G., & Mughal, Y. H. (2023). Employee perceptions of individual green HRM practices and voluntary green work behaviour: A signalling theory perspective. *Asia Pacific Journal of Human Resources*, 61(1), 32–56. https://doi.org/10.1111/1744-7941.12342

Guerra-Lombardi, V., Hernández-Martín, R., & Padrón-Fumero, N. (2024). Drivers, barriers and key practices of corporate sustainability strategy implementation in hotels. *International Journal of Hospitality Management*, 120, 103791. https://doi.org/10.1016/j.ijhm.2024.103791

Guerra-Lombardi, V., Tamara Floričić, & Sara García-Altmann. (2025). Sustainability Competencies in Hospitality: Perspectives from Industry Leaders. Tourism in Southern and Eastern Europe 2025, (Conference Proceedings), 8, 171-180. https://doi.org//10.20867/tosee.08.16

Hall, C. M. (2011). Policy learning and policy failure in sustainable tourism governance: From first- and second-order to third-order change? *Journal of Sustainable Tourism*, 19, 649–671. https://doi.org/10.1080/09669582.2011.555555

Hong, N. T., Hieu, L. T., Huong, D. T., & Phuong, T. T. M. (2024). Impact of green human resource management on employees' green behavior in hotels. *Heritage and Sustainable Development*, 6(2), 639–656. https://doi.org/10.37868/hsd.v6i2.673

Ivasciuc, I.-S., & Ispas, A. (2023). Exploring the Motivations, Abilities and Opportunities of Young Entrepreneurs to Engage in Sustainable Tourism Business in the Mountain Area. *Sustainability*, 15(3), 1956. https://doi.org/10.3390/su15031956

Jackson, D., & Tomlinson, M. (2022). The relative importance of work experience, extra-curricular and university-based activities on student employability. *Higher Education Research & Development*, 41(4), 1119-1135. https://doi.org/10.1080/07294360.2021.1901663

Mínguez, C., Martínez-Hernández, C., & Yubero, C. (2021). Higher education and the sustainable tourism pedagogy: Are tourism students ready to lead change in the post pandemic era? *Journal of Hospitality, Leisure, Sport & Tourism Education*, 29, 100329. https://doi.org/10.1016/j.jhlste.2021.100329

Rana, V. S., Raina, A., & Bathla, G. (2023). The effect of sustainable practices on customer attitude: A study of sustainable hospitality operations. *Emirati Journal of Business, Economics, & Social Studies*, 2(1), 4–13. https://doi.org/10.54878/3er5qg34

Salvatore, R., Cocco, E., & Mines, A. F. (2021). Sustainable Tourism, Young Entrepreneurship, and Social Innovation in Peripheral Rural Areas: Case Studies from Southern Italy. In R. P. Marques, A. I. Melo, M. M. Natário, & R. Biscaia (Eds), *The Impact of Tourist Activities on Low-Density Territories: Evaluation Frameworks, Lessons, and Policy Recommendations* (pp. 95–123). Springer International Publishing. https://doi.org/10.1007/978-3-030-65524-2_5

Scott, F. J., & Willison, D. (2021). Students' reflections on an employability skills provision. *Journal of Further and Higher Education*, 45(8), 1118–1133. https://doi.org/10.1080/0309877X.2021.1928025

Silva, S., Silva, C., & Oliveira, M. (2025). The Value of Skills for a Sustainable Tourism and Hospitality Industry. *Tourism and Hospitality*, 6(1), Article 1. https://doi.org/10.3390/tourhosp6010014

Song, W., Yu, H., & Xu, H. (2020). Effects of green human resource management and managerial environmental concern on green innovation. *European Journal of Innovation Management*, 24(3), 951–967. https://doi.org/10.1108/EJIM-11-2019-0315

Tanova, C., & Bayighomog, S. W. (2022). Green human resource management in service industries: The construct, antecedents, consequences, and outlook. *The Service Industries Journal*, 42(5–6), 412–452. https://doi.org/10.1080/02642069.2022.2045279

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SAFETY AND SECURITY: KEY DRIVERS OF TOURISM DEVELOPMENT

Abstract: The global order is facing a series of systemic crises, including wars, political polarization, ecological disruptions, and pandemics. The tourism sector is particularly sensitive to the effects of these factors. Although destination choice and tourist arrivals are influenced by other factors (such as attractions, infrastructure, and economic development), safety and security are among the key determinants of tourism development and the competitiveness of tourist destinations.
The Travel & Tourism Development Index (TTDI) assesses the factors influencing the development of the tourism sector and ranks countries according to their capacity to develop tourism sustainably over the long term. One of the key pillars of this index is Safety and Security. The data suggest that countries with higher levels of safety and security tend to attract more tourists.
This paper focuses on the analysis of the Safety and Security pillar as a factor of Serbia's competitiveness in the international tourism market. According to the 2024 TTDI report, Serbia achieved a score of 6.10 in the Safety and Security pillar, the highest among all pillars, and ranked 32nd out of 119 countries.

Keywords: Safety and Security; Tourism Development; Competitiveness; Travel & Tourism Development Index (TTDI); Serbia.

1. INTRODUCTION

Tourism has experienced the worst crisis in the history of the sector due to the COVID-19 pandemic. Globally, international arrivals in 2020 fell by 72% compared to 2019, while international tourism receipts fell by 63%, which is also 10 times higher than the loss of tourism receipts during the 2009 global economic and financial crisis (WTO, 2023). The year 2024 marked a recovery in international tourism, with most destinations having more international tourists than before the pandemic, with 1.4 billion tourist arrivals recorded worldwide (UN Tourism, 2024). Further growth in international arrivals continued in 2025, with the growth rate approaching pre-pandemic growth trends. Although the estimated 1.52 billion international arrivals recorded worldwide in 2025 reached pre-pandemic levels, some destinations are still recovering and lagging behind pre-pandemic levels (UN Tourism, 2025).

The presented data clearly demonstrate the high vulnerability of tourism to various risks - ranging from disease outbreaks and natural disasters to terrorist attacks (Quintal, Lee, & Soutar, 2010; Fuchs & Reichel, 2011). Changes on the world stage can strongly influence changes in tourist behavior, and international tourism is particularly sensitive to safety and security issues (Seabra, Dolnicar, Abrantes, & Kastenholz, 2013). In addition to the fact that the tourism industry is highly vulnerable to changes in the global security environment, security risks also have a so-called

"spillover effect" because problems in one destination can affect the perception of a wider region or even the entire tourism system, as was the case with the COVID-19 pandemic (Hall, Timothy, & Duval, 2012).

Safety and security are fundamental factors in the development of tourism, especially in the context of increased global instability due to current geopolitical tensions and conflicts. Tourism is largely dependent on the perceived safety of a destination, as tourists usually consider potential risks before making a decision about where to travel. Tourist behavior, and therefore destinations, is largely driven by perceptions of security and the management of safety, security, and risk (Hall, Timothy, & Duval, 2012).

Given that safety and security are important concerns among tourists (Poon & Adams, 2000), the aim of the paper is to examine the role of safety and security in the development of tourism in conditions of global instability. A special focus of the paper is directed at the analysis of the safety and security of Serbia in order to determine its connection with the development and resilience of tourism.

2. THEORETICAL BACKGROUND

Tourism as an activity inherently involves the movement of people from a familiar to an unfamiliar environment, which increases the level of uncertainty and perception of risk. According to Wang & Wang (2018), travel represents a transition from a familiar to an unfamiliar environment, where changes in the environment can increase risk and uncertainty during the tourism experience. The following risk factors relevant to tourism have been highlighted in the literature (Floyd, Gibson, Pennington-Gray, & Thapa, 2004):

1. War and political instability
2. Health concerns
3. Crime
4. Terrorism.

In addition to the above factors, increasing attention is being paid to the impact of natural disasters on tourism demand, while terrorism and political instability have a particularly strong impact on changing travel intentions (Floyd, Gibson, Pennington-Gray, & Thapa, 2004). Something similar is found in Hall, Timothy and Duval (2012), who state that contemporary crises indicate a change in the nature of security and that health, social and environmental factors are becoming increasingly important, in addition to crime and terrorism. UN Tourism (2025) points to the relevance of the above factors, according to which uncertainty arising from geopolitical risks and ongoing conflicts, trade tensions and extreme weather conditions could affect traveler confidence and pose an increasing risk to tourism in 2026.

In this context, it should be emphasized that the literature distinguishes between the terms "safety" and "security". *Safety* refers to protection from unintentional events such as natural disasters or health risks, while *security* is associated with protection from intentional threats, such as terrorism and criminal activities. The distinction is based on intent - *safety* refers to accidental risks (e.g., industrial accidents), while *security* refers to intentional actions (e.g. terrorism or sabotage). This distinction reflects the different nature of incidents and different approaches to risk management (Jore, 2019). Both aspects have a major impact on tourism development, as they strongly influence the perception of a destination as safe and desirable.

In addition to objective indicators, the subjective perception of risk among tourists also plays a significant role. Therefore, especially in an era of turbulent global relations, the need for destination marketing organizations to demonstrate that they are safe for tourists is becoming increasingly important. Negative publicity, which is often unrelated to reality on the ground, can often affect tourist perceptions (Hall, Timothy, & Duval, 2012). Research shows that risk perception negatively affects destination evaluation and tourist satisfaction, which is reflected in the destination image (Xie, Huang, Lin, & Chen, 2020). The media, which reports on various crisis events such as terrorist attacks, wars, epidemics, and natural disasters, play a role in shaping potential tourists' risk perceptions, which also contributes to changing their travel intentions. Consequently, tourists often redirect their travel to alternative destinations that they perceive as safer (Scott, Laws, & Prideaux, 2010). Within this framework, special attention should be given to Maslow's theory of the hierarchy of needs (Maslow, 1943), according to which the need for safety and security is among the basic human needs. Therefore, destinations that instill a sense of security become preferred by tourists, while the perception of insecurity can lead to the avoidance of such destinations even in cases where the objective risks are not high.

The literature therefore suggests that the perception of personal safety risks of potential tourists has a major impact on tourism demand patterns and that safety is one of the most fundamental conditions for tourism development (Fletcher & Morakabati, 2008; Seabra et al., 2013). Creating conditions for tourists to feel safe before and during their trip can be crucial for the success of a destination in the international tourism market (Huan & Beaman, 2004, cited in Seabra et al., 2013).

The importance of safety and security for tourism development is highlighted by the Travel and Tourism Development Index (TTDI), in which one of the key pillars is Safety and Security. The Safety and Security pillar measures the extent

to which a country exposes locals, tourists and businesses to security risks (WEF, 2024a, p. 8). This pillar includes indicators such as confidence in local police, as well as terrorism and organized violence (WEF, 2024a, p. 56). Given that safety and security are an important factor in attracting tourists, but also a key prerequisite for the resilience of the tourism sector, especially in conditions of global instability, the next segment of the paper will analyze the assessment of Serbia's Safety and Security and its global position according to this factor.

3. RESEARCH METHODOLOGY

Safety and Security is one of the pillars that make up the Travel and Tourism Development Index (TTDI). Although the Travel and Tourism Development Index (formerly TTCI Travel and Tourism Competitiveness Index) has undergone various methodological changes since its inception, the Safety and Security pillar has been an integral part of this index in all editions.

The analysis includes Serbia's score and ranking for the Safety and Security pillar from 2009 to the latest TTDI edition for 2024. Data on international tourist arrivals to Serbia are also included for the same period to in order to examine potential relationship between safety and security and tourism demand.

In addition to the aggregate pillar results, individual variables that compose the Safety and Security pillar will also be analyzed for 2024 to provide a more detailed insight into its structure.

The data sources for the individual pillar variables include the 2023 Legatum Prosperity Index, United Nations Office on Drugs and Crime (UNODC), Institute for Economics & Peace, Global Terrorism Index 2023: Measuring the Impact of Terrorism, Uppsala Conflict Data Program, and the World Bank World Development Indicators (WEF, 2024a, p. 67). Data on international tourist arrivals are based on publications of the World Tourism Organization and the Statistical Office of the Republic of Serbia.

The study applies a descriptive and comparative analysis of the TTDI pillar and international tourist arrivals to identify trends and relationships.

4. RESEARCH RESULTS AND DISCUSSION

An examination of Table 1 shows a long-term trend of improvement in Serbia's performance within the Safety and Security pillar in the period from 2009 to 2024. The pillar value records a continuous increase from 4.8 in 2009 to 6.1 in 2024, which confirms a significant improvement in the perception and objective indicators of safety and security. At the same time, Serbia's rank shows certain oscillations - from 85th place in 2009 to the best rank (17th place) in 2021, followed by a slight decline to 32nd place in 2024. This divergence between the growth of results and changes in rank can be explained by the relative progress of other countries, which is in line with the findings that the competitiveness of tourist destinations has a distinctly relative character (Dwyer & Kim, 2003).

Table 1: Score and Rank of the Safety and Security Pillar for Serbia

Safety and Security	2009	2011	2013	2015	2017	2019	2021	2024
Score (1-7)	4.8	4.9	5	5.46	5.4	6.03	6.16	6.1
Rank	85	66	55	59	72	26	17	32

Source: Authors' presentation based on TTCI and TTDI reports

A more detailed analysis of the structure of the Safety and Security pillar (Table 2) indicates that Serbia scores exceptionally high on indicators related to the absence of terrorism and organized violence (maximum score 7 and shares first place with several other countries with the highest score), which represents a significant comparative advantage. These results confirm the thesis that macro-security factors, such as political stability and low levels of violence, play a key role in the perception of a destination as safe (Pizam & Mansfeld, 2006). In contrast, the lower score and lower rank in the indicator of confidence in the police (4.53; 65th place) indicate the existence of institutional challenges that may affect tourists' subjective sense of safety. This is in line with the literature emphasizing that the perception of safety is not determined exclusively by objective security indicators, but also by the quality of institutions and trust in them (Fuchs & Reichel, 2011).

Table 2: Scores and Ranks of the Safety and Security Pillar Variables for Serbia, 2024

Safety and Security	Score	Rank
Confidence in local police	4.53	65
Safety walking alone at night	5.2	35
Homicide rate	6.79	36
Global Terrorism Index	7	1
Organized violence, deaths	7	1

Source: Authors' presentation based on the Economy Profiles in the TTDI 2024 Edition

Data on international tourist arrivals (Table 3) further suggests a positive relationship between improvements in safety and security and tourism demand. Between 2009 and 2019, the number of tourist arrivals grew almost continuously, in parallel with the improvement of Serbia's safety and security score.

Table 3: International tourist arrivals in Serbia

Year	International tourist arrivals (1000)
2009	645
2010	683
2011	764
2012	810
2013	922
2014	1029
2015	1132
2016	1281
2017	1497
2018	1710
2019	1847
2020	446
2021	871
2022	1773
2023	2134
2024	2385

Source: Authors' presentation based on UNWTO and Statistical Office of the Republic of Serbia reports.

This trend was abruptly interrupted in 2020 due to the COVID-19 pandemic (Figure 1), confirming the vulnerability of the tourism sector to global crises. However, recovery began in 2021, and in 2024 a historical maximum of 2.385 million international arrivals in Serbia was reached. The recovery and further growth of tourism may be partly associated with the relatively high level of safety and security in Serbia, which is consistent with the view that safety and security are among the key determinants of destination choice.



Figure 1: International tourist arrivals in Serbia
Source: Authors' presentation based on UNWTO and Statistical Office of the Republic of Serbia reports

However, it should be emphasized that the relationship between safety and security and tourist arrivals is not linear or unidirectional. Although improving security indicators contribute to the growth of tourism demand, the results are also influenced by other factors, such as infrastructure development, destination promotion and general economic conditions (Ritchie & Crouch, 2003). In this sense, Serbia's high position in the pillar of Safety and Security is a necessary, but not sufficient condition for long-term competitiveness in the international tourism market.

5. CONCLUSION

Tourism is an industry that is highly vulnerable to various risks, of which terrorism, political instability and crime have a particular impact on changing travel intentions. In addition to objective risks, the subjective perception of risk among tourists significantly influences tourism demand.

Since one of the basic human needs is the need to feel safe and secure, potential tourists will choose destinations that they perceive as safe and secure. The importance of safety and security for tourism development is confirmed by the Travel and Tourism Development Index, where one of the pillars that make up its structure is the Safety and Security pillar.

Looking at the TTDI editions from 2009 to the last one published in 2024, a continuous improvement in Serbia's Safety and Security pillar score can be observed, while at the same time Serbia's ranking in this pillar improved over the observed period. Serbia's score for the Safety and Security pillar increased from the initial 4.8 to 6.16 (out of a maximum of 7) in 2021, while it dropped slightly to 6.1 in 2024. At the same time, in addition to the highest score in 2021, Serbia also had the most favorable ranking according to this pillar, placing 17th on the list.

An analysis of the structure of this pillar and its individual variables shows that Serbia ranks below 50th place in most indicators, except for one. However, in the Global Terrorism Index and Organized violence indicators, Serbia achieves the maximum score of 7, sharing first place with countries that also have the highest score.

Considering that safety and security are of great importance when choosing tourist destinations, and that the current circumstances of geopolitical instability and conflict in Europe and the Middle East are placing additional pressure on the tourism sector (WEF, 2024a), promoting Serbia as a relatively safe and secure tourist destination can be a key factor in attracting tourists and contributing to maintaining stability and resilience in conditions of global instability.

REFERENCES

Dwyer, L., & Kim, C. (2003). Destination competitiveness: determinants and indicators. *Current issues in tourism*, *6*(5), 369-414.

Fletcher, J., & Morakabati, Y. (2008). Tourism activity, terrorism and political instability within the Commonwealth: The cases of Fiji and Kenya. *International Journal of Tourism Research*, *10*(6), 537-556.

Floyd, M. F., Gibson, H., Pennington-Gray, L., & Thapa, B. (2004). The effect of risk perceptions on intentions to travel in the aftermath of September 11, 2001. *Journal of Travel & Tourism Marketing*, *15*(2-3), 19-38.

Fuchs, G., & Reichel, A. (2011). An exploratory inquiry into destination risk perceptions and risk reduction strategies of first time vs. repeat visitors to a highly volatile destination. *Tourism management*, *32*(2), 266-276.

Hall, C. M., Timothy, D. J., & Duval, D. T. (2012). *Security and Tourism: Towards a New Understanding?* In C. M. Hall, D. J. Timothy, & D. T. Duval (Eds.), *Safety and Security in Tourism* (pp. 1-18). Routledge.

Jore, S. H. (2019). The conceptual and scientific demarcation of security in contrast to safety. *European journal for security research*, *4*(1), 157-174.

Maslow, A. H. (1943). A theory of human motivation. *Psychological Review*, *50*(4), 370-396.

Pizam, A., & Mansfeld, Y. (2006). *Tourism, Security and Safety: From Theory to Practice.* Elsevier.

Poon, A., & Adams, E. (2000). How the British will travel 2005. *Bielefeld: Tourism Intelligence International*.

Quintal, V. A., Lee, J. A., & Soutar, G. N. (2010). Risk, uncertainty and the theory of planned behavior: A tourism example. *Tourism management*, *31*(6), 797-805.

Ritchie, J. B., & Crouch, G. I. (2003). *The competitive destination: A sustainable tourism perspective*. Cabi.

Scott, N., Laws, E., & Prideaux, B. (2010). Safety and security in tourism. *Recovery Marketing after Crises, New York and London: Routledge*.

Seabra, C., Dolnicar, S., Abrantes, J. L., & Kastenholz, E. (2013). Heterogeneity in risk and safety perceptions of international tourists. *Tourism Management*, *36*, 502-510.

Statistical Office of the Republic of Serbia (2025). *Statistical Yearbook of the Republic of Serbia.* Available at: https://publikacije.stat.gov.rs/G2025/Pdf/G20252058.pdf (accessed on 5 March 2026).

UN Tourism (2024). *International tourism recovers pre-pandemic levels in 2024.* Available at: https://www.untourism.int/news/international-tourism-recovers-pre-pandemic-levels-in-2024 (accessed on 3 March 2026).

UN Tourism (2025). *International tourist arrivals up 4% in 2025 reflecting strong travel demand around the world.* Available at: https://www.untourism.int/news/international-tourist-arrivals-up-4-in-2025-reflecting-strong-travel-demand-around-the-world (accessed on 3 March 2026).

Wang, W., & Wang, C. (2018). Cognition and Assessment of Tourism Disaster Risk Based on a Tourism Spot of Green Island. *Environment and Natural Resources Research*, *8*(4), 32-45.

World Economic Forum (2009). *The Travel & Tourism Competitiveness Report 2009*. Available at: https://www.hospitalitynet.org/file/152003764.pdf (accessed on 3 March 2026).

World Economic Forum (2011). *The Travel & Tourism Competitiveness Report 2011*. Available at: https://www.globalwellnesssummit.com/wp-content/uploads/Industry-Research/Global/2011-WEF-Travel-Tourism-Competitiveness-Report.pdf (accessed on 3 March 2026).

World Economic Forum (2013). *The Travel & Tourism Competitiveness Report 2013.* Available at: https://www3.weforum.org/docs/WEF_TT_Competitiveness_Report_2013.pdf (accessed on 3 March 2026).

World Economic Forum (2015). *The Travel & Tourism Competitiveness Report 2015*. Available at: https://www3.weforum.org/docs/TT15/WEF_Global_Travel&Tourism_Report_2015.pdf (accessed on 3 March 2026).

World Economic Forum (2017). *The Travel & Tourism Competitiveness Report 2017*. Available at: https://www3.weforum.org/docs/WEF_TTCR_2017_web_0401.pdf (accessed on 3 March 2026).

World Economic Forum (2019). *The Travel & Tourism Competitiveness Report 2019.* Available at: https://www3.weforum.org/docs/WEF_TTCR_2019.pdf (accessed on 3 March 2026).

World Economic Forum (2021). *Travel & Tourism Development Index 2021.* Available at: https://www3.weforum.org/docs/WEF_Travel_Tourism_Development_2021.pdf (accessed on 3 March 2026).

World Economic Forum (2024a). *Travel & Tourism Development Index 2024*. Available at: https://www3.weforum.org/docs/WEF_Travel_and_Tourism_Development_Index_2024.pdf (accessed on 3 March 2026).

World Economic Forum (2024b). T*ravel & Tourism Development Index 2024 Edition, Interactive data and economy profiles.* Available at: https://www.weforum.org/publications/travel-tourism-development-index-2024/interactive-data-and-economy-profiles-afaa00a59c/ (accessed on 3 March 2026).

World Tourism Organization (2012). *UNWTO Tourism Highlights, 2012 Edition.* Available at: https://www.e-unwto.org/doi/pdf/10.18111/9789284414666 (accessed on 12 March 2026).

World Tourism Organization (2015). *UNWTO Tourism Highlights, 2015 Edition.* Available at: https://www.e-unwto.org/doi/epdf/10.18111/9789284416899 (accessed on 12 March 2026).

World Tourism Organization (2016). *UNWTO Tourism Highlights, 2016 Edition.* Available at: https://www.e-unwto.org/doi/epdf/10.18111/9789284418145 (accessed on 12 March 2026).

World Tourism Organization (2017). *UNWTO Tourism Highlights, 2017 Edition.* Available at: https://www.e-unwto.org/doi/epdf/10.18111/9789284419029 (accessed on 12 March 2026).

World Tourism Organization (2018). *UNWTO Tourism Highlights, 2018 Edition.* Available at: https://www.e-unwto.org/doi/epdf/10.18111/9789284419876 (accessed on 12 March 2026).

World Tourism Organization (2019). *International Tourism Highlights, 2019 Edition.* Available at: https://www.e-unwto.org/doi/pdf/10.18111/9789284421152 (accessed on 12 March 2026).

World Tourism Organization (2023). *International Tourism Highlights, 2023 Edition – The Impact of COVID-19 on Tourism (2020–2022).* Available at: https://www.e-unwto.org/doi/epdf/10.18111/9789284424986 (accessed on 12 March 2026).

World Tourism Organization (2024). *International Tourism Highlights, 2024 Edition.* Available at: https://www.e-unwto.org/doi/epdf/10.18111/9789284425808 (accessed on 12 March 2026).

Xie, C., Huang, Q., Lin, Z., & Chen, Y. (2020). Destination risk perception, image and satisfaction: The moderating effects of public opinion climate of risk. *Journal of Hospitality and Tourism Management*, *44*, 122-130.

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EXAMINING THE EFFECTS OF FDI ON THE ECONOMIC GROWTH OF THE REPUBLIC OF SERBIA

Abstract: Foreign direct investment (FDI) represents an important source of capital, particularly for transition economies, as it stimulates investment activity, increases productivity, and contributes to economic growth, while strengthening macroeconomic stability and the openness of the economy. In this research, economic development will be monitored through the movement of gross domestic product (GDP), which represents an important indicator of economic activity and overall economic growth. However, the degree of impact of foreign direct investment on gross domestic products and economic growth is conditioned by various economic and institutional factors. The empirical research aims to examine whether and to what extent foreign direct investment inflows contribute to economic growth through increases in gross domestic product in the Republic of Serbia during the period from 2014 to 2024. The study will be based on secondary annual data obtained from the National Bank of Serbia and the Statistical Office of the Republic of Serbia. For the purposes of this research, the multiple linear regression method will be applied, enabling the identification of causal relationships as well as the estimation of economic impact. The results are expected to show a positive and statistically significant impact of foreign direct investment on the economic growth of the Republic of Serbia, confirming their importance as a mechanism for strengthening macroeconomic stability and long-term development. The results indicate a clear upward trend in foreign direct investment inflows, accompanied by overall growth in gross domestic product in Republic of Serbia. The analysis suggests a positive association between FDI inflows and economic growth, highlighting their importance as a factor contributing to macroeconomic development and long-term economic expansion.
Keywords: *foreign direct investment, gross domestic product, economic growth, the Republic of Serbia.*

1. INTRODUCTION

In the modern economy, foreign direct investments (FDI) represent one of the key instruments of connecting national economies with global flows of capital, production and trade. Their importance is reflected in the transfer of technologies, the creation of new jobs, the increase in export competitiveness and the acceleration of economic growth (Assamah & Yuan, 2024; Đurić et al., 2016). Therefore, many countries use FDI as a basic mechanism of economic modernization and integration into international value chains, thereby ensuring long-term stability and sustainable growth (Khan et al., 2025). The Republic of Serbia started this process late, due to political and economic sanctions

during the 1990s, which delayed its integration into international capital flows (Ratkaj et al., 2020). It was only in the early 2000s that the more intensive inflow of FDI began, and from 2010 to the present, there has been a steady growth of investments in key sectors such as manufacturing, mining, construction and finance (Statistical Yearbook, 2025). Serbia stands out as one of the more successful countries in the region in terms of the volume of attracted FDI, which indicates an improvement in the investment climate and macroeconomic stability (Vujadinović & Marjanović, 2025). According to data from the National Bank of Serbia, in the last decade, Serbia achieved above-average results in attracting FDI compared to countries of similar size and level of development, ranking 45th in the world in terms of inflow value in 2023 (National Bank of Serbia, 2024).

This research aims to analyze the characteristics and dynamics of FDI inflows to Serbia and their impact on economic growth as, measured by increasing Gross Domestic Product (GDP). By analyzing absolute and relative indicators, the study explores how FDI has not only provided essential capital but has also driven the modernization of key sectors. This study covers the period from 2014 to 2024, as a decade of significant structural reforms and intensified efforts to attract foreign capital. The descriptive statistical method will be applied for the analysis of key economic indicators. The research is grounded in official secondary data obtained from the National Bank of Serbia (NBS) and the Statistical Office of the Republic of Serbia (SORS), ensuring a high degree of reliability and institutional relevance.

2. LITERATURE REVIEW

Foreign direct investment is essential to a nation's economic success, and each country strives to ensure the largest possible inflow of these investments (Liu et al., 2025; Marjanović et al., 2024). Because foreign direct investment can accelerate economic growth and development, countries are improving their economies to attract it (Ahmed & Ibrahim, 2019). As foreign direct investments have the potential to greatly boost a nation's economic growth, they can be quite significant. Their importance is demonstrated by their ability to support the development of competitiveness and comparative advantages (Domazet & Marjanović, 2026; Vujadinović & Marjanović, 2024). The long-run effect of FDI on growth is significantly positive in investment- and factor-driven economies (Yimer, 2023). The efforts of nations to improve the competitiveness of their institutional systems are closely linked to attracting foreign direct investments (Gülcü, 2024; Marjanović et al., 2022; Miković, 2020). An increase in FDI relative to GDP drives growth only when the host nation has adequate absorptive capacity, with trade openness above the threshold (Minh & Trinh, 2023). FDI stock and economic growth in Eurozone countries have a positive long-run cointegrating relationship, according to Pegkas's (2015) analysis of the relationship between FDI and economic development from 2002 to 2012.

Dorakh (2022) concludes that trade and FDI connectivity remain more global than regional after using a panel data approach for 39 countries from 2000 to 2020 to examine the connectivity among institutional and economic factors affecting FDI flows within Europe compared to those between European and non-European countries. Anwar et al. (2023) examined how GDP growth affected foreign direct investment (FDI) in ASEAN-5 nations between 2004 and 2019. The results showed that GDP growth significantly and positively affects FDI. According to Marjanović et al. (2025), the cost of doing business is the most significant factor in Serbia's economic environment for international investors. Foreign investors avoid unstable and dangerous nations, as reflected in the allocation of FDI inflows from lower-income economies to more stable, higher-income nations (Nguyen & Lee, 2021). The research results of Liang et al. (2023) show a positive relationship between FDI and economic growth. An increase in FDI inflow boosts a developing nation's economic growth. Since economic growth often provides host nations with a location advantage and increases company confidence, it is considered a favorable factor in attracting foreign direct investment (Ghazalian, 2023; Bermejo Carbonell & Werner, 2018; Domazet et al., 2025). Gherghina et al. (2019) studied the relationship between foreign direct investment inflows and economic growth, and their empirical results support a non-linear relationship between FDI and gross domestic product per capita. Over 60% of all foreign direct investment in Western Balkan countries between 2010 and 2019 went to Serbia, making it the most desirable place to invest, according to a study by Marjanović and Đukić (2020). Additionally, the results of the study by Vujadinović and Marjanović (2025), which examined greenfield investments between 2015 and 2023, indicate that the Republic of Serbia is the most desirable investment destination in the region and attracts the highest percentage of FDI.

3. DATA AND METHODOLOGY

This research is based on the analysis of secondary data obtained from relevant and reliable institutional sources, primarily the National Bank of Serbia (NBS) and the Statistical Office of the Republic of Serbia (SORS). The dataset covers the period from 2014 to 2024, which represents a decade characterized by significant economic reforms, increased openness to foreign capital, and intensified integration into global economic flows in Republic of Serbia.

The study focuses on three key macroeconomic indicators: foreign direct investment (FDI) inflows, real gross domestic product (GDP) growth, and GDP in current prices. FDI inflows are expressed in billions of euros, real GDP growth is presented in percentage terms, while GDP in current prices is measured in billions of dinars. In addition, sectoral data on FDI was used to identify the most attractive industries for foreign investors, including manufacturing, construction, mining, and financial and insurance activities. The methodological approach is primarily based on descriptive statistical analysis which enables a comprehensive understanding of the dynamics of the observed economic indicators. Graphical

representations are used to illustrate trends and patterns, while tabular data provide a clearer overview of statistical relationships.

4. RESEARCH RESULTS

The results of the analysis provide a comprehensive overview of the trends and structural characteristics of foreign direct investment (FDI) inflows and economic growth in Republic of Serbia during the period 2014–2024. They highlight the dynamic relationship between increasing FDI inflows and the overall expansion of economic activity, as reflected in key economic indicators.

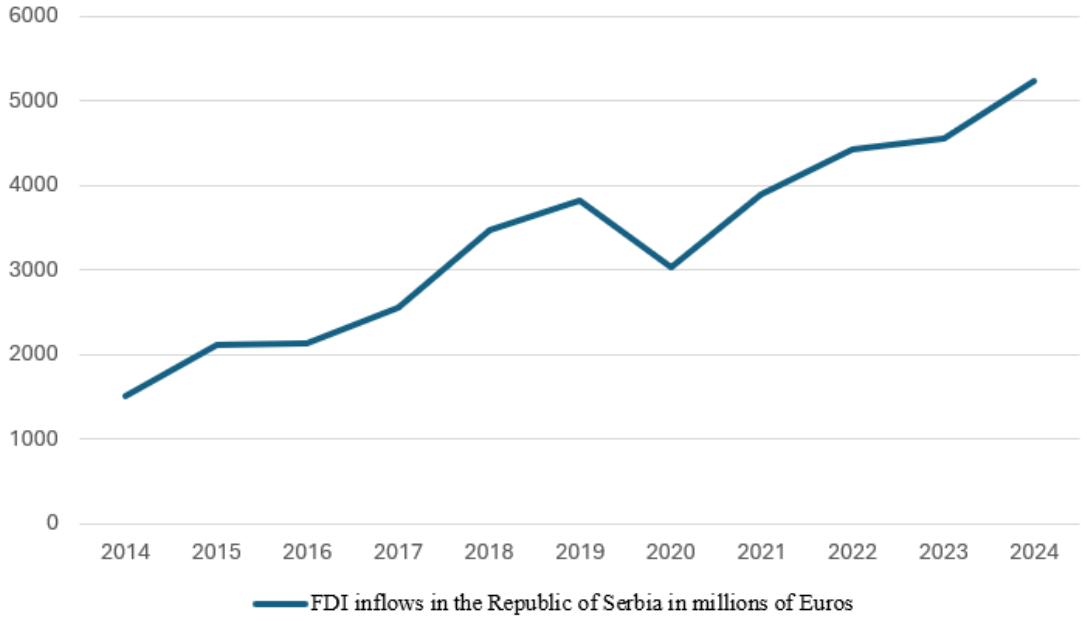


Figure 1: FDI inflows in the Republic of Serbia in millions of Euros
Source: Authors based on SORS

The figure1 shows the movement of the inflow of foreign direct investments (FDI) in the Republic of Serbia in the period from 2014 to 2024, expressed in millions of euros. Based on the data presented, a clear long-term upward trend can be observed, with certain short-term oscillations. In the initial year (2014), the inflow of FDI amounted to 1,500.5 million euros. During the next two years, a moderate growth of 2,126.9 million euros was recorded, which indicates the stabilization of the investment environment. More pronounced growth was recorded in 2017, 2018 and 2019, when inflows reached 3,815.3 million euros. In 2020, due to the global crisis, there was a decline, but already in 2021, there is a recovery, after which growth continues in 2022 (4,432.5 million euros) and 2023 (4,564.4 million euros). The highest value of the inflow of foreign direct investments was achieved in 2024 and amounted to EUR 5,230.9 million.

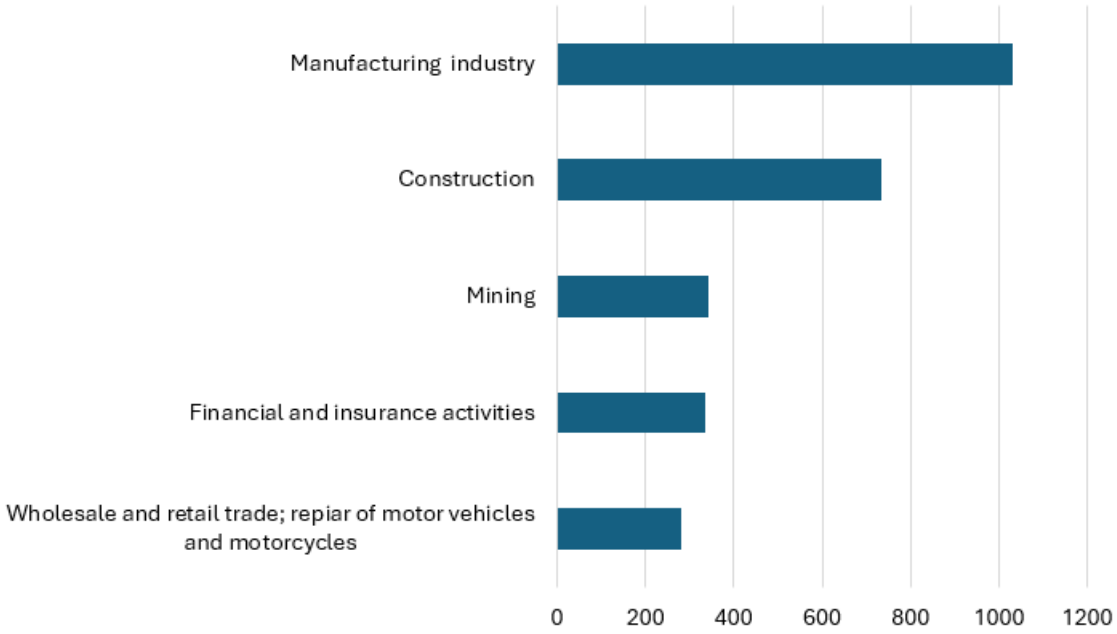


Figure 2: The top 5 sectors by average FDI inflows during 2014-2024
Source: Authors based on SORS

The graph 2 shows the five leading sectors according to the average inflow of foreign direct investments (FDI) in the Republic of Serbia in the period from 2014 to 2024.Based on the presented data, the processing industry takes the first place, which indicates its dominant importance in the structure of foreign investments. This sector represents a key pillar of investment attraction and plays a leading role in the country's industrial development. In second place is construction, with significantly lower but still significant average investments. This sector records stable interest from investors, due to the intensive development of infrastructure and urbanization. Mining sector and financial and insurance activities have approximately similar levels of average investments, but with slightly more pronounced oscillations in the observed period. Their importance is growing especially in recent years, which indicates the diversification of investment flows. In the last place is wholesale and retail trade and repair of motor vehicles and motorcycles, which indicates a relatively smaller, but still present importance of this sector in total investments.

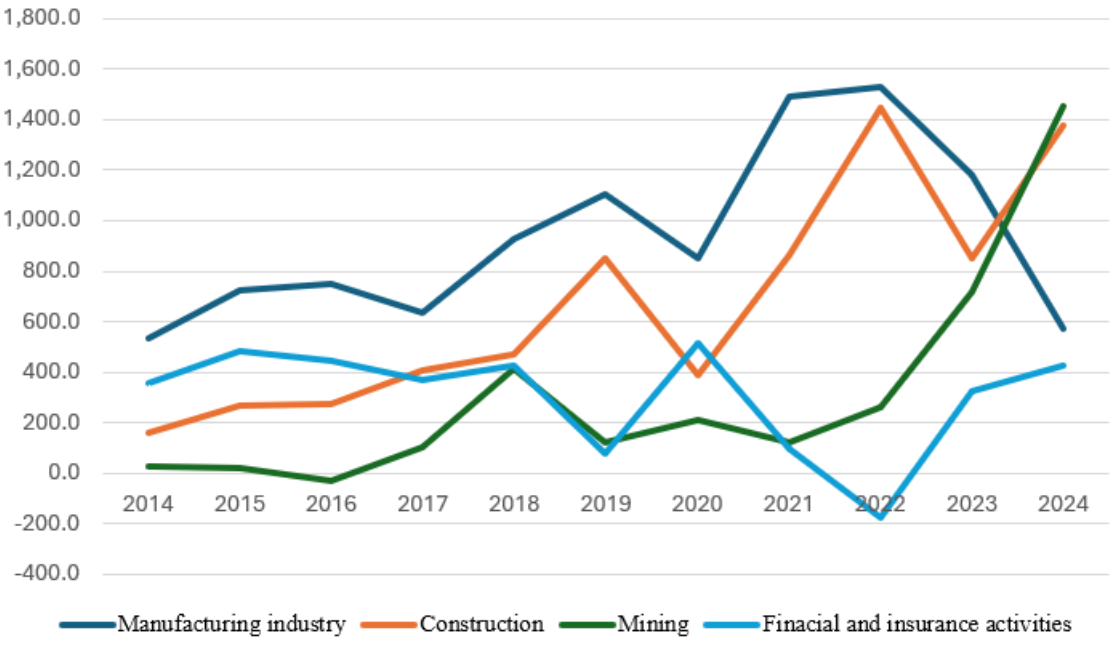


Figure 3: FDI inflows in Processing industry, Construction, Mining and Financial and insurance activities
Source: Authors based on SORS

Figure3 shows the movement of the inflow of foreign direct investments (FDI) by sector in the Republic of Serbia in the period from 2014 to 2024. The following sectors are covered: manufacturing, construction, mining and financial and insurance activities. In the observed period, the manufacturing industry recorded a continuously high level of investment and represented the leading sector in most of the analyzed intervals. After moderate growth from 2014 to 2017, there is a significant increase in investment during 2021 and 2022, when investments reach their highest values. This is followed by a slight decline until 2024. Construction is characterized by more pronounced oscillations. After a gradual growth from 2014 to 2019, there is a decline in 2020 due to the covid pandemic, then a strong recovery and a sharp growth peaking in 2022. In the initial years, mining records a low level of investment, but from 2021 there is sudden and continuous growth. This sector reaches its peak in 2024, making it also one of the most significant. Financial and insurance activities are characterized by pronounced oscillations. After growth until 2020, there is a sharp decline, with negative values recorded in 2022. In the following years, the sector is recovering but remains unstable compared to other sectors.

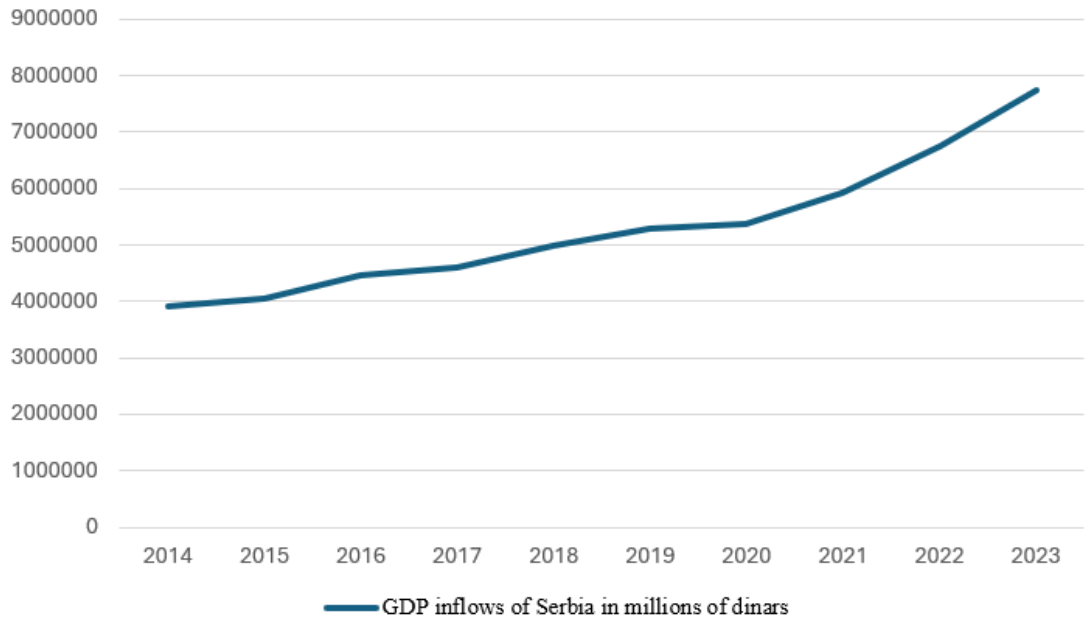


Figure 4: GDP inflows of Serbia in millions of dinars
Source: Authors based on SORS

The graph 4 shows the movement of gross domestic product (GDP) in the Republic of Serbia in the period from 2014 to 2023, expressed in millions of dinars.Based on the data presented, a continuous upward trend of GDP can be observed throughout the observed period. In 2014, the GDP was approximately 3.9 billion, after which it recorded gradual growth in the following years. In the period from 2015 to 2017, growth was moderate and stable, without significant oscillations.From 2018, there is a slightly more intense increase in GDP, which continues in 2019 and 2020, although a slight slowdown in growth can be observed in 2020. This is followed by a phase of accelerated growth - especially from 2021, when GDP begins to grow more significantly.The most pronounced increase was recorded in the last two years of the observed period. In 2022 and 2023, there was a sharp increase in GDP value, with 2023 reaching the highest level in the entire period.

Table 1: Descriptive statistics for FDI and GDP in the Republic of Serbia (2014-2024)

	FDI inflow (EUR bn)	Real GDP growth (%)	GDP current (EUR bn)
Mean	3.34	2.86	52.45
Meridian	3.46	3.00	48.11
Std.Daviation	1.15	2.71	15.58
Minimum	1.50	-1.80	37.01
Maximum	5.23	7.90	83.26
Skewness	0.18	0.50	0.88
Kurtosis	-1.17	0.10	-0.55

Source: Author's calculation based on NBS and SORS data.

This Table 1 shows the basic descriptive statistical indicators for the inflow of foreign direct investments (FDI), the real growth of the gross domestic product (GDP) and the level of GDP in current prices in the Republic of Serbia. First of all, the inflow of foreign direct investments (FDI) shows relative stability and continuity. The moderate standard

deviation and small range of asymmetry indicate that there were no extreme oscillations, but a gradual movement with a slight upward trend. This suggests that the Serbia was a reliable and stable destination for foreign investors during the observed period. On the other hand, real GDP growth is much more variable. A high standard deviation, as well as the presence of a negative minimum value, indicate that at a certain point there was a decline in economic activity, which can be associated with external economic shocks or crises. Conversely, a high maximum value shows the economy's potential for strong recovery and accelerated growth. When it comes to GDP in current prices, there is a clear upward trend. The larger difference between the average and the median, as well as the positive asymmetry, indicate that higher values were recorded in the recent period, which confirms the long-term growth of the economy and the increase in overall economic activity.

5. CONCLUSION

The results of the analysis indicate that foreign direct investments have played a significant role in the economic development of Republic of Serbia during the period from 2014 to 2024. A clear upward trend in FDI inflows has been observed, despite the presence of short-term fluctuations, particularly during the global crisis in 2020. The temporary decline in that year reflects the sensitivity of investment flows to global economic disturbances. However, the relatively quick recovery and continued growth in the subsequent years highlight the resilience of the Serbian economy, as well as its increasing attractiveness to foreign investors. This suggests that macroeconomic stability, institutional improvements, and investment incentives have played an important role in maintaining investor confidence. Sectoral analysis shows that the manufacturing industry has been the dominant recipient of FDI, highlighting its importance as a driver of industrial development and export competitiveness. At the same time, increasing investments in mining, construction, and financial sectors indicate a gradual diversification of investment flows and a broader economic base. This diversification is particularly important for reducing dependence on a limited number of sectors and enhancing the overall resilience of the economy. The analysis of GDP trends further supports these findings. While real GDP growth exhibits certain fluctuations, reflecting sensitivity to external shocks, the overall positive average growth rate indicates steady economic expansion. In contrast, GDP in current prices shows a strong and continuous upward trend, confirming the long-term increase in economic activity. Descriptive statistical indicators suggest that FDI inflows are relatively stable compared to the more dynamic nature of economic growth. The moderate variability of FDI indicates a steady inflow of foreign capital, while the higher variability in GDP growth points to cyclical movements and sensitivity to broader economic conditions. Nevertheless, the presence of high maximum growth rates highlights the economy’s capacity to achieve strong expansion during favorable periods, particularly following economic downturns. The findings confirm that FDI has been an important factor in supporting economic growth, structural transformation, and modernization of key sectors in Republic of Serbia. Although challenges remain, particularly in terms of growth stability, the overall trend indicates a positive development trajectory and strengthening integration into the global economy. Continued efforts to improve the investment climate, diversify the economic structure, and strengthen institutional capacity will be essential for maintaining this momentum and ensuring long-term integration into the global economy.

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REFERENCES

Ahmed, Y. A., & Ibrahim, R. R. (2019). The impact of FDI inflows and outflows on economic growth: an empirical study of some developed and developing countries. *Raparin Journal of Humanities (RJH)*, *6*(1), 129-157.

Anwar, C. J., Suhendra, I., Imansyah, T., & Chendrawan, T. S. (2023). GDP Growth and FDI nexus in ASEAN-5 Countries: The role of macroeconomic performances. *JEJAK: Jurnal Ekonomi dan Kebijakan*, *16*(1).

Assamah, D., & Yuan, S. (2024). Greenfield investment and job creation in Ghana: a sectorial analysis and geopolitical implications of Chinese investments. *Humanities and Social Sciences Communications*, *11*(1), 1-11.

Bermejo Carbonell, J., & Werner, R. A. (2018). Does foreign direct investment generate economic growth? A new empirical approach applied to Spain. *Economic geography*, *94*(4), 425-456.

Domazet, I., & Marjanović, D. (2026). National Competitiveness in the Western Balkans: Challenges and Opportunities. In Christiansen, B. & Zhuplev, A. (Eds.), *National Competitive Advantage Amid Rapid Global Transformation*, 315-350. Hershey: IGI Global.

Domazet, I., Marjanović, D., & Beraha, I. (2025). The impact of the tax system on Serbia’s competitiveness. *Teme*, 167-183. Bermejo Carbonell, J., & Werner, R. A. (2018). Does foreign direct investment generate economic growth? A new empirical approach applied to Spain. *Economic geography*, *94*(4), 425-456.

Dorakh, A. (2022). Trade and FDI connectivity in Europe: the European Union, Western Balkans and new EU candidate countries. *Eastern Journal of European Studies*, *13*(2), 24-53.
Đurić, D., Ristić, J., & Đurić, D. (2016). Foreign direct investments in the role of strengthening the export competitiveness of the Serbian economy. *Економика пољопривреде*, *63*(2), 531-546.
Ghazalian, P. L. (2023). Does economic growth attract FDI inflows? A dynamic panel analysis. *Economies*, *12*(1), 1.
Gherghina, Ş. C., Simionescu, L. N., & Hudea, O. S. (2019). Exploring foreign direct investment–economic growth nexus—Empirical evidence from central and eastern European countries. *Sustainability*, *11*(19), 5421.
Gülcü, Y. (2024). Determinants of foreign direct investment inflows in the european union (EU). *İnönü Üniversitesi Uluslararası Sosyal Bilimler Dergisi*, *13*(1), 124-135.
Liang, C., Shah, S. A., & Bifei, T. (2021). The Role of FDI Inflow in Economic Growth: Evidence from Developing Countries. *Journal of Advanced Research in Economics and Administrative Sciences*, *2*(1), 68-80.
Liu, L., Gozgor, G., Mahalik, M. K., & Pal, S. (2025). The impact of the US-China tensions on FDI dynamics in emerging economies. *Finance Research Letters*, *78*, 107255.
Khan, M. S., Audi, M., & Ali, A. (2025). Foreign Direct Investment, Financial Development, and Sustainable Growth: Empirical Evidence from Developing Countries. *Journal of Social Signs Review*, *3*(08), 189-211.
Marjanović, D., Domazet, I., Vukmirović, V., & Simović, V. (2025). Economic Factors as a Driving Force for Foreign Direct Investment in Serbia. *Eastern European Economics*, 1-27.
Marjanović, D., Domazet, I., & Vukmirović, V. (2024). Legal environment as a factor in the inflow of Foreign Direct Investment: Case of Serbia. *Journal of Eastern European and Central Asian Research*, *11*(3), 478-492.
Marjanović, D., Domazet, I., & Vukmirović, V. (2022). Social Environment as a Factor of Capital Investment in Serbia. *Eastern European Economics*, *60*(3), 247-264.
Marjanović, D., & Đukić, M. (2020). Western Balkan countries as an attractive investment destination. *Economic Analysis: journal of emerging economics*, 53(2), 109-120.
Miković, N. (2020). The Competitiveness overview of Serbia, Montenegro and Croatia in 2019. *Journal of Women's Entrepreneurship and Education,* 1-2, 53-71.
Minh, V. T. H., & Trinh, P. T. T. (2023). The impact of FDI on economic growth in developing countries: the role of FDI inflow and trade openness. *The Economics and Finance Letters*, *10*(3), 216-229.
National Bank of Serbia. (2025). Key macroeconomic indicators. Belgrade, Serbia, available at: https://nbs.rs/sr_RS/drugi-nivo-navigacije/statistika/stranedirektneinvesticije/, viewed at: 14.4.2026
Nguyen, C. P., & Lee, G. S. (2021). Uncertainty, financial development, and FDI inflows: Global evidence. *Economic Modelling*, *99*, 105473.
Pegkas, P. (2015). The impact of FDI on economic growth in Eurozone countries. *The Journal of Economic Asymmetries*, *12*(2), 124-132.
Ratkaj, I., Sibinović, M., & Manić, E. (2020). FDI in Serbia. In Foreign Direct Investment in the Successor States of Yugoslavia: A Comparative Economic Geography 25 Years Later (pp. 23-50). Cham: Springer International Publishing.
Statistical Office of the Republic of Serbia (2025). Statistical yearbook of the Republic of Serbia 2025. Belgrade, Serbia. available at: https://www.stat.gov.rs/sr-latn/publikacije/publication/?p=17536&tip=2, viewed at: 14.4.2026
Vujadinović, J., & Marjanović, D. (2025). Greenfield investments in the Western Balkans: a catalyst for economic growth and development. In *Strategic management and Decision Support Systems in Strategic Management (pp. 164-170).* Subotica: Faculty of Economics in Subotica.
Vujadinović, J., & Marjanović, D. (2024). The influence of FDI on development tourist activities in the Republic of Serbia. In Grubišić, Z. et al. (Eds.) *Global Economic Trends – Challenges and Opportunities*, 59-62. Belgrade: Belgrade Banking Academy.
Yimer, A. (2023). The effects of FDI on economic growth in Africa. *The Journal of International Trade & Economic Development*, *32*(1), 2-36.

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THE ACCELERATED RISE OF ARTIFICIAL INTELLIGENCE IN THE BANKING SECTOR IN CONDITIONS OF GLOBAL INSTABILITY

Abstract: Artificial Intelligence (AI) is rapidly moving from experimental to operational implementation and is becoming a key tool for transforming the banking industry, as a standard that is changing the lending process, risk management, customer relationships, user experience, fraud detection, customer churn prevention and decision-making process. Banks that use AI wisely are becoming industry leaders, providing faster, smarter and more personalized services to customers, while automating business processes. The aim of the paper is to comprehensively explore and highlight the application opportunities that AI brings to the banking sector, how banks scale AI solutions with technological, investment and regulatory implications, and to contribute to the understanding of the role that AI plays in the banking industry by focusing on its application, implementation, challenges and potential benefits for stimulating innovation and competition, through the example of global leading banks and the accelerated rise of AI in the banking sector of the Republic of Serbia. The subject of research in this paper is the accelerated development of AI in banking in conditions of global instability and market volatility, where the introduction of AI imposes the need for resilience, smart and rapid adaptation, talent development and responsible innovation in order to create additional value in the market. The research methodology is based on a combination of analysis of scientific and professional literature, analysis of relevant reports from regulatory institutions, banks and consulting firms, as well as a comparative analysis of the maturity level of AI implementation in the banking sector of developed countries and the Republic of Serbia. The research results indicate that the key to AI implementation lies in the smart use of technologies, compliance with regulatory requirements, transparency and ethical principles in data management, where the best practices of leading global banks provide a framework for how AI is used to increase efficiency, stimulate innovation, develop talent and compete in the banking sector. The paper provides theoretical and practical implications for understanding and implementing AI in the banking sector, where from a practical point of view it provides significant guidance to top managers and bank owners for implementing AI in a selected business model, where the assessment of the maturity of AI implementation compared to market leaders provides recommendations, promotes transparency and trust in the implementation of AI. Ethics, data quality and transparency are key to trust, and banks that implement AI in accordance with these principles will be the ones that progress the fastest. The proposal for future research primarily relates to the analysis of potential risks and challenges of implementing AI in terms of stability and cybersecurity, which is also a limitation of this research, which is primarily oriented towards the positive aspects and the implementation of best practices of AI in the banking sector.
Keywords: Artificial Intelligence (AI); digital transformation; banking sector; innovations, protection.

1. INTRODUCTION

The The application of artificial intelligence (hereinafter referred to as AI) is one of the most current topics in modern banking. Clients in digital business conditions have increasing expectations, competition is increasingly innovative, and banks are increasingly investing in innovation-driven transformation, where the level of maturity of AI application determines the market position, which also represents an opportunity for further development of the banking industry. By using advanced technology, banks can optimize business functions and processes, reduce costs and provide better service to customers, where the application of AI becomes a key “grail” of digital transformation, changing the banking landscape with a holistic approach to the customer.

The aim of the paper is to explore and highlight the application opportunities that AI brings to the banking sector, with a focus on its application, implementation, challenges and potential benefits for stimulating innovation and competition, through the example of global leading banks in developed markets, but also the accelerated rise of AI in the banking sector of the Republic of Serbia. The key research questions in the paper relate to the role of AI applied in the banking sector; what are the key technologies for applying AI in banking; what are the key development strategies and top management decisions in implementing AI in banks; the level of maturity of AI application and which banks are the most advanced in applying AI; how AI affects bank performance with a presentation of leading global banks that are market leaders in AI implementation and how they are actively adapting their people, policies and processes, what lessons they have learned and what best practices they have adopted to accelerate innovation and increase competitiveness; as well as the accelerated rise of AI in the banking sector of the Republic of Serbia. Also, the paper should answer whether the "new" bank, which is adaptable, innovative, with a personalized/holistic approach to the client, will create a digital leader that will meet the needs of new generations and become a bank that represents a combination of technology, responsible regulation and lasting trust in times of rapid change and uncertainty.

The research methodology is based on a combination of analysis of scientific and professional literature, analysis of relevant reports of regulatory institutions, banks and consulting firms, as well as a comparative analysis of the degree of maturity of the application of artificial intelligence in the banking sector. In the first part of the research, a literature review will be conducted to identify key areas of AI application in banking, including credit scoring, risk management, fraud detection, process automation, customer support and personalization of banking services. Special attention will be paid to the challenges of AI implementation, such as regulatory requirements, data protection, ethical issues, transparency of algorithms and the need to develop employees' digital competencies. The empirical part of the paper will use the content analysis of publicly available business reports of banks, announcements of the National Bank of Serbia, strategic documents and relevant international reports on the application of AI in the financial sector. As an additional analytical framework, the Evident AI Index will be used, which measures the maturity of banks in the application of AI through four dimensions: talent, innovation, leadership and transparency. Based on this index, the practice of leading global banks will be presented, and then compared with the available data on banks in the Republic of Serbia.

2. ARTIFICIAL INTELLIGENCE IN BANKING – LITERATURE REVIEW

AI applications are a broad field of computer science that focuses on creating models capable of performing tasks that typically require human intelligence, such as natural language understanding, image recognition, decision-making, and learning from data. These tasks involve complex problem-solving and human-like decision-making, which has been a subject of interest to researchers for more than seven decades (Agrawal et al., 2019; Furman and Seamans, 2019; Brynjolfsson et al., 2021). In addition, the past few years have seen a significant increase in the practical application of AI in various industries, such as finance, healthcare, and manufacturing, thanks to advances in computing power, data storage, and low-latency, high-bandwidth communication protocols (Biallas and O'Neill, 2020). The reason for the widespread adoption of AI in sectors such as financial services is its versatility (Milana and Ashta, 2021). A survey by the Bank of England and the FCA (Financial Conduct Authority) found that 80% of banks surveyed reported using or developing machine learning and AI applications (Blake et al., 2022). The increased use of AI in banking can be partly attributed to intense competition within the sector (Kruse et al., 2019). The banking industry generates a huge and ever-growing amount of data, including daily transactions, market trends, and customer information. Such rich data can be used to control AI algorithms and create predictive models, making it an ideal domain for AI applications (Boot et al., 2021). These applications can identify patterns and predict future market trends, enabling banks to make better decisions about investments and other business operations. AI can also analyze customer behavior and preferences, offering tailored recommendations and personalized services (Zheng et al., 2019). Despite all the benefits of AI in the banking sector, industry experts and academic research suggest that financial institutions have not been able to fully exploit the potential of AI (Fabri et al., 2022). Empirical evidence on its impact on bank performance and risk also provides mixed results. This is partly due to the numerous challenges and barriers to using AI models. One of the main concerns of clients is the issue of data bias and transparency, as improper use of AI can lead to discriminatory decisions (Ashta and Herrmann, 2021).

As AI becomes increasingly popular in the banking sector, banks are facing challenges related to the explainability and interpretability of AI models, which require transparency and accountability in decision-making processes (Fabri et al., 2022). Lack of interpretability can make it difficult for banks to identify and correct errors or biases in their decision-making mechanisms using AI, resulting in legal and financial consequences. Therefore, explainability and interpretability are key factors for the responsible and ethical use of artificial intelligence in the banking sector (Fabri et al., 2022). Such challenges arising from the application of AI in banking highlight the importance of effective model governance and regulation to ensure the ethical and responsible use of AI (Ryll et al., 2020). Such measures not only increase customer trust in AI, but also help banks avoid negative consequences such as legal liability, reputational risk, and customer loss/attrition. By using AI, banks can gain a competitive advantage by introducing innovative services and improving operational efficiency (Ryll et al., 2020). However, strict regulations can impose significant burdens on bankers who want to implement AI systems, including additional costs related to data privacy, security measures, or hiring more people to monitor and maintain the technology. These costs can cause banks with limited resources to reduce their allocation to AI development, which will affect their competitiveness and find other business models through cooperation with fintech companies or M&A processes. Regulators must balance the benefits and risks of AI and ensure that appropriate safeguards are in place to mitigate negative outcomes. For example, the LSE has partnered with IBM Watson and SparkCognition to develop AI-enhanced supervisory capabilities, while FINRA is using AI to identify and prevent stock market abuse (Prove., 2021). A recent surge in publications has shed light on the various opportunities, challenges, and implications of AI in the banking industry (Bahrammirzaee, 2010; Königstorfer and Thalmann, 2020), and most empirical studies indicate a positive correlation between AI adoption and profitability, implying that banks are actively investing in AI technologies.

The banking sector has transformed at an unprecedented pace in the last 5 years. It all started as a response to surviving the pandemic, but then progressed to a complete reinvention of the way banks operate, communicate with customers and grow. The most significant changes in the period 2020-2026. according to the Bank of England in Summary of AI roundtables, 2026. are reflected in the adoption of digital banking services by all age groups and the adoption of a cloud-first strategy, where by 2023. 74% of banks followed the example of Capital One from the US market. By 2022. banks are like technology companies, where the focus is on platform thinking, applications and BaaS (banking as a service) allow third-party companies to access banking services via APIs. Notable examples of BaaS are all fintech companies like Stripe, Revolut, N26, and BBVA Open Platform, where cybersecurity has become a competitive advantage, unlike before, when it was just a compliance task, and sustainability has moved from an idea to a global implementation. 2023 has become a year of deep thinking about what customers really want and where banks have responded with hybrid user experiences. Banks have provided a way to seamlessly interact between apps, branches, or video calls with consultants, empowering their customers to practically manage their finances. In 2024, compliance has expanded from “check-the-box” activities like AML or KYC to AI ethics, data privacy, and ESG disclosure. AI in 2025 is becoming the core where generative AI powers personalized user experiences, advanced analytics, and increases operational efficiency in the banking sector. AI in 2026 shifts the focus to AI agents that act autonomously to complete tasks, optimize workflows, and guide customers through building a positive user experience.

3. KEY ADVANCED TECHNOLOGIES AND ACCELERATED APPLICATION OF ARTIFICIAL INTELLIGENCE IN THE BANKING SECTOR

The application of AI is fundamentally restructuring the DNA of the banking industry and, according to McKinsey&Company's 2024 study, Extracting value from AI in banking, is already witnessing a shift from experimental AI to operational AI, where generative AI models create content and personalize communication, and proactive agent-based AI models take on the role of executors who independently complete processes. According to Delloite's 2024 study, Changing the game. The impact of AI on the banking and capital markets sector, AI in banking refers to the use of key advanced technologies such as: machine learning, natural language processing (NLP), predictive analytics and robotic process automation (RPA). Also, according to Deloitte's 2021 study, Artificial Intelligence: Transforming the Future of Banking, the main categories of AI applications in banking, according to the areas of banking operations, are as follows: Customer Interaction (Front Office): chatbots and virtual assistants, offer personalization, biometric authentication; Risk and Security Management (Middle Office): Fraud Detection, Credit Scoring, Anti-Money Laundering (AML); Operational Efficiency (Back Office): Process Automation (RPA), Analytical Forecasting, Investment Banking, Algorithmic Trading with Split-Second Order Execution Based on Market Signals, and Robo-Advisors. The most common AI application cases in banking are as follows:

1. Fraud Detection and Anti-Money Laundering (AML) where AI analyzes transaction history, location, and behavior to detect suspicious activity in real time. According to Kellton, AI in Banking: Use Cases, Benefits, and the Future of Finance, AI/ML, 2026, JPMorgan Chase reported a 20% reduction in account validation rejection rates thanks to AI-powered payment verification that uses generative adversarial networks (GANs),

multimodal analysis (facial biometrics, keystroke patterns, mouse movements) in real time to simulate and stay ahead of sophisticated identity theft attempts. Automation of the Know Your Customer (KYC) and Anti-Money Laundering (AML) processes reduces manual labor by up to 70%, according to Kellton, AI in Banking: Use Cases, Benefits, and the Future of Finance, AI/ML, 2026.

2. Generative AI that has transformed clumsy chatbots into sophisticated virtual assistants that summarize bank statements, explain loan terms, and help customers create a budget. Modern AI uses AI agents that can autonomously perform tasks such as collecting missing loan documents or initiating background actions with a 98% success rate without human intervention, according to Kellton, AI in Banking: Use Cases, Benefits, and the Future of Finance, AI/ML, 2026.
3. Hyper-personalization - Banks today have access to vast amounts of data where AI allows them to move from segmentation (grouping people by age) to individualization. If AI notices that a customer is researching flights to Europe, the bank can immediately offer a discount on travel insurance or a credit card with no foreign transaction fees. Real-time sentiment analysis now allows banks to instantly adjust offers during live chats, resulting in a better user experience.
4. Smart Credit Scoring - Traditional credit scoring often ignores loan applicants without a credit history. AI models can analyze alternative data such as utility bill payments, rent, and even fingerprints to assess creditworthiness. This promotes financial inclusion while reducing the risk of default. According to Kellton's research, AI in Banking: Use Cases, Benefits, and the Future of Finance, AI/ML, 2026, advanced machine learning models have improved loan approval accuracy by 30%, allowing banks to safely approve loans to millions of previously underserved individuals.
5. Automated underwriting and document processing - Banks are using AI for documents to instantly extract data from tax returns in order to shorten the loan execution time. Intelligent Document Recognition (IDR) has reduced the time it takes to write and summarize documents by 50%, enabling instant lending protocols at most banks. The transition to agent-based underwriting in 2026 enables 99% code accuracy according to specifications in complex credit applications, freeing up employees to focus solely on risk negotiations, credit details, and repayment capacity, according to Kellton, AI in Banking: Use Cases, Benefits, and the Future of Finance, AI/ML, 2026.

According to the KPMG report: Alliance or obsolescence: How banks can win with an AI-driven ecosystem from 2026, 88% of financial institutions have integrated AI into at least one key business function, signaling near-full market penetration, while the global AI market in banking grew to an estimated $45.59 billion in 2026. Also, according to the same KPMG report, it is projected that the application of generative AI in the banking sector will lead to productivity improvements of up to 6% in banking operations by 2030, significantly reducing the cost-to-income ratio.

According to the 2025 E&Y Parthenon Retail and Commercial Banking Generative AI Survey, 80% of banks have implemented or gradually launched generative AI capabilities, with 61% already seeing strong impacts and 89% seeing strong impacts in the next two years; 99% of banks are familiar with agent-based AI, however only 31% have pursued implementation, and an additional 46% are interested in the technology; the identification of AI use cases is balanced between front-office, middle-office and back-office, with front-office leading the way in implementation. Also according to the same E&Y survey, banks cited data challenges as the biggest barrier to successful implementation, while 22% of banks had concerns about data privacy, and an additional 21% had limited access to high-quality data.

By moving from reactive to proactive AI services and their applications in banking, banks are insulating themselves from market volatility and setting new global standards for transparency and speed. According to the E&Y, Parthenon Retail and Commercial Banking Generative AI banking 2025 study, the main benefits of implementing AI are reflected in: operational efficiency and cost reduction, 24/7 availability, improved risk management and improved employee productivity, where AI becomes the so-called "co-pilot" for bank managers, providing real-time insights and suggesting the "next best action" during meetings with clients. This synergy of humans and AI saves time, allowing bankers to focus on building deeper, more empathetic relationships that machines cannot replace.

4. DEVELOPMENT STRATEGIES, IMPLEMENTATION AND RISKS OF ARTIFICIAL INTELLIGENCE IN BANKING

Successful Successful AI is impossible without a thoughtful, leadership-backed strategic framework that prioritizes quality over quantity. The main challenge for bankers is well-known: translating bold strategies into measurable progress. According to a 2024 study by Buehler et al. for McKinsey & Company, banks must make seven key decisions to successfully scale GenAI, including choosing an operating model, data architecture, talent management, and establishing security controls. A focus on prioritizing use cases, scaling strategy, and business case is essential to moving from pilots to full implementation. According to Buehler et al., 2024, the key decisions are:

- Strategy and Vision – defining the genAI development strategy at the organization-wide or specific business unit level.
- Domains and Use Cases – deciding who defines the organization's business domains for genAI deployment and the specific use cases within those domains.
- Implementation model – decide whether to procure targeted solutions from vendors, design or integrate broader, more comprehensive solutions, or develop in-house solutions.
- Funding – banks typically fund use cases through a combination of individual business units and a central team dedicated to building a foundation for gen AI development.
- Talent – define the skills required for successful gen AI implementation, and secure the necessary talent through hiring, training, outsourcing, or a combination of these strategies.
- Risk – determine who defines risk protection measures (e.g., data privacy, intellectual property infringement) and risk mitigation strategies.
- Change Management – form a team to lead the change management process to ensure the necessary changes in mindset and behavior, in order to successfully adopt genVI throughout the organization.

To choose the operating model that works best, banks need to set clear expectations for AI implementation and build flexibility into the model so that it can adapt and improve over time, both in terms of organization and funding due to the impact on banking performance. On this path, banks face several critical challenges, according to the Caplan Artificial AI strategy for banks in Bosnia and Herzegovina, Serbia and Croatia Guide to digital transformation from 2026, such as: talent shortages and competition from IT companies, integrating AI with existing banking systems that are often decades old, data quality, employee fear of job loss and resistance to change, and protecting AI models from attacks and manipulation. Also, according to the Caplan Artificial AI strategy for banks in Bosnia and Herzegovina, Serbia and Croatia Guide to digital transformation from 2026, successful implementation of AI in banking requires a systemic approach that includes the following phases: strategic assessments and goal definition, pilot and proof-of-concept phase; scaling and integration; and the optimization and continuous learning phase. The key success factors of an AI strategy according to Caplan Artificial AI strategy for banks in Bosnia and Herzegovina, Serbia and Croatia Guide to digital transformation, 2026 are: leadership support, where AI is a strategic priority and not an IT project; a culture of innovation where experimentation is allowed and mistakes are treated as an opportunity for learning; cooperation with local AI experts who understand the specifics of the banking market and a focus on data management as the foundation of successful AI implementation.

The main obstacles, or risks, that arise on the path to AI implementation in the banking industry, according to the Kellton research: AI in Banking. Use Cases, Benefits, and the Future of Finance, AI/ML from 2026 are: outdated systems and data silos; the problem of the "black box", explainability and transparency; the evolution of data privacy and cybersecurity; the talent gap and cultural resistance. Banks are investing heavily in privacy-enhancing technologies to process data without revealing individual identities, as well as in retraining, reassigning employees from manual tasks to monitoring and refining AI-driven workflows. Successfully overcoming these obstacles requires a delicate balance between aggressive digital expansion and the conservative principles of traditional financial stability, where banks must manage risks, human capital, and digital trust.

According to the Kellton study: AI in Banking. Use Cases, Benefits, and the Future of Finance, AI/ML from 2026 in the coming period AI will move from backend tools to digital interfaces, where over 90% of financial functions will use autonomous agents for the end-to-end user experience. It also highlights the development of the so-called invisible banking, the rise of agent-based financial advisors, collaboration between humans and AI (CoBots) where the branch of the future will have CoBots that help employees create sales opportunities and focus entirely on the emotional needs of customers.

5. DEGREE OF MATURITY OF ARTIFICIAL INTELLIGENCE ADOPTION IN DEVELOPED BANKING SYSTEMS AND RESEARCH RESULTS

The In order to determine the degree of maturity of adoption of AI in developed banking systems, and for the needs of the empirical part of the work, the Evident AI Index will be used as an additional analytical framework. According to the Evident Insights report, The Evident AI Index Key Findings Report: The global standard benchmark from the year 2025, the Evident AI Index is a global standard indicator of the degree of maturity of the application of AI in developed banking markets and is of great importance to both banks, investors and financial advisors for measuring performance and monitoring progress over time in order to improve in areas where it is needed; but also identifying best practices, informed strategic decision-making, promoting transparency and responsibility, as well as encouraging competition and innovation.

The Evident AI Index was launched in 2023 as the most comprehensive and reliable indicator of its kind, which analyzes the world's 50 largest banks across North America, Europe and the Asia-Pacific region. According to Evident

Insights 2025, the Evident AI Index evaluates 50 banks based on over 100 individual indicators categorized into four pillars: talent, innovation, leadership, and transparency. Based on this index, the practices of leading global banks for 2025 will be presented, and then compared with available data on banks in the Republic of Serbia in the next chapter. According to Evident Insights, The Evident AI Index Key Findings Report: The global standard benchmark from 2025, measures the maturity of AI implementation in banking across four dimensions:

1. Talent – analyzes the bank's ability to attract, retain, and develop AI experts, including an assessment of the size and structure of AI teams. This pillar includes an analysis of over 200 jobs in five core competency areas: AI development, data engineering, AI model risk, AI software implementation, and AI product management.

2. Innovation – measures the bank's ability to generate new AI ideas and applications, tracking patent activity, research and business implementation, as well as investments and acquisitions focused on partnerships, as well as engagement with the open ecosystem.

3. Leadership – a pillar that assesses the commitment and vision of the bank's leaders in developing AI applications, where the leadership team's focus is on AI applications through development strategy, communication, executive team composition, team leader positioning and external engagement in monitoring areas related to AI applications.

4. Transparency - a pillar that examines the extent to which banks focus on the implementation of responsible AI, as evidenced by the formation of special teams within the bank for the responsible implementation of AI, the publication of ethical principles and codes of conduct, as well as internal acts and initiatives on responsible AI, all with the aim of making use cases explainable, auditable and reliable, thereby reducing regulatory and reputational risk, while strengthening the trust of clients and investors.

The Evident AI Index is calculated using a weighted scoring system, where each pillar contributes a certain percentage to the overall result, and according to the Evident Insights report from 2025, the weights are as follows: talent - 45%; innovation – 30%, leadership – 15% and transparency – 10%.

Table number 1 shows the ranking of the first ten banks according to the value of the Evident AI Index for the year 2025:

Table 1: Evident AI Index Rankings – The first ten banks

Bank	Rank +/- YoY change 2025 vs 2024		TALENT		INNOVATION		LEADERSHIP		TRANSPARENCY	
JPMorganChase (SAD)	1	-	2	-	1	-	1	+2	1	-
Capital One (SAD)	2	-	1	-	2	+1	20	-6	17	-3
Royal Bank of Canada	3	-	12	-6	3	-1	3	+5	3	+7
CommBank (Australija)	4	+1	4	+3	13	-1	4	-2	2	+3
Morgan Stanley (SAD)	5	+5	13	+5	4	-	9	+8	21	+21
Wells Fargo (SAD)	6	-2	6	-2	5	-	40	-4	14	-6
UBS (Švajcarska)	7	-1	3	-	25	-7	7	+8	4	+11
HSBC (UK)	8	-1	14	+1	8	+1	15	-10	6	-3
Goldman Sachs (SAD)	9	+2	7	+6	9	-3	18	+9	23	+14
Bank of America (SAD)	10	+5	10	+1	7	+4	12	+6	24	-4

Source: Evident AI Index Banks: Key Findings Report, Evident Insights 2025.

Analyzing the 2025 Evident Insights report, key findings include:

- the dominance of North American banks where US and Canadian banks continue to lead the list, holding 7 of the top 10 spots globally. JP Morgan Chase is the leader, as the only bank in the top 3 in all three pillars, where the two undisputed leaders JPMorgan Chase and Capital One have convincingly defended their positions 1 and 2 compared to 2024, as well as Royal Bank of Canada;
- another five banks CommBank, Morgan Stanley, Wells Fargo, UBS and HSBC have maintained their status among the top 10, of which Morgan Stanley has achieved a significant jump of +5 points compared to the previous year;
- the explosion of AI talent (where one in 50 employees at large banks works in data and AI-related positions);
- the rise of generative AI (where 85% of solutions are focused on internal use and employee assistance);
- the connection to financial results (strong correlation between AI maturity and operational efficiency where around 60% of banks have reduced the cost-to-income ratio);

- increasing transparency (application of responsible AI and transparent reporting by banks on specific outcomes of AI projects).

Also, according to the Evident Insights report from 2025, the demand for AI Product Managers and AI ethics experts has drastically increased in the Talent pillar, where leaders like JPMorgan Chase and Capital One are not only hiring, but implementing massive "AI literacy" programs for all employees. In the second pillar of innovation, banks such as Royal Bank of Canada and JPMorgan are publishing scientific papers on par with tech giants (Google, Meta) where the focus is on partnerships with AI startups and universities. In the third pillar of Leadership & Strategy, AI strategy comes directly from the executive board chair and board of directors where leaders treat AI as a long-term investment, not a short-term expense. Banks that quickly make decisions on the implementation of new models such as generative AI jumped the most in the ranking, such as the example of the Morgan Stanley bank. In the pillar Transparency/Responsible AI, as part of the Governance pillar, which has become crucial due to regulations such as the EU AI Act, a growing number of banks are publicly documenting how their AI models make decisions, for example when approving loans, in order to avoid bias. Also, banks are beginning to publicly communicate how much AI has saved them money or increased revenue, which was not the case before, while in the area of cyber security, transparency about the risks of applying AI models has become a standard for banks that want to keep their clients' trust.

According to the above, we can also conclude that the difference between the winners and the rest is that the leaders integrate all four pillars, that is, they use talents to push innovation, with strong leadership support and complete transparency towards regulators. Bank leaders in the application of AI are actively adapting employees, policies and business processes, while at the same time responsible application of AI in order to increase efficiency, improve the decision-making process and encourage innovation in the banking sector.

6. APPLICATION OF ARTIFICIAL INTELLIGENCE IN THE BANKING SECTOR OF THE REPUBLIC OF SERBIA AND RESEARCH RESULTS

The banking sector in the Republic of Serbia is making significant progress in adopting AI technology. Although considered a traditional industry, it has bravely and quickly embraced all the challenges brought by the development of advanced technology and digital transformation, which is not just a technological change, but represents a fundamental change in the way our banks understand and serve their clients. Currently, 19 banks, seven payment institutions, six electronic money institutions, two virtual currency service providers, 16 financial leasing providers, 4 voluntary pension fund management companies, 7 voluntary pension funds, 16 joint-stock insurance companies, 4 joint-stock reinsurance companies, as well as fintech companies, which closely cooperate with these financial service providers, operate in the financial market of the Republic of Serbia.

According to the announcement of the NBS on the results of work in 2025, applications in the financial sector include: blockchain technology/DLT, AI, machine learning, cloud, Big data. In the Republic of Serbia, ten banks are already using AI, while five banks are planning to start implementing it. Six banks, in addition to the existing application, plan to improve the application of AI in their business processes. AI is most often applied in banks in Serbia in the following areas: Predictive Analytics (seven banks), Robotic Process Automation (six banks), Machine Learning (four banks) and Real time Analytics (three banks). The National Bank of Serbia uses AI through advanced supervision SupTech, Supervisory Technology and through the modernization of RegTech payment systems, ensuring the stability and security of the domestic financial market. According to the announcement of the NBS from the portal business side regarding the use of AI in its work from 2024, the NBS uses Predictive Analytics and Machine Learning for the purposes of the early warning system, which predicts the probability of a problematic situation in banks using machine learning techniques (self-organizing maps and logistic regression Lasso). With this, the NBS monitors the riskiness of banks from the aspect of the probability of a problematic situation. Within the IPS system there is a fraud management module, which provides a fraud detection mechanism. Machine Learning NBS uses for assessments of the macroeconomic environment for scenario validation during stress-testing of the banking sector, but also as an additional tool when projecting a reference indicator for evaluating the countercyclical protective layer of capital. Real time Analytics, Video/Image Analytics, Robotic Process Automation as tools also play a role in the monitoring of certain processes, in preparation for printing and image processing, as well as in the automation of production processes. Also, starting in 2022, the NBS uses a model that allows inflation to be monitored in real time. the so-called web scraping.
According to the Caplan Artificial AI strategy for banks in Bosnia and Herzegovina, Serbia and Croatia Guide to digital transformation from 2025, key AI initiatives in the Serbian banking sector include: advanced algorithms for credit scoring based on alternative data sources; real-time fraud detection systems that analyze transactions in milliseconds; personalized financial recommendations through AI analysis of consumer habits and voice banking solutions in the Serbian language. Also according to the same source Caplan 2025, key areas of application of AI in our banks are: a revolution in customer support through AI chatbots and the ability to resolve up to 80% of standard queries without human intervention; advanced risk analysis and credit scoring; real-time detection of fraud that deviates from typical customer behavior, geographical anomalies in transactions, speed and frequency of transactions, correlations between

different computers and users, personalization of banking services. In accordance with the 2025 NBS announcement, the regulator requires our banks to provide detailed documentation of AI risk management models, a mandatory audit of algorithms used for credit scoring, and preparation for compliance with the future AI law that is currently being drafted.

In the announcement on the results of the work in 2025, the NBS did not list the names of banks that apply AI in their operations, and this paper presents publicly available data that could be obtained by searching bank websites, other public sources, and business reports of our banks. Available data indicate that these include large systemically important banks, such as Raiffeisen Bank, Banca Intesa, OTP, Aikbank, NLB Komercijalna Banka, Unicredit Banka.

Raiffeisen Bank was named the best digital bank in Serbia in 2025 by Global Finance magazine for the past 8 years, representing the main driver of the transformation and introduction of AI in the Serbian banking sector. Based on publicly available data from the Raiffeisen Bank website, the strategic approach is reflected in the importance of digital transformation by the bank's board, a focus on data as a new fuel in modern environmental conditions, and investments in the education of existing employees. The implementation of AI in Raiffeisen Bank refers to advanced models for predicting credit risk, personalization of offers in real time through a mobile application, a voice banking assistant in the Serbian language, the so-called REA, as the first conversational bot on the market. The focus is also on automating document processing, faster access to knowledge, as well as supporting operations. The goal is for AI to be present in everyday activities for both users and employees, and to bring measurable benefits, whether through saving time, increasing accuracy, or better interaction with clients.

Intesa Bank, based on the source of publicly available information from the bank's website, has a special laboratory for AI that works within the Innovation Center, and deals with the development of practical solutions and theoretical research based on a comprehensive knowledge base about the specific requirements and limitations of the business and financial sector. It applies a rigorous scientific method to identify problems and find solutions using models to protect financial portfolios from significant and adverse market movements. Using AI, the team can analyze in seconds the most comprehensive set of risk factors, which used to take weeks. The laboratory is a partner of the Institute for Scientific Exchange (ISI), a research institution in Turin. Through the application of AI, Intesa Bank helps ISI to stimulate research while developing practical solutions that can be applied in modern business.

OTP Bank, based on sources of publicly available information from the bank's website, actively applies AI through strategic partnerships, internal innovations and the development of digital services, and in its application always points out that AI transforms banking, but trust and people (employees and clients) remain its essence. Within the bank, it has a Directorate for Data Management, AI and Innovation, and is becoming a bank that is proactive in applying AI. One of the most visible examples of the application of AI in the bank are chatbots and virtual assistants. The OTI assistant already today answers customers' frequently asked questions, relieves employees and allows them to focus on more complex tasks. In parallel, it has an internal AI assistant, a tool that helps employees find key information faster in a sea of documents. Ethics, transparency and data protection come first. The ambition is not just for the bank to introduce AI, but to do it thoughtfully and responsibly, so that the client always knows that his data is safe. OTP in cooperation with the company SambaNovaSystems is creating the fastest AI supercomputer in Europe, while Global Finance included the OTP Group Innovation Center OTP LAB among the best financial innovation laboratories in the world for the sixth consecutive year.

AIK bank as a domestic bank is focused on a revolution based on the application of AI where powerful mathematical models work in the back office and already bring enormous value in fraud detection, credit score and customer relationship management. Based on the available information from the bank's website, as well as AIK Bank, since 2026 it has been using an integrated approach in order to provide personalized solutions and an efficient user experience. It also uses chatbots, biz assistants and speech models in communication with clients. The next step is the application of AI agents that not only analyze data but also perform complex tasks.

7. CONCLUDING REMARKS

AI has the power to revolutionize financial services by unlocking new levels of efficiency, hyper-personalization, predictive insights, fraud detection, and real-time decision-making. Banks that use AI wisely can position themselves as industry leaders, delivering faster, smarter, and more personalized services to customers while optimizing business processes. The key to implementing AI lies in the smart use of technology, compliance with regulatory requirements, and ethical principles in data management, where AI is used to increase efficiency, productivity, and drive innovation in the banking sector.

The paper provides theoretical and practical implications for understanding and implementing AI in the banking sector, provides important guidelines for top managers and bank owners to measure success and monitor progress in implementing AI, allowing banks to assess their maturity compared to their competitors, identify areas where they are successful and areas where improvements are needed. It also provides examples of best practices from successful global

banks in implementing AI, in order to make decisions about their own development strategies and investments in AI, promotes transparency, responsible AI implementation and trust in the use of AI in the banking sector.

Banks are already transforming from traditional institutions that provide stability and which clients trust to technology companies, which do not lose their traditional role but strengthen it with innovations and new advanced technologies. Virtual assistants, predictive analytics and personalized offers are clear indicators of this transformation. And what awaits us in the future? In the coming years, AI will not change the essence of banking, which is trust, but it will change the way it is built on a daily basis. This means that the future of banking is not in universal solutions, but in a unique experience tailored to each client, where the application of AI plays a major role.

The proposal for future research primarily relates to the application of proactive agent AI, as well as to the stability and security reflected in exposure to various types of non-financial risks, especially in the area of cybersecurity threats, where the bank of the future will represent a combination of technology, responsible regulation and lasting trust in times of rapid change, uncertainty and the need for resilience. Ethics, data quality and transparency are the key to trust, and banks that implement AI in accordance with these principles will be the ones that progress faster.

REFERENCES

Agrawal, A., Gans, J.S., Goldfarb, A. (2019). Artificial Intelligence. The Ambiguous Labor Market Impact of Automating Prediction. Journal of Economic Perspectives 33, 31–50. Retrieved March 20, 2026, from https://doi.org/10.1257/jep.33.2.31

Ashta, A., Herrmann, H. (2021). Artificial intelligence and fintech. An overview of opportunities and risks for banking, investments, and microfinance. Strategic Change 30, 211–222. Retrieved March 20, 2026, from https://doi.org/10.1002/jsc.2404

Bahrammirzaee, A. (2010). A comparative survey of artificial intelligence applications in finance artificial neural networks, expert system and hybrid intelligent systems. Neural Comput & Applic 19, 1165–1195. Retrieved from https://doi.org/10.1007/s00521-010-0362-z

Biallas, M., O'Neill, F. (2020). Artificial Intelligence Innovation in Financial Services. Retrieved March 25, 2026, from https://doi.org/10.1596/34305

Boot, A., Hoffmann, P., Laeven, L., Ratnovski, L. (2021). Fintech: what's old, what's new?. Journal of Financial Stability 53, 100836. Retrieved March 20, 2026, from https://doi.org/10.1016/j.jfs.2020.100836

Blake, K., Gharbawi, M., Thew, O., Visavadia, S., Gosland, L., Mueller, H. (2022). Machine learning in UK financial services. Retrieved March 26, 2026, from

https://www.bankofengland.co.uk/report/2022/machine-learning-in-uk-financial-services

Brynjolfsson, E., Rock, D., Syverson, C. (2021). The Productivity J-Curve: How Intangibles Complement General Purpose Technologies. American Economic Journal: Macroeconomics 13, 333–372. Retrieved March 27, 2026, from https://doi.org/10.1257/mac.20180386

Buehler, K., Corsi, A., Jurisic, M., Lerner, L., Siani, A., & Weintraub, B. (2024). Scaling gen AI in banking. Choosing the best operating model. McKinsey & Company. Retrieved March 29, 2026, from

https://www.mckinsey.com/industries/financial-services/our-insights/scaling-gen-ai-in-banking-choosing-the-best-operating-model

Caplan Artificial, (2025). AI strategy for banks in Bosnia and Herzegovina, Serbia and Croatia Guide to digital transformation. Retrieved March 27, 2026, from https://caplan.ai/ai-strategija-za-banke-u-bih-srbiji-i-hrvatskoj-vodic-za-digitalnu-transformaciju/

Evident Insights (2025). The Evident AI Index Key Findings Report: The global standard benchmark

of AI maturity. Evident Insights. Retrieved March 20, 2026, from https://evidentinsights.com/ai-index/

Furman, J., Seamans, R. (2019). AI and the Economy. Innovation Policy and the Economy 19, 161–191. Retrieved March 21, 2026, from https://doi.org/10.1086/699936

Fabri, L., Wenninger, S., Kaymakci, C., Beck, S., Klos, T., Wetzstein, S. (2022). Potentials and Challenges of Artificial Intelligence in Financial Technologies. MCIS 2022 Proceedings. 14.

Kruse, L., Wunderlich, N., Beck, R. (2019). Artificial Intelligence for the Financial Services Industry. What Challenges Organizations to Succeed

Königstorfer, F., Thalmann, S. (2020). Applications of Artificial Intelligence in commercial banks – A research agenda for behavioral finance. Journal of Behavioral and Experimental 42. Finance 27, 100352. Retrieved March 23, 2006, from https://doi.org/10.1016/j.jbef.2020.100352

Milana, C., Ashta, A. (2021). Artificial intelligence techniques in finance and financial markets: A survey of the literature. Strategic Change 30, 189–209. Retrieved April 02, 2026,

from https://doi.org/10.1002/jsc.2403

Prove. (2021). How Banks & Regulators Are Applying Machine Learning. Retrieved March 25, 2026, from https://www.prove.com/blog/how-banks-regulators-are-applying-machine-learning

Ryll, L., Barton, M.E., Zhang, B.Z., McWaters, R.J., Schizas, E., Hao, R., Bear, K., Preziuso, M., Seger, E., Wardrop, R., Rau, P.R., Debata, P., Rowan, P., Adams, N., Gray, M., Yerolemou, N., (2020). Transforming Paradigms: A Global AI in Financial Services Survey. https://doi.org/10.2139/ssrn.3532038

Zheng, X., Zhu, M., Li, Q., Chen, C., Tan, Y., (2019). FinBrain. When finance meets AI 2.0. Frontiers Inf Technol Electronic Eng 20, 914–924. 50. from https://doi.org/10.1631/FITEE.1700822

Bank of England, UK (2026). Summary of AI roundtables. Retrieved March 26, from https://www.bankofengland.co.uk/minutes/2026/february/summary-of-ai-roundtables-feb-2026

Deloitte (2021). Artificial Intelligence. Transforming the future of banking. Retrieved April 3, 2026, from https://www.deloitte.com/us/en/services/consulting/articles/ai-in-banking.html

Deloitte (2024). Changing the game. The impact of AI on the banking and capital markets sector. Retrieved April 3, 2026, from https://www.deloitte.com/lu/en/Industries/financial-services/perspectives/changing-the-game.html

Kellton (2026). AI in Banking. Use Cases, Benefits, and the Future of Finance, AI/ML. Retrieved March 30, 2026, from https://www.kellton.com/kellton-tech-blog/ai-in-banking-use-cases-benefits-future-of-finance

KPMG, (2026). Alliance or obsolescence. How banks can win with an AI-driven ecosystem. Retrieved April 3, 2026, from https://assets.kpmg.com/content/dam/kpmgsites/ie/pdf/insights/banking/ie-banks-ai.pdf.coredownload.inline.pdf

Kher P., Gupta S., Trull Z. (2025). Parthenon Retail and Commercial Banking Generative AI Survey. Ernest & Young. Retrieved March 31, 2026, from https://www.ey.com/en_us/insights/banking-capital-markets/ai-in-banking-ey-parthenon-genai-survey-insights;https://www.ey.com/content/dam/ey-unified-site/ey-com/en-us/insights/banking-capital-markets/documents/ey-gen-ai-in-retail-and-commercial-banking.pdf

McKinsey & Company (2024). Extracting value from AI in banking: Rewiring the enterprise. Retrieved April 3, 2026, from https://www.mckinsey.com/industries/financial-services/our-insights/extracting-value-from-ai-in-banking-rewiring-the-enterprise

NBS (2024). Portal business side - questions related to the use of artificial intelligence in the work of the NBS. Retrieved April 3, 2026, from https://www.nbs.rs/sr/scripts/showcontent/index.html?id=19693&konverzija=no

NBS (2026). Announcement on the results of the work of the National Bank of Serbia in 2025. Retrieved April 3, 2026, from https://www.nbs.rs/sr_RS/scripts/showcontent/index.html?id=21134

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ENVIRONMENTAL MANAGEMENT ACCOUNTING AS A RISK MANAGEMENT TOOL IN TIMES OF GLOBAL INSTABILITY

Abstract: Global instability, characterized by climate change pressures, geopolitical tensions, energy market volatility, supply chain disruptions, and regulatory uncertainty, has significantly reshaped the contemporary business environment. In such conditions, organizations face increasing environmental and financial risks that require more sophisticated management tools and decision-support systems. Environmental Management Accounting (EMA) has emerged as a relevant mechanism for identifying, measuring, and managing environmental costs and risks within unstable economic contexts.
This paper examines the role of EMA as a risk management instrument in times of global instability. Drawing on the theoretical foundations of management accounting and sustainability governance, the study analyzes how EMA tools—such as environmental cost allocation, material flow cost accounting, and eco-efficiency indicators—support risk identification, enhance resource efficiency, and improve strategic decision-making under uncertainty. The analysis argues that EMA contributes to organizational resilience by reducing information asymmetry related to environmental exposures, increasing transparency in cost structures, and strengthening long-term economic sustainability.
By positioning Environmental Management Accounting within the broader debate on global instability and business environment resilience, the paper contributes to the understanding of how accounting practices can mitigate systemic risks and support sustainable value creation in volatile global conditions.
Keywords: environmental management accounting, risk management, global instability

1. INTRODUCTION

Global instability has become a defining feature of the contemporary economic landscape, driven by climate change, geopolitical tensions, energy market volatility, supply chain disruptions, and increasing regulatory pressures (World Economic Forum, 2024; United Nations Environment Programme, 2022). These developments have significantly affected the business environment, created new forms of uncertainty and exposed organizations to complex environmental and financial risks. In such conditions, traditional management approaches are often insufficient to support effective decision-making and long-term sustainability (Bhimani et al, 2021; Garrison et al, 2020).
In response to these challenges, increasing attention has been directed toward the role of accounting systems in managing uncertainty and supporting organizational resilience. Environmental Management Accounting (EMA), as a specialized branch of management accounting, provides tools for identifying, measuring, and analyzing environmental costs and resource flows (Schaltegger et al, 2013; United Nations Division for Sustainable Development, 2001). Despite its recognized importance in supporting sustainable decision-making, the role of EMA in the context of global instability remains insufficiently explored in the existing literature.
This paper addresses this gap by examining Environmental Management Accounting as a risk management tool in times of global instability. The study focuses on the ability of EMA to support organizations in identifying environmental risk

exposures, improving resource efficiency, and enhancing strategic decision-making under conditions of uncertainty (Medved & Jovanović, 2020). By integrating insights from management accounting and sustainability governance, the paper aims to contribute to a better understanding of the role of accounting practices in stabilizing business operations in volatile global environments (Bhimani et al, 2021; Garrison et al, 2020; Horngren et al, 2018; Weygandt et al, 2020).
The remainder of the paper is structured as follows. The next section outlines the nature of environmental risks in the context of global instability. This is followed by an overview of key Environmental Management Accounting tools and their relevance for risk management. The final sections discuss the implications of EMA for organizational resilience and conclude with key insights and recommendations.

2. ENVIRONMENTAL RISKS IN THE CONTEXT OF GLOBAL INSTABILITY

Global instability has significantly intensified the scale and complexity of environmental risks faced by organizations. Climate change, energy market volatility, geopolitical tensions, and disruptions in global supply chains have contributed to increased uncertainty in both operational and strategic decision-making. These risks are no longer peripheral but have become central determinants of organizational performance and long-term sustainability.
Environmental risks can be broadly classified into physical and transition risks, in line with the TCFD framework (TCFD, 2017: 5-6). Transition risks include regulatory, market, technological, and reputational dimensions (EC, 2020; UNEP, 2022).

1. Physical risks arise from the direct impacts of climate change and environmental degradation on economic activities and organizational operations. These risks can be further divided into acute and chronic risks. Acute physical risks are associated with extreme weather events, such as floods, storms, heatwaves, and wildfires, which can cause immediate disruptions to production processes, infrastructure, and supply chains. Chronic physical risks, on the other hand, relate to long-term environmental changes, including rising temperatures, sea-level rise, and increasing resource scarcity, which gradually affect asset values, operational efficiency, and long-term planning. In the context of global instability, physical risks represent a direct source of operational vulnerability, as they can lead to unexpected costs, interruptions in production, and reduced reliability of resource supply.
2. Transition risks emerge from the process of adjusting to a low-carbon and more sustainable economy. These risks reflect changes in regulatory frameworks, market conditions, technological developments, and societal expectations, all of which can significantly affect organizational performance and strategic positioning.
    a) Policy and legal (regulatory) risks - These risks arise from the introduction of new environmental policies, regulations, and legal requirements aimed at mitigating climate change and promoting sustainability. Examples include carbon pricing mechanisms, emissions limits, environmental taxes, and mandatory sustainability reporting standards. Such measures may increase compliance costs, require operational adjustments, and expose organizations to potential legal liabilities.

    b) Market risks - Market risks result from changes in supply and demand dynamics driven by evolving consumer preferences, investor expectations, and stakeholder pressures toward environmentally responsible products and services. Organizations that fail to adapt may face declining demand, loss of competitiveness, or reduced access to capital (Dasinapa, 2024; Krstić et al, 2024).

    c) Technological risks - Technological risks are associated with the development and adoption of new, more sustainable technologies. While such innovations can create opportunities, they may also render existing processes, assets, or business models obsolete, requiring significant investment and strategic adaptation (Latan et al, 2018).

    d) Reputational risks - Reputational risks arise from changing public and stakeholder perceptions regarding environmental responsibility. Organizations that are perceived as environmentally unsustainable may experience damage to their brand, reduced customer trust, and increased scrutiny from regulators and investors.

These categories of environmental risks highlight the need for accounting systems capable of capturing both physical and transition-related exposures, which further emphasizes the relevance of Environmental Management Accounting in supporting risk identification and decision-making. Traditional accounting systems, primarily focused on financial performance, often fail to capture the full scope of environmental risks and their economic implications (Bhimani et al, 2021; Horngren et al, 2018; Weygandt et al, 2020). This limitation creates information gaps that can undermine effective risk management and strategic planning. Consequently, there is an increasing need for accounting frameworks capable of incorporating environmental cost information and supporting decision-making under conditions of heightened uncertainty. In this context, Environmental Management Accounting emerges as a relevant tool for addressing these challenges. Management accountants have devoted substantial academic and empirical research efforts

for more than two decades to the development of contemporary cost accounting systems, appropriate cost and production management models, as well as to the advancement of new and the improvement of existing techniques and tools for environmentally oriented business decision-making (Medved & Jovanović, 2020).

3. ENVIRONMENTAL MANAGEMENT ACCOUNTING: CONCEPT AND TOOLS

Environmental Management Accounting (EMA) has emerged as an important extension of traditional management accounting, aimed at integrating environmental considerations into organizational decision-making processes. Unlike conventional accounting systems, which primarily focus on financial outcomes, EMA incorporates both physical and monetary information related to environmental impacts, resource use, and associated costs. This dual perspective enables organizations to better understand the relationship between environmental performance and economic results.

EMA is grounded in the recognition that many environmental costs remain hidden within overhead accounts and are therefore inadequately addressed in decision-making processes. By systematically identifying and allocating environmental costs, EMA enhances cost transparency and supports more informed managerial decisions. In this sense, EMA contributes not only to environmental performance but also to improved economic efficiency and long-term sustainability (Schaltegger, 2018; Fousteris et al, 2018; Jasch, 2003).

A key feature of EMA is the use of specific tools and techniques designed to capture environmental information (Burritt et al, 2023). Among the most prominent are environmental cost accounting, material flow cost accounting (MFCA), and eco-efficiency indicators. Environmental cost accounting focuses on identifying, measuring, and allocating costs related to environmental protection, waste management, and resource consumption. MFCA provides a detailed analysis of material and energy flows within production processes, highlighting inefficiencies and potential cost savings (IFAC, 2021; ISO 14051, 2021; ISO 14031, 2021; IFRS S1, IFRS S2, 2023). Eco-efficiency indicators link environmental performance with economic outcomes, enabling organizations to evaluate the efficiency of resource use in relation to value creation (Christ & Burritt, 2015). The key Environmental Management Accounting tools and their relevance for risk management are summarized in Table 1.

Table 1: Key Environmental Management Accounting Tools and Their Role in Risk Management

EMA Tool	Main Focus	Type of Information	Role in Risk Management
Environmental Cost Accounting	Identification and allocation of environmental costs	Monetary	Improves cost transparency and identifies environmental cost drivers
Material Flow Cost Accounting (MFCA)	Analysis of material and energy flows	Physical & Monetary	Detects inefficiencies and reduces resource-related risks
Eco-efficiency Indicators	Relationship between environmental and economic performance	Combined indicators	Supports performance evaluation and sustainable decision-making

Source: Author's elaboration based on Burritt et al (2002), Schaltegger et al (2013), and UNDSD (2001).

As shown in Table 1, EMA tools provide both physical and monetary information that enhances the identification of environmental risks and supports more informed decision-making under conditions of uncertainty.

In the context of global instability, the relevance of EMA tools becomes particularly evident. Increased volatility in energy prices, disruptions in resource availability, and tightening environmental regulations require organizations to adopt more flexible and responsive management systems. EMA supports this need by providing timely and relevant information that can be used to assess environmental risks, optimize resource allocation, and support strategic decision-making under uncertainty.

Furthermore, EMA contributes to enhancing transparency and accountability within organizations, aligning internal management processes with external sustainability expectations. This is particularly important in an environment where investors, regulators, and other stakeholders increasingly demand reliable information on environmental performance and risk exposure. By bridging the gap between environmental and financial information, EMA strengthens the informational basis for both internal and external decision-making.

4. ENVIRONMENTAL MANAGEMENT ACCOUNTING AS A RISK MANAGEMENT MECHANISM

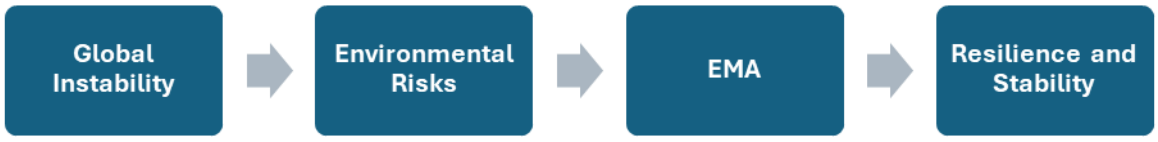
The broader framework for managing climate-related risks is reflected in the TCFD recommendations, which emphasize governance, strategy, risk management, and metrics and targets as core elements of organizational response to climate-related challenges (TCFD, 2017), as it's shown in Picture 1. Within this framework, Environmental Management Accounting can be positioned as an important internal tool that supports risk identification, measurement, and decision-making processes.

In conditions of global instability, organizations are increasingly exposed to complex and interrelated environmental risks that directly affect cost structures, operational stability, and long-term strategic positioning. These risks, driven by energy price volatility, resource scarcity, regulatory uncertainty, and climate-related disruptions, require more advanced and integrated approaches to management and decision-making. In this context, Environmental Management Accounting (EMA) can be understood as a relevant mechanism for risk identification, assessment, and mitigation.



Picture 1: Core Elements of Recommended Climate-related Financial Disclosures
Source: TCFD, Final Report, 2017, p. iv

EMA contributes to risk management primarily through improved transparency of environmental cost structures. By identifying and allocating costs related to resource consumption, emissions, and waste, organizations gain a clearer understanding of their exposure to environmental risks. This enhanced visibility enables more accurate cost forecasting and supports proactive responses to changes in external conditions, such as fluctuations in energy prices or the introduction of new environmental regulations.
Furthermore, EMA supports the identification of inefficiencies within production and operational processes. Tools such as material flow cost accounting (MFCA) allow organizations to detect losses associated with inefficient resource use, thereby reducing both environmental impact and financial risk. In times of instability, such insights are particularly valuable, as they enable organizations to optimize resource allocation and maintain operational continuity despite external disruptions.
Picture 2 illustrates the conceptual framework linking global instability, environmental risks, and the role of Environmental Management Accounting (EMA) as a mechanism for risk mitigation and organizational resilience.



Picture 2: Conceptual Framework: Environmental Management Accounting as a Risk Management Mechanism under Global Instability
Source: Author's conceptualization based on the literature.

EMA also plays a significant role in supporting strategic decision-making under uncertainty. By integrating environmental and financial information, it provides a more comprehensive basis for evaluating investment options, including those related to energy efficiency, cleaner technologies, and sustainable production processes. This integration enhances the organization's capacity to respond to emerging risks while simultaneously identifying opportunities for cost savings and value creation (Mukwarami et al, 2023).
EMA contributes to strengthening organizational accountability and transparency, which are essential for maintaining stakeholder trust in volatile environments. Reliable information on environmental costs and risks supports communication with investors, regulators, and other stakeholders, thereby reducing uncertainty and enhancing the credibility of organizational decisions.
Overall, Environmental Management Accounting functions as a mechanism that not only supports internal risk management but also contributes to broader organizational resilience. By enabling better-informed decisions and

fostering transparency, EMA helps organizations navigate the challenges of global instability and maintain sustainable performance in uncertain business environments.

5. CONCLUSION

Global instability has fundamentally reshaped the contemporary business environment, increasing the importance of effective risk management, transparency, and sustainability-oriented decision-making. In such conditions, environmental risks have become central to organizational performance, requiring accounting systems capable of capturing not only financial outcomes but also environmental cost structures and risk exposures.

This paper has emphasized that Environmental Management Accounting (EMA) represents a relevant and increasingly necessary tool for addressing these challenges. By integrating environmental and financial information, EMA enhances transparency, supports the identification and assessment of environmental risks, and improves strategic decision-making under conditions of uncertainty. In this way, EMA contributes not only to internal organizational efficiency but also to the broader stability of the business environment by strengthening institutional credibility and reducing information asymmetry.

The analysis further suggests that the role of EMA extends beyond operational support, positioning it as a mechanism that can facilitate organizational resilience in the face of global instability. Through improved cost visibility, resource efficiency, and alignment with sustainability requirements, EMA enables organizations to better respond to external shocks and adapt to evolving regulatory and market conditions.

From a policy perspective, the development and wider adoption of standardized environmental accounting frameworks may further enhance the capacity of organizations to manage environmental risks and contribute to more stable and transparent economic systems. In this context, the alignment of EMA practices with international sustainability reporting standards represents an important direction for future development.

This study is subject to certain limitations. As a conceptual analysis, it does not provide empirical evidence on the effectiveness of Environmental Management Accounting practices in managing environmental risks. In addition, the analysis is based on a general theoretical framework and does not account for sector-specific or country-specific differences that may influence the implementation of EMA.

Future research could extend this conceptual analysis by empirically examining the relationship between EMA practices, environmental risk management, and organizational resilience across different industries and institutional contexts, particularly in economies exposed to higher levels of global uncertainty.

REFERENCES

Bhimani, A., Horngren, C. T., Datar, S. M., & Rajan, M. (2021). *Management and Cost Accounting* (7th ed.). Pearson Education

Burritt, R. L., Hahn, T., & Schaltegger, S. (2002). Towards a comprehensive framework for environmental management accounting—Links between business actors and environmental management accounting tools. *Australian Accounting Review, 12*(2), 39–50. Retrieved Mart 3, 2026 from: https://doi.org/10.1111/j.1835-2561.2002.tb00202.x

Burritt, R. L., Schaltegger, S., & Christ, K. L. (2023). Environmental management accounting—Developments over the last 20 years from a framework perspective. *Australian Accounting Review, 33(4), 336–351. https://doi.org/10.1111/auar.12407*

Christ, K. L., & Burritt, R. L. (2015). Material flow cost accounting: A review and agenda for future research. *Journal of Cleaner Production, 108*, 1378–1389. Retrieved Mart 5, 2026 from https://doi.org/10.1016/j.jclepro.2014.09.005

Dasinapa, M. B. (2024). The Integration of Sustainability and ESG Accounting into Corporate Reporting Practices. Advances in Applied Accounting Research, 2(1), 13–25. Retrieved Mart 7, 2026 from https://doi.org/10.60079/aaar.v2i1.167

Garrison, R. H., Noreen, E. W., & Brewer, P. C. (2020). *Managerial Accounting* (17th ed.). McGraw-Hill Education.

European Commission. (2020). *The European Green Deal*. https://eur-lex.europa.eu/resource.html?uri=cellar:b828d165-1c22-11ea-8c1f-01aa75ed71a1.0002.02/DOC_1&format=PDF

Fousteris, A. E., Didaskalou, E. A., Tsogas, M.-M. H., & Georgakellos, D. A. (2018). The Environmental Strategy of Businesses as an Option under Recession in Greece. *Sustainability*, *10*(12), 4399. Retrieved Mart 5, 2026 from https://doi.org/10.3390/su10124399

Horngren, C. T., Datar, S. M., & Rajan, M. (2018). Cost Accounting: A Managerial Emphasis. Pearson.

International Federation of Accountants (IFAC). (2021). *Putting the focus on environmental management accounting*. Retrieved Mart 3, 2026 from https://www.ifac.org

International Organization for Standardization. (2011). *ISO 14051: Environmental management—Material flow cost accounting—General framework*. ISO.

International Organization for Standardization. (2021). *ISO 14031: Environmental management—Environmental performance evaluation—Guidelines*. ISO.

International Sustainability Standards Board (ISSB). (2023). *IFRS S1: General Requirements for Disclosure of Sustainability-related Financial Information* and *IFRS S2: Climate-related disclosures*. IFRS Foundation.

Jasch, C. (2003). The use of Environmental Management Accounting (EMA) for identifying environmental costs. *Journal of Cleaner Production, 11*(6), 667–676. https://doi.org/10.1016/S0959-6526(02)00107-5

Jovanović D., Todorović M., Medved I. (2020). Environmental Management Accounting Support to ISO 14001 Implementation in Serbia – A Case Study. Fresenius Environmental Bulletin. ISSN 1018-4619. Vol. 29 (4), 2290-2299. Retrieved Mart 10, 2026 from https://www.researchgate.net/publication/340006105_ENVIRONMENTAL_MANAGEMENT_ACCOUNTI

Krstić, D. D., Lazić, S. D., & Ljubojević, N. M. (2024). Uticaj ESG faktora na performanse kompanije. *Tehnika – Menadžment*, 74(4), 481-490.

Latan, H., Chiappetta Jabbour, C. J., Lopes de Sousa Jabbour, A. B., Wamba, S. F., & Shahbaz, M. (2018). Effects of environmental strategy, environmental uncertainty and top management's commitment on corporate environmental performance: The role of environmental management accounting. *Journal of Cleaner Production*, 180, 297–306. Retrieved Mart 5, 2026 from https://doi.org/10.1016/j.jclepro.2018.01.106

Medved, I., Jovanović, D. (2020). Industry 4.0 Incentives for Environmental Management Accounting. Proceedings of the 25th International Scientific Conference Strategic Management and Decision Support Systems in Strategic Management. Retrieved Mart 7, 2026 from https://doi.org/10.46541/978-86-7233-386-2_36

Mukwarami, S., Nkwaira, C., & van der Poll, H. M. (2023). Environmental Management Accounting Implementation Challenges and Supply Chain Management in Emerging Economies' Manufacturing Sector. *Sustainability*, *15*(2), 1061. Retrieved Mart 10, 2026 from https://doi.org/10.3390/su15021061

Schaltegger S, Gibassier D, Zvezdov D (2013), Is environmental management accounting a discipline? A bibliometric literature review. *Meditari Accountancy Research*, Vol. 21 No. 1 pp. 4–31. Retrieved Mart 5, 2026 from https://doi.org/10.1108/MEDAR-12-2012-0039

Schaltegger, S. (2018). Linking Environmental Management Accounting: A Reflection on (Missing) Links to Sustainability and Planetary Boundaries. *Social and Environmental Accountability Journal*, *38*(1), 19–29. https://doi.org/10.1080/0969160X.2017.1395351.

TFCD - Task Force on Climate-related Financial Disclosures (2017). Final Report. Recommendations of Task Force on Climate-related Financial Disclosures. https://assets.bbhub.io/company/sites/60/2021/10/FINAL-2017-TCFD-Report.pdf

United Nations Environment Programme (UNEP). (2022). *Emissions Gap Report 2022*. Retrieved Mart 15, 2026 from https://www.unep.org

Weygandt, J., Kimmel, P., & Mitchell, J. (2020). Financial and Managerial Accounting (4th ed.). Wiley.

World Economic Forum. (2024). *The Global Risks Report 2024*. Retrieved Mart 8, 2026 from https://www.weforum.org/reports/global-risks-report-2024

DOI: 10.46541/978-86-7233-439-5_532



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COMPARATIVE ANALYSIS OF DETERMINANTS OF PUBLIC DEBT IN SELECTED COUNTRIES OF THE WESTERN BALKANS

Abstract: The excessive accumulation of public debt of many countries in the past few decades, especially in the context of financial instability and low rates of economic growth, has increased the need for a deeper analysis of the factors influencing the dynamics of public debt. The aim of this paper is to identify the impact of specific variables on the level of public debt in selected countries of the Western Balkans. The paper analyzes studies that focus on determinants of public debt, and it defines four fundamental independent variables. The panel data regression model is used to interpret the impact of these variables on the public debt as a dependent variable, while it uses data from 2002 to 2024. The research results provide an empirical basis for a better understanding of the dynamics of public debt and its main drivers and can be significant for policymakers in defining activities aimed at maintaining the stability of public debt.

Keywords: public debt, determinants of public debt, panel regression, the Western Balkans.

1. INTRODUCTION

The excessive accumulation of public debt of many countries in the past few decades, especially in the context of financial instability and low rates of economic growth, has increased the need for a deeper analysis of the factors influencing the dynamics of public debt. Global public debt, which has been rising since the global financial crisis, is a significant economic problem. Both developed and developing countries are currently facing an increase in debt, worsened by the COVID-19 pandemic, energy shocks, and monetary tightening that led to expansive fiscal policy. High levels of public debt significantly impact the Western Balkans countries, which are developing economies. One of the impacts is that it makes it more difficult for a country to handle future economic crises. Countries with high debt levels find it challenging to borrow additional money and boost spending in order to sustain their economies in crisis. Furthermore, excessive levels of public debt may raise interest rates, making borrowing more expensive for both individuals and corporations. Higher unemployment rates and reduced GDP growth may follow from these circumstances. The aim of this paper is to identify the impact of specific variables on the level of public debt in selected countries of the Western Balkans. The structure of the paper is as follows: After the introduction, the second section of the paper offers a summary of the literature, which includes studies on how different macroeconomic factors affect public debt. The third section describes the data and methodology used to analyze the relationship between public debt, GDP growth, inflation, current account balance, and unemployment in selected countries of the Western Balkans. The results of the econometric models are presented in the paper's fourth and most significant section. A summary of the study's key findings and suggestions for more research on the subject are included at the end of the report.

2. LITERATURE REVIEW

The paper analyzes studies that focus on determinants of public debt. Those determinants are most commonly macroeconomic, political, institutional, and structural variables. There are numerous studies that analyzed the effects of GDP growth on the level of public debt. Research conducted by Law, Ng, Kutan, and Law (2021); Lim (2019); De Vita, Trachanas, and Luo (2018); Gomez and Rivero (2017); Gomez and Rivero (2015); Bell Johnston and Jones (2015); and Ajovin and Navarro (2015) determined a negative impact of GDP growth on public debt. The research by Gargouri and Ksantini (2016) was conducted on a sample of 12 European countries and indicated a statistically significant and negative impact of GDP growth on public debt. Benović and Milenković (2024) analyzed determinants of public debt in the Republic of Serbia and found that there is a statistically significant negative impact of GDP growth on public debt and that the increase in GDP growth by 1% causes a decrease in public debt by 0.702646%. Using AMECO data, Pegkas, Staikouras, and Tsamadias (2020) conclude that public debt has a negative long-term impact on economic growth. The findings show that public debt and GDP growth are causally related in both directions over the long term. Twelve economies in the Eurozone were included in the sample. The authors advise the Eurozone economies to conduct a fiscal consolidation. Abubakar and Mamman (2020) used a regression model to analyze the impact of public debt on GDP growth in 37 OECD countries. The authors investigate the permanent versus transitory effects of public debt on GDP growth. They found a significant negative permanent and positive transitory effect of public debt on GDP growth. Ghourchian and Yilmazkuday (2020) compare the impact of public debt on GDP growth in 83 economies between 1960 and 2014 using the two-stage least squares methodology. According to the findings, real GDP growth would be lowered by roughly 0.01% on average across economies for every 1% increase in the debt-to-GDP ratio. Checherita-Westphal and Rother (2012) employ a two-stage least squares regression model with a control variable for long-term real interest rates and fiscal balance. The authors examine how public debt affected the increase of GDP in twelve Euro Area nations between 1970 and 2011. They found that public debt has a nonlinear effect on GDP growth, with a turning point at roughly 90 to 100 percent of GDP beyond which the debt-to-GDP ratio negatively affects long-term growth. Soo, Kueh, Ab-Rahim, and Tan-Hwang Yau (2023) assess the impact of the public debt threshold on the current account balance and fiscal balance in selected ASEAN countries (Indonesia, Malaysia, Philippines, Singapore, Thailand, and Vietnam) by using annual data from 1990 to 2021. The results indicate that the public debt threshold level is at 63.36%. When the public debt threshold is below 63.36%, there is a negative relationship between the current account balance and fiscal balance, whereas when the public debt threshold is higher than 63.36%, there is a positive nexus between the current account balance and fiscal balance. Tang and Issahaku (2024) assess the role of institutional quality in the relationship between public debt and unemployment in the SSA region. The study used annual panel data of 36 selected SSA economies covering 1996–2020. The System Generalized Method of Moments was used as the main empirical estimation tool. The findings from the study indicated that public debt acquisition is not contributing to reducing the unemployment situation in the SSA region.

3. MATERIAL AND METHODS

The subject of this study is a comparative analysis of the impact of macroeconomic factors such as GDP growth, inflation, current account balance, and unemployment on the public debt of a selected group of Western Balkans countries, which includes Albania, Bosnia and Herzegovina, Montenegro, North Macedonia, and the Republic of Serbia. In this section, the dependent and independent variables used in this study are defined, and the hypotheses and main models that are the subject of testing are stated, as well as the formulas of the diagnostic test used.

3.1. Data description

The econometric analysis, based on annual data from 2002 to 2024, includes the general government gross debt as a percentage of gross domestic product as a dependent variable and four selected macroeconomic indicators incorporated into the model as independent variables. All the data used was downloaded from the websites of the International Monetary Fund and the World Bank. The description of variables is presented in Table 1.

Table 1: Description of the selected variables

Variable name	Notation	Calculation	Role of variable
General government gross debt	DEBT	% of GDP	Dependent
Real GDP growth	GDP	Annual % change	Independent
Inflation rate, end of period consumer prices	INF	Annual % change	Independent
Current account balance	CAB	% of GDP	Independent
Unemployment	UNEMPLOY	% of total labor force	Independent

Source: Author

3.2. Hypothesis and tests

The findings of earlier theoretical and practical research and studies in this field served as a foundation for choosing the variables and the initial hypotheses, as well as for deriving conclusions about the impact of the chosen variables on the level of public debt in selected countries of the Western Balkans. The research is based on the following hypotheses:

H01: Real GDP growth has a statistically significant impact on the public debt of Western Balkans countries.
H02: The inflation rate has a statistically significant impact on the public debt of Western Balkans countries.
H03: The current account balance has a statistically significant impact on the public debt of Western Balkans countries.
H04: Unemployment has a statistically significant impact on the public debt of Western Balkans countries.

For the purpose of the analysis, Stata software was used. After presenting descriptive data, a number of diagnostic tests were used to reject non-stationarity and multicollinearity hypotheses, including the unit root test and correlation matrix derivation. Finally, the influence of independent variables on the dependent variable was interpreted using the fixed effects and random effects models to derive an adequate regression model.
After defining research hypotheses and reviewing the diagnostic tests, the following regression model, which represents the subject of this study, is derived:

$$DEBT_t = \alpha + \beta_1 GDP_t + \beta_2 INF_t + \beta_3 CAB_t + \beta_4 UNEMPLOY_t + \epsilon_t \quad (1)$$

Where:

- DEBTt, as a dependent variable, is the level of general government gross debt as a % of GDP at time t.
- GDP_t is the annual real GDP growth rate in % at time t.
- INF_t is the annual inflation rate in % at time t.
- CAB_t is the current account balance as a % of GDP at time t.
- $UNEMPOY_t$ is the unemployment rate as a % of the total labor force at time t.
- ϵ_t is the white noise process.

4. RESULTS AND DISCUSSION

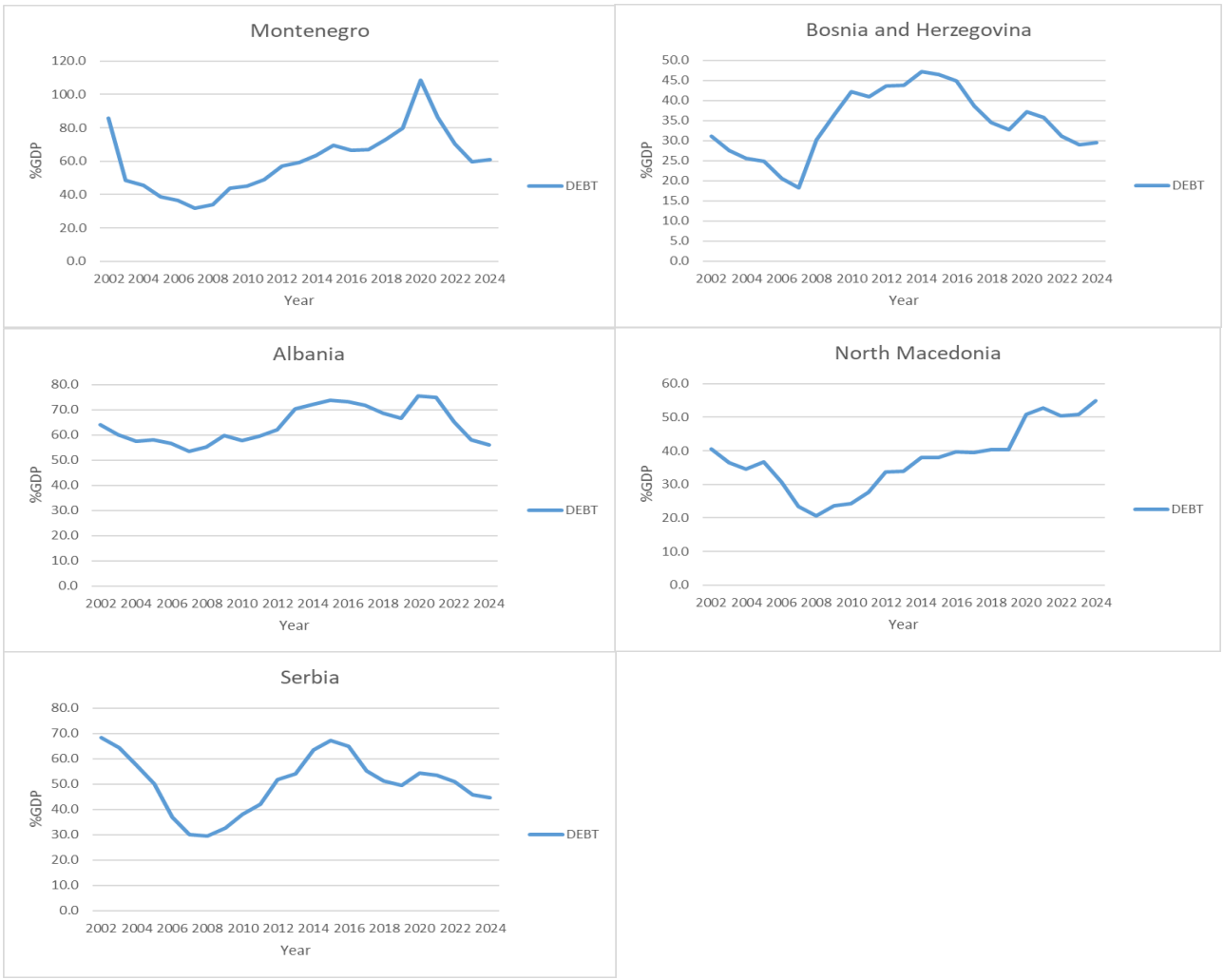
In this part of the study, a descriptive analysis of the variables used in the sample of Western Balkans countries that are the subject of this study is presented. Empirical analysis is based on panel analysis containing 5 cross-sectional units (5 Western Balkans economies) during the period 2002-2024. Therefore, the number of observations included in the panel is 115. In addition to the descriptive analysis, the movement of the general government gross debt in selected Western Balkans countries in the period 2002-2024 is graphically illustrated. The data was collected from the websites of the International Monetary Fund and the World Bank. Table 2 shows the descriptive analysis of the variables in the example of selected Western Balkans countries. It is noticeable that the largest amount of standard deviation is present in the variable of public debt (16.62%), which means that there is the largest spread between the minimum and maximum values of the indicator. The highest amount of public debt was achieved by Montenegro (108.40% of GDP) in 2020, while the lowest amount of public debt was achieved by Bosnia and Herzegovina (18.20% of GDP) in 2007. The highest rate of real GDP growth was achieved by Montenegro (13.00%) in 2021, while the highest inflation rate was achieved by North Macedonia (18.70%) in 2022. The highest amount of current account deficit was achieved by Montenegro (-49.50% of GDP) in 2008, while the highest unemployment rate was achieved by North Macedonia (37.30%) in 2005.

Table 2: Descriptive statistics of the selected variables

Variables	Obs	Mean	Std. Dev.	Min	Max
DEBT	115	49.21565	16.61918	18.20000	108.40000
GDP	115	3.160000	3.351271	-15.00000	13.000000
INF	115	3.500000	3.977877	-2.200000	18.700000
CAB	115	-9.007017	7.646516	-49.50000	0.3810000
UNEMPLOY	115	19.92261	7.555689	7.200000	37.300000

Source: Author

In addition to the descriptive analysis, the movement of public debt in selected Western Balkans countries in the period 2002-2024 is shown in Picture 1. Until the global financial crisis, there was a gradual downward trend in public debt in all of the selected countries of the Western Balkans; however, there was an increase starting in 2009 and continuing until 2015, followed by a substantial decline. Again, in 2020, due to the crisis caused by the COVID-19 pandemic, there was an increase in public debt, followed by its stabilization and a more moderate decline over the period 2021–2024.



Picture 1: Movement of the general government gross debt in selected Western Balkans countries in the period 2002-2024.
Source: Author

Certainly, one of the main conditions for performing a correct panel regression model is the absence of multicollinearity of the used variables. Both the variance inflation factor (VIF) test and the correlation matrix were used to prove the absence of multicollinearity. The correlation matrix that displays the relationship between the independent and dependent variables is shown in Table 3. It is noticeable that the level of correlation between the independent variables does not exceed the threshold of 0.80.

Table 3: Correlation matrix

	DEBT	GDP	INF	CAB	UNEMPLOY
DEBT	1.0000				
GDP	-0.1497	1.0000			
INF	-0.0349	0.2484	1.0000		
CAB	-0.0617	-0.0575	-0.0838	1.0000	
UNEMPLOY	-0.5115	-0.0343	-0.1943	0.0001	1.0000

Source: Author

The absence of multicollinearity can also be confirmed by using the variance inflation factor, which is a frequently used collinearity test. Table 4 shows that the value of VIF does not exceed the threshold value of 10, so the absence of multicollinearity of the used variables is confirmed.

Table 4: Variance inflation factor

Variables	VIF	1/VIF
GDP	1.07	0.936770
INF	1.11	0.898838
CAB	1.01	0.991287
UNEMPLOY	1.04	0.961783
Mean VIF	1.06	

Source: Author

One of the most important requirements for an econometric analysis of time series is stationary data, which is crucial for the econometric approach (Mushtaq, 2011). The mean and variance of time series must be constant values. If the p-value is more than 0.05, the data is not steady and has a unit root. The unit root test is used to eliminate non-stationary data since it can result in an unfavorable regression model (spurious regression). The order of integration of the variables is determined using the Levin-Lin-Chu and Im-Pesaran-Shin unit root tests. The test findings are summarized in Table 5. The results of the unit root test show that, with the exception of the public debt and unemployment rate, all variables are stationary at level because the probability does not exceed the 5% significance level, while the public debt and unemployment rate data become stationary after performing the first difference.

Table 5: Unit root test

Variables	Level		1st difference	
	Levin-Lin-Chu	Im-Pesaran-Shin	Levin-Lin-Chu	Im-Pesaran-Shin
DEBT	-4.2376 (0.2207)	-0.5472 (0.2921)	-6.4419 **(0.0012)***	-3.0267 **(0.0012)***
GDP	-6.6108 **(0.0006)***	-3.2120 **(0.0007)***	-13.5662 (0.0000)	-9.6474 (0.0000)
INF	-7.5360 **(0.0000)***	-3.8386 **(0.0001)***	-12.1507 (0.0000)	-8.3226 (0.0000)
CAB	-5.1365 **(0.0034)***	-1.7956 **(0.0363)***	-10.7435 (0.0000)	-7.3186 (0.0000)
UNEMPLOY	-1.0053 (0.7481)	1.2456 (0.8935)	-8.5520 **(0.0000)***	-4.8020 **(0.0000)***

Source: Author

After diagnostic tests of multicollinearity and unit root, fixed effects and random effects models were used to derive an adequate regression model. The results of the panel regression model are presented in Table 6.

Table 6: Panel regression model

Variables	Fixed effects	Random effects
GDP	**-1.2252600** **(0.000)***	-1.2376470 (0.000)
INF	**-0.3304495** **(0.024)***	-0.2914774 (0.030)
CAB	**-0.3346700** **(0.000)***	-0.1581511 (0.017)
dUNEMPLOY	-0.0419432 (0.888)	-0.0984712 (0.742)
C	1.5776680 (0.129)	3.023089 (0.001)
R - squared	0.4915	0.4712
Prob.	0.0473	-

Source: Author

The main test used to identify the adequacy of fixed effects and random effects models is the Hausman specification test. This test serves to show which of these two used models presents more adequate results. Based on the results from Table 7, it is noticeable that the probability does not exceed the threshold value of 0.05, so the fixed-effects model proved to be more adequate than the random-effects model. At the same time, the probability value of 0.0473 indicates that the fixed-effects model is more adequate than the pooled OLS model as well.

Table 7: Hausman specification test

Variables	Coefficients	
	Fixed effects	**Random effects**
GDP	-1.2252600	-1.2376470
INF	-0.3304495	-0.2914774
CAB	-0.3346700	-0.1581511
dUNEMPLOY	-0.0419432	-0.0984712
Prob>chi2	**0.0431**	

Source: Author

Based on the obtained results, it is noticeable that the influence of all independent variables, except the unemployment rate, proved to be statistically significant. Therefore, H01, H02, and H03 cannot be rejected, while H04 is rejected. It is noticeable that the increase in GDP growth, inflation rate, and current account balance by 1% causes a decrease in public debt by 1.2252600%, 0.3304495%, and 0.3346700%, respectively. The R-squared indicator of the regression model indicates that the given variables describe more than 49% of the changes in the public debt variable. The probability of the regression model is statistically significant ($p < 0.05$), which indicates that the model explains a significant amount of variance in the dependent variable.

5. CONCLUSION

The aim of this paper was to identify the impact of specific macroeconomic variables on the level of public debt in selected countries of the Western Balkans in the period from 2002 to 2024 by using the panel regression model. The results of the coefficients assessment using the fixed-effects model indicate that GDP growth, inflation rate, and positive current account balance can affect the decrease in public debt. Therefore, H01, H02, and HO3 could not be rejected. The results, which outline the importance of the impact of GDP growth, inflation rate, and current account balance on the decrease of public debt, are in line with economic theory. Further, obtained results indicate that the unemployment rate has a negative coefficient and has no statistically significant influence on the public debt. Therefore, H04 was rejected. The regression is significant, and the signs of the main explanatory variables are those that are expected. This study provides an empirical basis for a better understanding of the dynamics of public debt and its main drivers and can be significant for policymakers in defining activities aimed at maintaining the stability of public debt.
This research has certain limitations since the analysis was carried out in a small sample of countries and covered a rather short period of time. The suggestion for future research is the use of a larger number of countries that will be included in panel regression analysis, on the basis of which it could be concluded about the factors influencing the level of public debt in conditions of uncertainty.

REFERENCES

Abubakar, A. B., & Mamman, S.O. (2020). *Permanent and Transitory Effect of Public Debt on Economic Growth*. Journal of Economic Studies, Emerald Group Publishing Limited, vol. 48(5), pages 1064-1083.

Bell, A., Johnston, R. & Jones, K. (2015). Stylised Fact or Situated Messiness? The Diverse Effects of Increasing Debt on National Economic Growth, Journal of Economic Geography, 15(2), 449-472.

Benović, N., & Milenković, I. (2024). Analysis of the Influence of Selected Macroeconomic Variables on the Public Debt of Serbia. International Scientific Conference Strategic Management and Decision Support Systems in Strategic Management, 89-95.

Checherita-Westphal, C., & Rother, P. (2012). *The impact of high government debt on economic growth and its channels: An empirical investigation for the euro area.* European Economic Review, 2012, vol. 56, issue 7, 1392-1405.

Daniel Tang & Haruna Issahaku (2024). Public debt and unemployment in Sub-Saharan Africa: the role of institutional framework, SN Business & Economics, Springer, vol. 4(3), pages 1-26, March.

De Vita, G., Trachanas, E. & Luo, Y. (2018). Revisiting the Bi-Directional Causality Between Debt and Growth: Evidence from Linear and Nonlinear Tests, Journal of International Money and Finance, 83, 55-74.

Gargouri, I., & Ksantini, M. (2016). The Determinants of Public Debt. The Romanian Economic Journal, 18(59), pp. 111-124.

Gómez-Puig, M. & Sosvilla-Rivero, S. (2017). Heterogeneity in the Debt-Growth Nexus: Evidence from EMU Countries, International Review of Economics and Finance, 51, 470-486.

Gomez-Puig, M.& Sosvilla-Rivero, S. (2015). The Causal Relationship Between Debt and Growth in EMU Countries, Journal of Policy Modelling, 37(6), 974-989.

Ghourchian, S., & Yilmazkuday, H. (2020). *Government consumption, government debt and economic growth.* Review of Development Economics, 2020, vol. 24, issue 2, 589-605.

Law, S. H., Ng, C. H., Kutan, A. M., & Law, Z. K. (2021). Public debt and economic growth in developing countries: Nonlinearity and threshold analysis. Economic Modelling, 98, 26-40.

Lim, J. J. (2019). Growth in the Shadow of Debt, Journal of Banking and Finance, 103, 98-112.

Mushtaq, R. (2011). *Augmented Dickey Fuller Test.* DOI: https://dx.doi.org/10.2139/ssrn.1911068

Pegkas, P., Staikouras, C. & Tsamadias, C. (2020). On the Determinants of Economic Growth: Empirical Evidence from the Eurozone Countries, International Area Studies Review, 23(2), 1-20.

Puente-Ajovín, M. & Sanso-Navarro, M. (2015). Granger Causality Between Debt and Growth: Evidence from OECD Countries, International Review of Economics & Finance, 35, 66-77.

Xin-Lin Soo, Jerome Swee-Hui Kueh, Rossazana Ab-Rahim & Josephine Tan-Hwang Yau. (2023). Public Debt, Current Account Balance, and Fiscal Balance: The Threshold Effects in Selected ASEAN Countries, Business and Economic Research, Macrothink Institute, vol. 13(3), pages 23-39, December.

INTERNET

https://www.imf.org/en/countries. Accessed on March 26, 2026.

https://data.worldbank.org/. Accessed on March 26, 2026.

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EXPORT COMPETITIVENESS OF TOBACCO AND TOBACCO PRODUCTS OF THE REPUBLIC OF SERBIA IN THE PERIOD FROM 2014 TO 2024

Abstract: The tobacco industry represents one of the industrial sectors that attracts the attention of scientific researchers, both due to its economic significance and its impact on human health. The focus of this paper is to determine the export competitiveness of tobacco and tobacco products of the Republic of Serbia in the period from 2014 to 2024. The relevant indicators of export competitiveness used in the analysis are the Revealed Comparative Advantages (RCA) index and the Lafay index. The analysis covers the trade of Serbian tobacco and tobacco products with the EU and CEFTA countries. The results differ depending on the applied indicator, given that the Lafay index incorporates both imports and exports in its calculation, whereas the RCA index excludes the impact of imports. In the observed period, the preliminary results indicate the existence of both comparative advantages and disadvantages in relation to the observed groups of countries; however, the results vary within the period and depending on the applied indicator of comparative advantage. The conclusion is that there is an expansion in the exports of Serbian tobacco and tobacco products, accompanied by the achievement of comparative advantage, but their presence changes over the years and depending on the indicators used.
Keywords: tobacco, export, import, comparative advantage, Lafay index, RCA index.

1. INTRODUCTION

The tobacco industry represents a set of economic activities encompassing the cultivation, processing, manufacturing, packaging, distribution, and sale of tobacco-based products (World Health Organization & National Cancer Institute, 2017). It is characterized by high levels of organization and significant oversight by state institutions and regulatory bodies, high capital concentration, and the presence of several multinational companies that hold the majority market share. The tobacco supply chain is a series of interconnected activities that track tobacco from its production—namely, the raw leaf—all the way to the finished product. The primary stages of the tobacco supply chain can be outlined as follows:

1. **Tobacco production** (cultivation on agricultural farms, as well as harvesting);
2. **Processing and fermentation** (the process of treating raw, unprocessed tobacco and its preparation for distribution to tobacco product manufacturers);
3. **Industrial manufacturing** (processed tobacco is used for the production of cigarettes, cigarillos, smokeless tobacco, etc.);
4. **Packaging and distribution;**
5. **Trade, retail and marketing**.

Regarding the impact of tobacco on human health, it is essential to emphasize that despite its proven negative effects, tobacco continues to have widespread use and is a daily fixture in the consumption patterns of a large portion of the population. According to data from the World Health Organization (WHO), tobacco is one of the leading causes of premature death in humans, estimated to claim approximately 7 million lives annually, including 1.6 million non-smokers who are exposed to tobacco as secondary users (World Health Organization, 2025). Key steps in the process of reducing tobacco use include even stricter market control and oversight, professional assistance for users wishing to quit tobacco consumption, bans on the advertising of tobacco products, and tax increases. The subject of this research is the analysis of the persistence of comparative advantages in the export of tobacco and tobacco products from Serbia in the period from 2014 to 2024. The aim of the research is to identify Serbia's export position using the RCA and LFI indices. First, an analysis of scientific literature on the topic of tobacco will be conducted in the Literature Review section. The research methods and approach will be presented in the Methodology chapter. The results obtained through the observed methodology will be presented in the Research Results section. The analysis of the results and their theoretical foundation will be detailed in the Discussion section. The summary of research results and findings will be expressed in the Conclusion chapter.

2. LITERATURE REVIEW

Several studies examine various aspects of the Serbian tobacco industry. For this research, studies focusing on the export position of the Serbian tobacco industry are of greater significance; however, papers that observe the domestic tobacco market can also be relevant for the analysis and explanation. The position of the Serbian tobacco industry on the international market, as well as on the EU and CEFTA markets, was analyzed by Zekić and colleagues (Zekić et al., 2016). First, the development of production and trade performance of tobacco and tobacco products was observed. The aforementioned authors analyzed the period from 2006 to 2013 and pointed out that the average growth rate of tobacco production in the observed period was -2.46%. The highest production was recorded in 2009, when approximately 10.5 thousand tons of tobacco were produced on an area of about 6.5 thousand hectares, amounting to approximately 1.62 tons per hectare. The negative average growth rate of tobacco production is a consequence of the negative contribution of cultivated land, whose average annual growth rate in the observed period was -2.77%. The tobacco supply chain is divided into three links: tobacco growers, tobacco processors, and industrial manufacturers of tobacco products. Tobacco growers are identified as farms, most commonly family-owned holdings, which cultivate tobacco based on agreements and in cooperation with tobacco processors. In the period from 2006 to 2012, a massive decline in the number of holdings specialized in tobacco cultivation was observed, while on the other hand, the average planted area per hectare and production per farm increased (Matkovski & Đokić, 2014). The abolition of support for tobacco production is cited as the key cause of this phenomenon, which dealt a severe blow to agricultural holdings that financed their production through these funds, leading them to abandon production. Tobacco processors are enterprises engaged in the processing and fermentation of raw tobacco obtained from growers, which is then transported in its processed form to industrial manufacturers of tobacco products. The most prominent multinational companies involved in the manufacturing of tobacco products are China National Tobacco Corporation, Japan Tobacco International, British American Tobacco, Philip Morris International, Altria Group Inc, and Imperial Tobacco Group, while in Serbia, the operating companies include Japan Tobacco International, which privatized the tobacco industry in Senta, British American Tobacco, which privatized the tobacco industry in Vranje, and Philip Morris International, which privatized the tobacco industry in Niš (Vuković, Mijić & Spahić, 2015). Regarding trade performance, specifically Serbia's position in foreign markets, there was a constant increase in the value of exported tobacco and tobacco products between 2006 and 2013. In each year, the share of processed tobacco exports within the total exports of the agri-food sector was higher than the share of unprocessed tobacco exports in the same sector (Zekić et al., 2016). In the observed period, a decline in tobacco imports was recorded until 2007, after which a steady growth occurred. The abolition of the per-kilogram premium for domestic tobacco producers is highlighted as a possible reason for this phenomenon, as it led to a price increase and prompted processors and industrial manufacturers to seek cheaper imported tobacco. It is also important to note that Serbia’s foreign trade position changed significantly during the observed period, given that the Stabilization and Association Agreement between Serbia and the EU entered into force on September 1, 2013, which substantially facilitated the export of Serbian products to EU member states. Furthermore, the CEFTA agreement established a free trade zone, introducing a duty-free regime with CEFTA member countries (Nuševa et al., 2024). Regarding the methodology used by Zekić and colleagues (Zekić et al., 2016), several comparative advantage indicators were employed. These indicators include the Revealed Comparative Advantage index (RCA), the Lafay Index (LFI), and the Grubel–Lloyd Intra-Industry Trade index (GLIIT). The results obtained by applying the RCA index showed that during the observed period, Serbia achieved a comparative advantage in the export of tobacco and tobacco products in all years except 2006, with a noticeable upward trend in this indicator. When focusing on specific markets, comparative advantages are present in the international market and the EU market. However, comparative disadvantages were observed in the CEFTA market, as the recorded RCA values were below the reference threshold. It is also significant to mention that despite the identified comparative disadvantages, the Serbian tobacco industry has recorded a constant growth in RCA index values within the CEFTA market. Looking at the results obtained via the LFI, a completely different situation is evident. According to this indicator, Serbia records comparative advantages in tobacco industry exports within the CEFTA market, while recording comparative disadvantages in the EU market. The difference in

results is primarily a consequence of the distinction between these two methods. On one hand, RCA only takes into account product exports and their share in the country's total exports (Balassa, 1965), while LFI examines the country's overall foreign trade position, i.e., both exports and imports (Lafay, 1992). Analyzing the trade balance, Serbia records a negative balance with the EU and a positive one with CEFTA. Therefore, the LFI points to comparative disadvantages in the EU market and comparative advantages in the CEFTA market (Zekić et al., 2016). The Grubel–Lloyd Index (Grubel & Lloyd, 1975) indicates the integration of a specific product into foreign markets. According to the research results, tobacco and tobacco products from Serbia are well-integrated into international markets, particularly the EU and CEFTA, with a steady upward trend in the indicator from 2006 to 2013 (Zekić et al., 2016). The paper concludes that the LFI is the most reliable tool for analyzing export comparative advantages due to the comprehensiveness of the method.

An analysis of the characteristics of the tobacco and tobacco products supply chain in Serbia was conducted by Tica et al. (2023). Their study covers the period from 2013 to the latest year for which data were available. This research is significant as it fills a gap in the literature regarding the tobacco industry—a gap largely resulting from pressures to reduce the consumption of tobacco and related products within the European Union. Conversely, due to less stringent regulations, literature on the Serbian tobacco industry remains accessible and diverse. The distinctiveness of this work lies in its comprehensive analysis of the entire supply chain, from production to consumption and export, further enhancing its importance. Regarding the Serbian tobacco industry specifically, a significant decline in the number of tobacco growers is observable. During the observed period, the number of producers fell from 1,781 to 775 (Tica et al., 2023), representing a substantial decrease of 56.5%. However, the same period saw a rise in total tobacco production and the average planted area per farm. This suggests that only the most productive producers—those capable of achieving economies of scale and operating independently of state support (which was abolished in 2011)—have remained in the market. Notably, Serbia is the sixth-largest tobacco producer in Europe and the only country where production is increasing, at a rate of approximately 1% annually. This trend contrasts sharply with the rest of Europe, particularly EU member states, where public policies are directed toward reducing production and consumption in accordance with EU regulations. As for other supply chain participants, there are 12 processors operating in Serbia, four of which are companies that also manufacture tobacco products. To analyze market concentration, the Herfindahl-Hirschman Index (HHI) was utilized, measuring the market share of specific companies relative to the total number of firms. The analysis determined that between 2013 and 2021, the Serbian tobacco market was highly concentrated. This resulted in significant market power for manufacturers, allowing them to offer lower purchase prices to tobacco growers while selling finished products to consumers at higher prices than those that would prevail under competitive conditions. Swinnen and Vandeplas (2010) defined this phenomenon as "double market power." However, a downward trend in the HHI was also noted during the period, indicating the entry of new market players, increased competition, and a subsequent decline in tobacco product prices. The authors also conducted a regression analysis to examine the impact of factors such as the HHI, liquidity, indebtedness, firm size, asset turnover (fixed and current), and growth on Return on Assets (ROA). The results indicated that the HHI, liquidity, and leverage exert a negative impact on firm profitability (ROA). Conversely, factors such as firm size, asset turnover, and growth positively influence this indicator. Regarding consumers, tobacco consumption remains very high and above the EU average, partly due to the relatively low price of tobacco products.

Research by Vladisavljević et al. (2020) provides insight into the price-inelastic demand for cigarettes in Serbia, suggesting that price changes do not significantly alter demand. Using Deaton's demand model (1988), the authors found that for the period 2006–2017, the price elasticity coefficient for cigarettes in Serbia was -0.639. Thus, a 1% increase in price leads to a reduction in demand of only 0.64%. Consequently, Serbian consumers lack adequate substitutes for cigarettes, a fact the state could leverage to increase excise taxes and fiscal revenue. While increasing excises could theoretically serve the social goal of reducing cigarette use and improving public health, the findings suggest that the habits of Serbian smokers do not change significantly due to price hikes, implying that the public health effect might be negligible.

The export of tobacco and tobacco products from Serbia has shown steady growth, averaging 6% annually, and accounted for approximately 8% of Serbia's total agri-food exports on the global market during the analyzed period. Furthermore, since 2014, the tobacco industry has maintained a consistent positive trade balance due to higher exports relative to imports. Regarding comparative advantage, the Lafay Index (LFI) indicates very weak (CEFTA) or non-existent (EU) advantages, resulting from increased imports during the period. From 2013 to 2022, Serbian imports of tobacco products grew by an average of 11% annually, with half of these imports originating from the EU. This explains the lack of comparative advantage in trade with the EU, as the LFI methodology incorporates imports into its calculation. However, an increase in comparative advantage was observed in exports to non-traditional trade partners (Algeria, Japan, Egypt, Israel, and Turkey), which is expected given that approximately 80% of total tobacco exports were directed to these countries. Regarding the degree of market integration, measured by the Grubel-Lloyd Intra-Industry Trade (GLIIT) index, values were above the reference threshold, indicating good integration. However, a significant decline in integration with CEFTA countries was noted, dropping from approximately 72% in 2013 to only 21% in 2022. By utilizing these methods and indicators, this paper provides a comprehensive analysis of the Serbian

tobacco industry, encompassing the entire supply chain and export competitiveness. Furthermore, it builds upon the work of Zekić et al. (2016) (covering 2006–2013), allowing for a broader perspective over an extended timeframe.

3. METHODOLOGY

The analysis of the comparative advantages of Serbian tobacco exports was conducted using the Revealed Comparative Advantage (RCA) index and the Lafay Index (LFI), in relation to the global level, the EU, and CEFTA. The selection of these two indicators is logical, considering they are the most frequently used in the available literature analyzing the comparative advantages of countries or regions. Data on Serbia's total exports and imports, as well as the exports and imports of Serbian tobacco, were retrieved from the website of the Statistical Office of the Republic of Serbia (SORS, 2025). Regarding the data on total exports and imports at the EU and CEFTA levels, as well as data on their tobacco exports and imports, they were obtained from the FAO website (2026).

In this paper, the analysis was first conducted using the RCA index. This index was first introduced by Balassa (1965) and later modified by Vollrath (1991). This study utilizes the original version of the index, which compares the share of a specific good's exports in a country's total exports to the share of the same good's exports in the total exports of the country or group of countries with which the comparison is made, or where comparative advantages are being examined. The formula for the RCA index is as follows:

$$RCA_{i,j} = \frac{\frac{X_{i,j}}{X_{i,t}}}{\frac{X_{w,j}}{X_{w,t}}}$$

Where:

- $X_{i,j}$ – exports of product *j* from country *i*
- $X_{i,t}$ – total exports of all goods *t* from country *i*
- $X_{w,j}$ – exports of product *j* from the group of countries *w*
- $X_{w,t}$ – total exports of all goods *t* from the observed group of countries *w*.

RCA index values greater than 1 signal the existence of comparative advantages in the export of the observed product compared to the reference group of countries, while index values less than 1 indicate the existence of comparative disadvantages.

The second index used is the LFI. It differs from the RCA because it takes imports into account as well, rather than just exports. It was introduced by Lafay (1992), and its formula is:

$$LFI_j^i = 100\left(\frac{x_j^i - m_j^i}{x_j^i + m_j^i} - \frac{\sum_{j=1}^{N}\left(x_j^i - m_j^i\right)}{\sum_{j=1}^{N}\left(x_j^i + m_j^i\right)}\right)\frac{x_j^i + m_j^i}{\sum_{j=1}^{N}\left(x_j^i + m_j^i\right)}$$

Where:

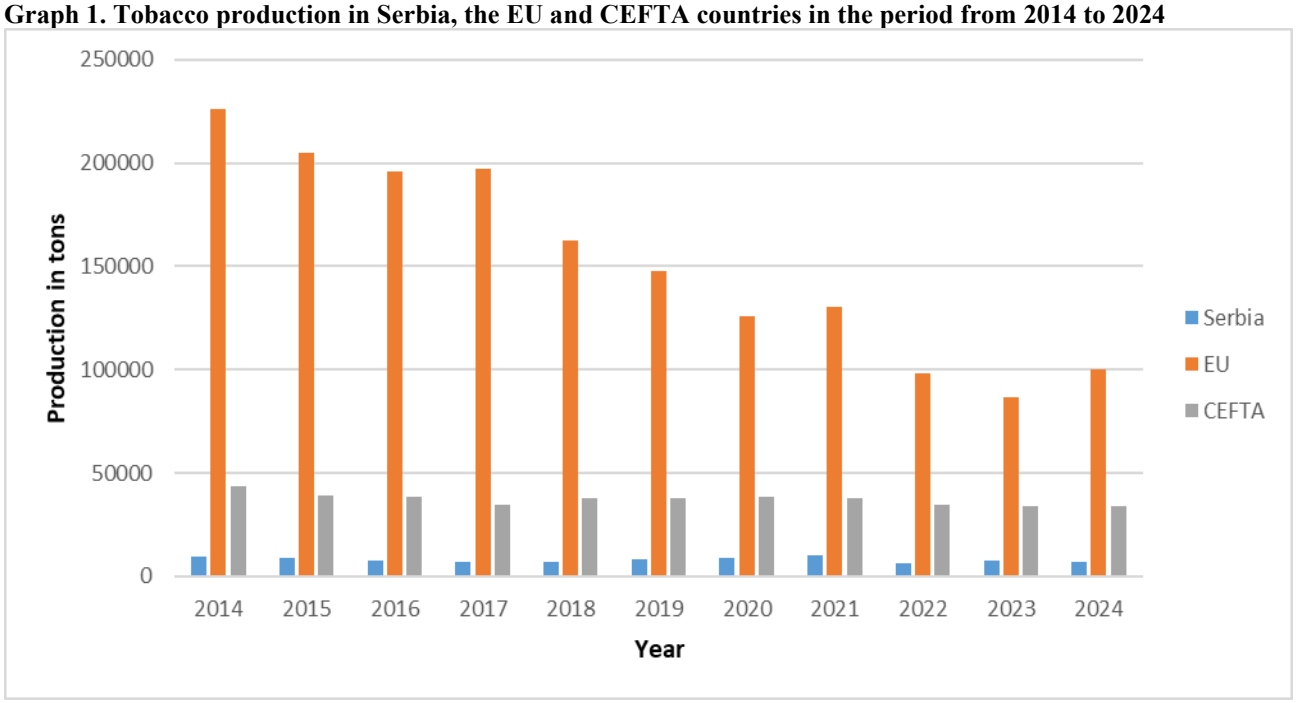
- x – export
- m – import
- *i* – country
- *j* – product
- *N* – number of observed units.

If the LFI values are greater than 0, it is concluded that the country achieves a comparative advantage in the export of the observed product, while values less than 0 signal comparative disadvantages.

4. RESEARCH RESULTS

In order to comprehend and accurately interpret the research findings, it is essential to analyze indicators such as tobacco production, as well as the export and import of tobacco and tobacco products. In this context, the following graph illustrates tobacco production in Serbia, the EU, and CEFTA countries during the observed period.

Graph 1. Tobacco production in Serbia, the EU and CEFTA countries in the period from 2014 to 2024

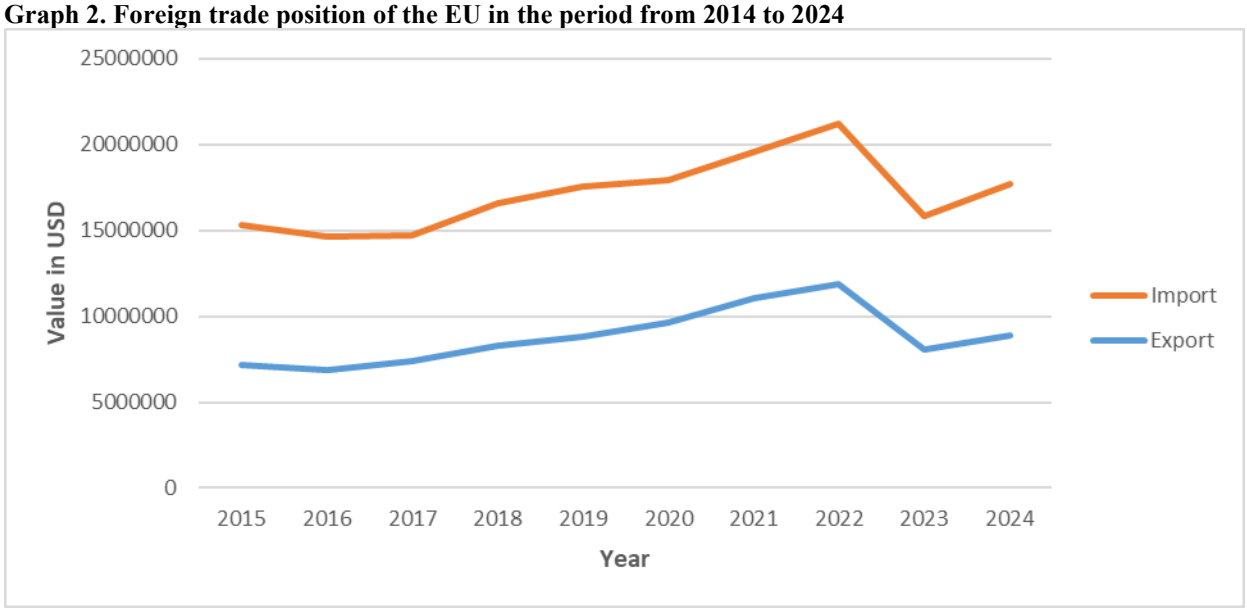


Source: Author's illustration based on FAO data (2026).

It can be observed that the EU records by far the highest quantities of tobacco produced compared to CEFTA and Serbia; however, a declining trend is evident throughout the observed period. As expected, Serbia realizes the lowest production levels, characterized by minor fluctuations over the years. A similar situation is observed regarding the CEFTA countries, whose production levels are situated between those of the EU and Serbia.

The next essential indicator is foreign trade, specifically the comparison between the export and import of tobacco and tobacco products. In this segment, the EU achieves the highest export value for tobacco and tobacco products, characterized by steady growth from 2014 to 2022, followed by a decline in 2023 and 2024. Interestingly, throughout all the observed years, the import of tobacco and tobacco products consistently exceeded exports; thus, it can be concluded that the EU maintains a negative trade balance for this product group.

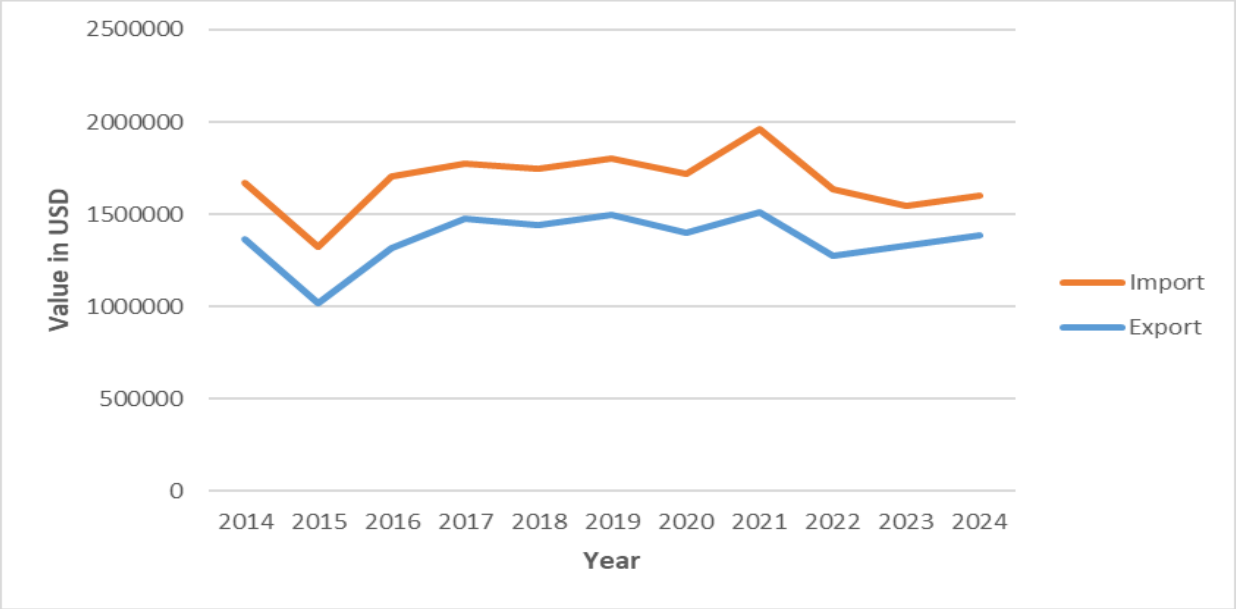
Graph 2. Foreign trade position of the EU in the period from 2014 to 2024



Source: Author's illustration based on FAO data (2026).

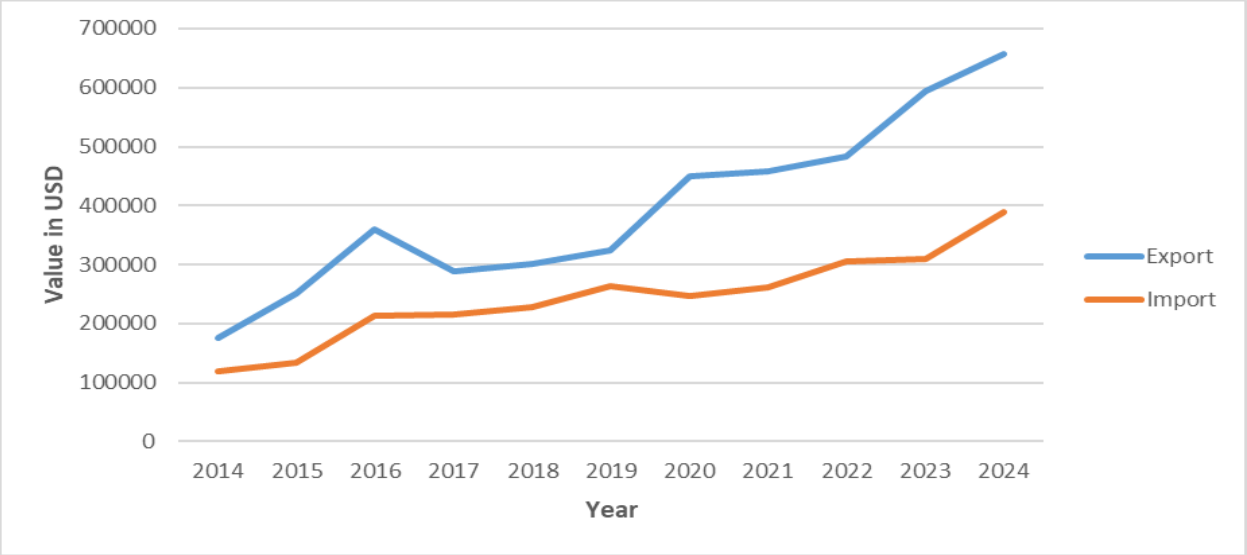
A similar situation is observed within CEFTA countries, although they record significantly lower values in both the export and import of tobacco and tobacco products. Conversely, Serbia maintained a positive trade balance in every year of the observed period, accompanied by a predominantly upward trend in exports. The only decline in exports occurred in 2017 compared to 2016, while the largest trade surplus for this product group was recorded in 2023 and 2024.

Graph 3. Foreign trade position of CEFTA countries in the period from 2014 to 2024



Source: Author's illustration based on FAO data (2026).

Graph 4. Foreign trade position of Serbia in the period from 2014 to 2024



Source: Author's illustration based on FAO data (2026).

The values presented in the graphs are expressed in USD. In view of the observed export and import trends, it is evident that Serbian exports of tobacco and tobacco products have been undergoing an expansion in recent years; consequently, the realization of comparative advantages in this field is also expected in the forthcoming period.

Regarding the research results, it is noticeable that they vary depending on the applied indicator, as well as the group of countries. This discrepancy primarily stems from the calculation methods of the observed indicators, given that the LFI considers both the import and export values of the product, while the focus of the RCA is solely on exports.

Table 1. Comparative advantages in the export of tobacco and tobacco products from Serbia relative to the EU and CEFTA in the period from 2014 to 2024

YEAR	EU/CEFTA	RCA	LFI
2014	EU	**3.28**	-9.93
	CEFTA	0.02	**2.42**
2015	EU	**1.52**	-21.55
	CEFTA	0.02	**2.66**
2016	EU	0.82	-25.94

	CEFTA	0.01	**3.66**
2017	EU	**1.33**	-6.85
	CEFTA	0.02	**5.99**
2018	EU	**1.37**	-6.21
	CEFTA	0.03	**5.76**
2019	EU	**1.84**	-15.35
	CEFTA	0.02	**5.66**
2020	EU	0.70	-18.59
	CEFTA	0.01	**2.89**
2021	EU	0.74	-19.78
	CEFTA	0.02	**3.54**
2022	EU	**1.34**	-24.14
	CEFTA	0.03	**3.91**
2023	EU	**1.24**	-29.30
	CEFTA	0.03	**4.35**
2024	EU	**1.07**	-33.77
	CEFTA	0.03	**5.39**

Source: Author's calculation.

Regarding the RCA index, when values are greater than zero, the existence of comparative advantages in the export of the observed product is established. Based on the table, it is concluded that comparative advantages exist in trade with the EU in all years, except for 2016, 2020, and 2021. As for the CEFTA countries, no comparative advantages are recorded. With the LFI, the situation is somewhat different. There is a complete absence of comparative advantages in exports to the EU, whereas significant comparative advantages in trade with CEFTA countries are recorded throughout all years of the observed period. The explanation for this may lie in the different methodologies used to calculate comparative advantages, given that the RCA index relies solely on export values, whereas the LFI index incorporates imports into the analysis as well. Accordingly, during the observed period, Serbia recorded a higher share of tobacco and tobacco product exports compared to the EU, except in the years where an absence of comparative advantage was noted. Conversely, when imports of these products are taken into account, the existence of comparative advantage in trade with the EU is entirely eliminated, whereas comparative advantages in trade with CEFTA are observed in every single year of the period under review. It is concluded that CEFTA accounts for a higher share of tobacco and tobacco product imports relative to Serbia. Reviewing the import-export dynamics once more, it can be stated that the obtained results are largely consistent with expectations.

5. DISCUSSION

The research findings primarily highlight the discrepancies between the methods employed to identify comparative advantages or disadvantages. The RCA index relies exclusively on the export performance of the observed country or group of countries. In contrast, the LFI incorporates import characteristics alongside exports, rendering it a more comprehensive methodology for determining a country's foreign trade position regarding a specific product or product group. In this specific case, comparative advantages in the export of tobacco and tobacco products from Serbia relative to the EU were identified for nearly every year of the observed period. This outcome is expected, considering the negative foreign trade position of the EU and the consistent growth of Serbia's tobacco industry exports. Furthermore, it is notable that Serbia did not achieve a comparative advantage over the EU in 2020 and 2021, which can be attributed to the COVID-19 pandemic and the subsequent disruptions in trade flows. Regarding the CEFTA region, the RCA index suggests the existence of comparative disadvantages in the export of tobacco and tobacco products. Much like the EU, CEFTA maintains a negative trade balance for this product group; however, the deficit among CEFTA countries is significantly smaller, which explains the RCA values being below the reference threshold. Conversely, the LFI index presents a different perspective. According to this metric, Serbia does not achieve comparative advantages in tobacco trade with the EU, while the comparative advantages in trade with CEFTA are substantial and exhibit a continuous upward trend. This discrepancy underscores the importance of including imports in the analysis; it suggests that while Serbia maintains a negative foreign trade position with the EU, it records an increasing trade surplus with CEFTA countries. It is evident that the inclusion of imports significantly alters the perception of a country's export competitiveness, particularly in instances where a negative trade balance exists with the specific country or group of countries serving as the benchmark (Akbaş & Sancar, 2021). These findings align with the results of Zekić et al. (2016), who also identified comparative advantages with the EU using the RCA index and with CEFTA through the LFI index. Due to the timeframe analyzed, this study serves as a longitudinal extension of the aforementioned research, confirming that the import-export dynamics of the Serbian tobacco industry have remained largely consistent across the observed periods. The limitation of this study lies in the relatively short observation period, which is a consequence of data

unavailability for a longer timeframe. A better insight into the existence of comparative advantages and the factors influencing them could be achieved if higher-frequency data were available, such as on a quarterly or monthly basis. Regarding tobacco production, which serves as a key determinant of export performance, it is crucial to observe that production within EU member states has experienced a continuous decline between 2017 and 2024, notwithstanding minor fluctuations. This downward trend is driven by increasingly stringent regulations aimed at tobacco control and a broader societal shift toward smoke-free environments and healthier lifestyles, complemented by frequent bans on tobacco use in both indoor and outdoor public spaces. In contrast, such regulations are notably more lenient in CEFTA countries and Serbia, where sharp declines in production have not been recorded. Furthermore, according to research by Tica et al. (2023), Serbia ranks as the sixth-largest tobacco producer in Europe and is the only country recording production growth (at a marginal annual rate of 1%). This climate fosters a favorable environment for maintaining a positive foreign trade position—primarily through exports—as evidenced by the results obtained via the RCA index. However, import values remain substantial and can significantly alter the perception of a country's trade position. For Serbia, the period following the abolition of production-based subsidies (per kilogram of tobacco) proved particularly challenging, as it led to price increases and a subsequent shift in demand toward cheaper imported alternatives. This factor contributes to the negative results yielded by the LFI index in trade with the EU. Conversely, research by Vladisavljević et al. (2020) provides a counterargument. Their study examines consumer behavior within the Serbian tobacco market, highlighting the price inelasticity of demand for this product group. The authors report a price elasticity coefficient of -0.639, implying that a 1% increase in tobacco prices results in a demand reduction of only 0.64%, which is statistically marginal. Although the study by Vladisavljević et al. (2020) covers only a portion of the period analyzed in this paper (2014–2017), its findings are instrumental in understanding the positive foreign trade position with CEFTA identified through the LFI method. In essence, despite rising prices, consumer habits among Serbian smokers remain largely unchanged, suggesting that demand persists consistently for both domestic and imported tobacco products.

6. CONCLUSION

The paper presents methods for determining comparative advantages in exports and provides an explanation of the export position of the Serbian tobacco industry regarding the EU and CEFTA markets from 2014 to 2024. Based on the available literature, the most significant indicators of export competitiveness were determined and subsequently applied in this study. The RCA index identified comparative advantages in the export of Serbian raw tobacco on both the global and EU markets, while indicating comparative disadvantages within the CEFTA market. Conversely, the LFI pointed to a lack of comparative advantages on the global market, moderate comparative advantages in the EU market, and the existence of certain comparative advantages within the CEFTA market. It was established that the discrepancy in results stems from the methodological differences between these indicators; furthermore, because the LFI incorporates imports into the analysis, it represents a more reliable measure of competitiveness.

The results demonstrate that the comparative advantage in exporting a specific product is not solely dependent on a country's export performance; rather, other significant factors fundamentally influence and reshape the foreign trade outlook of the observed country or group of nations. Foremost among these is import performance, which necessitates integration into the analysis—a core feature of the LFI methodology. By combining export data with import dependency, a more comprehensive view of the national trade balance is achieved, further validating the LFI index as a more reliable instrument for determining comparative advantages. In addition to imports, domestic production plays a pivotal role in establishing export potential. Although the number of tobacco producers in Serbia is declining, there is a concurrent increase in total output and the total area of land dedicated to tobacco cultivation, indicating a trend toward production consolidation and the emergence of fewer, larger-scale producers. Focusing on the Serbian context, the cessation of production-based subsidies (per kilogram of tobacco) led to the dissolution of smaller agricultural holdings. This underscores that state economic policies significantly dictate a country’s foreign trade position and its subsequent ability to secure comparative advantages. The EU case provides further empirical confirmation, where stringent regulations aimed at tobacco control have led to a persistent decline in production, a subsequent drop in exports, and a resultant negative trade position. Furthermore, market characteristics—such as scale, concentration, and consumer behavior—are critical determinants. While the EU market is the largest and exhibits the highest demand for tobacco products, anti-tobacco policies have constrained supply, leading to price increases. It can be posited that these price hikes exert an additional positive impact on public health and the reduction of tobacco smoke emissions within the EU. Conversely, Serbia presents a distinct contrast, as evidence shows that price fluctuations have a negligible impact on consumers' decisions to cease tobacco use. The CEFTA region represents a medium-sized market relative to the EU and Serbia, characterized by a balanced demand for both domestic and imported tobacco products based on observed trade flows. In conclusion, the primary determinants for achieving comparative export advantages include exports, imports, production volume, market and consumer characteristics, and the regulatory frameworks of the observed regions. Consequently, it is not unexpected that different indicators yield diverging results; it is imperative that the aforementioned determinants of export competitiveness be carefully considered when applying any specific methodological framework.

This study could be useful to various interest groups, such as:

- State authorities and institutions – the research results can be utilized by policymakers in the fields of agriculture, economics, and trade to design and implement more effective export support strategies for tobacco and tobacco products.
- Tobacco supply chain participants – tobacco growers, processors, and manufacturers of tobacco products can utilize this analysis for production and sales planning based on the research findings.
- Economic analysts and researchers – this paper can serve as a starting point for further research on the export competitiveness of the agri-food sector, the tobacco industry as a whole, or specific products. Furthermore, since the focus is on Serbia's export competitiveness, the research findings can be used for benchmarking against other countries or for comparing tobacco with other products that hold a significant share of Serbia's total exports.

Future research could focus, provided that data is available, on the export competitiveness of tobacco products or the entire tobacco industry over a longer period; additionally, it could investigate the degree of integration of these products into international markets.

ReferenceS

Akbaş, Y. E., & Sancar, C. (2021). The impact of export dynamics on trade balance in emerging and developed countries: An evaluation with middle income trap perspective. *International Review of Economics & Finance, 76,* 357–375. https://doi.org/10.1016/j.iref.2021.06.014

Balassa, B. (1965). Trade liberalization and revealed comparative advantage. *The Manchester School of Economic and Social Studies, 33*(2), 99–123.

Deaton, A. (1988). Quality, quantity, and spatial variation of price. *American Economic Review, 78(3),* 418–430.

Food and Agriculture Organization of the United Nations (FAO). (2026). *FAO website.* https://www.fao.org/

Grubel, H. G., & Lloyd, P. J. (1975). *Intra-industry trade: The theory and measurement of international trade in differentiated product.* Wiley.

Lafay, G. (1992). The measurement of revealed comparative advantages. In M. G. Dagenais & P. A. Muet (Eds.), *International trade modeling* (pp. 209–234). Chapman and Hall.

Matkovski, B. (2019). Agri-food competitiveness in South East Europe. *Outlook on Agriculture, 48*(4), 326–335. https://doi.org/10.1177/0030727019854770

Matkovski, B., & Đokić, D. (2014). Supporting tobacco production in Serbia. *Agroekonomika, 43*(63–64), 154–164.

Nuševa, D., Marić, R., Đurković Marić, T., Macura, N., & Kovačević, M. (2024). The impact of CEFTA Agreement on the Republic of Serbia foreign trade improvement. *Ekonomija – Teorija i Praksa, 17*(1), 109–126. https://doi.org/10.5937/etp2401109N

Swinnen, J. F. M., & Vandeplas, A. (2010). Market power and rents in global supply chains. *Agricultural Economics*, *41*, 109–120.

Statistical Office of the Republic of Serbia (SORS). (2025). *Official website.* https://www.stat.gov.rs/

Tica, T., Matkovski, B., Đokić, D., & Jurjević, Ž. (2023). Characteristics of the supply chain of tobacco and tobacco products: Evidence from Serbia. *Agriculture*, *13(9),* 1711. https://doi.org/10.3390/agriculture13091711

Vladisavljević, M., Zubović, J., Đukić, M., & Jovanović, O. (2020). Tobacco price elasticity in Serbia: Evidence from a middle-income country with high prevalence and low tobacco prices. *Tobacco Control, 29*(5), 331–336. https://doi.org/10.1136/tobaccocontrol-2019-055262

Vollrath, T. L. (1991). A theoretical evaluation of alternative trade intensity measures of revealed comparative advantage. *Weltwirtschaftliches Archiv / The Review of World Economics, 127*(2), 265–279.

Vuković, B., Mijić, K., & Spahić, N. (2015). Concentration of tobacco market: Evidence from Serbia. *Economics of Agriculture, 62*(2), 385–398.

World Health Organization, & National Cancer Institute. (2017). *The economics of tobacco and tobacco control* (National Cancer Institute Tobacco Control Monograph No. 21). U.S. Department of Health and Human Services, National Institutes of Health. https://cancercontrol.cancer.gov/brp/tcrb/monographs/monograph-21

Zekić, S., Matkovski, B., Đokić, D., & Kleut, Ž. (2016). Competitiveness of tobacco and tobacco products: The case of Serbia. *Custos e Agronegocio Online, 12*(2), 191–211. http://www.custoseagronegocioonline.com.br/numero2v12/OK%2010%20tobacco%20english.pdf

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DEMOGRAPHIC AGEING AND LABOUR MARKET CHALLENGES IN SERBIA: TRENDS, REGIONAL DISPARITIES AND POLICY IMPLICATIONS

Population ageing is one of the most important long-term demographic processes affecting contemporary societies, with substantial implications for labour markets, social protection systems, and regional development. This paper analyses demographic ageing trends in Serbia and examines their implications for labour market developments. Particular attention is given to labour supply, workforce replacement, regional disparities, and age- and gender-related employment patterns. The study adopts an indicator-based, descriptive, and comparative approach using official statistical sources from the Statistical Office of the Republic of Serbia (SORS), including the 2022 Census, population estimates, Labour Force Survey (LFS) data, and official population projections for 2022–2052. These are complemented by contextual data from the United Nations (UN), the World Bank, and ILOSTAT. International comparisons are used only as contextual benchmarks, with the primary analytical focus remaining on Serbia. The findings suggest that advanced demographic ageing, depopulation, and selective migration are associated with growing labour supply pressures, uneven regional labour market dynamics, and increasing challenges for workforce renewal. The paper concludes by outlining policy implications related to productivity growth, longer working lives, gender equality, skills development, migration management, and balanced regional development.
Keywords: population ageing; labour market; Serbia; depopulation; regional disparities; gender gaps

1. INTRODUCTION

Population ageing has become one of the central structural transformations of the twenty-first century. Declining fertility, increasing life expectancy, and changing migration patterns have altered the age composition of populations worldwide. These processes have important implications for labour supply, productivity, pension systems, health expenditure, and regional development (Bloom et al., 2010; Lee & Mason, 2011).

These pressures are particularly visible in Southeast Europe, where ageing is often accompanied by depopulation, persistent emigration, and pronounced territorial inequalities (Nikitović, 2015). In such contexts, labour market challenges can be intensified, as shrinking working-age cohorts coincide with weaker economic dynamism and regional polarisation. Serbia represents a clear example of this broader pattern.

Over recent decades, Serbia has experienced sustained population decline, fertility rates consistently below replacement level, and considerable migration losses, while life expectancy has continued to improve (Statistical Office of the Republic of Serbia [SORS], 2024a). These trends have resulted in an increasingly older population, with important implications for labour market functioning.

Against this background, the aim of this paper is to analyse demographic ageing trends in Serbia and to examine their implications for labour market developments. Specifically, this paper addresses three objectives:

1. To assess labour supply and workforce replacement challenges arising from demographic ageing in Serbia;
2. To examine regional disparities in demographic structures and labour market outcomes; and
3. To assess age- and gender-related dimensions of employment in the context of population ageing.

This paper does not seek to estimate causal effects using econometric modelling. Instead, it provides an indicator-based, policy-oriented assessment of the observable linkages between demographic ageing and labour market developments in Serbia. International comparisons are used only for contextual purposes and are not intended as a systematic cross-country analysis.

The remainder of this paper is structured as follows. Section 2 outlines the data sources and methodological approach. Section 3 analyses the scale of demographic ageing and its regional disparities in Serbia. Section 4 discusses labour market outcomes in the context of ageing. Section 5 considers older workers, sectoral issues, and the silver economy. Section 6 interprets future pressures using official population projections. Section 7 summarises the main findings and policy implications.

2. DATA AND METHODOLOGY

2.1. Data Sources

This study relies primarily on official statistical sources to ensure reliability and comparability. The core national data were obtained from the Statistical Office of the Republic of Serbia (SORS):

- 2022 Population Census (SORS, 2024a)
- Population estimates for 2023 (SORS, 2024b)
- Labour Force Survey (LFS) data for 2023 and 2024 (SORS, 2024c)
- Official population projections for 2022–2052 (SORS, 2024d)

To provide appropriate international context, selected indicators were drawn from internationally recognised sources:

- United Nations World Population Prospects 2024 (United Nations, Department of Economic and Social Affairs, Population Division [UN DESA], 2024)
- World Bank World Development Indicators (World Bank, 2024a, 2024b)
- ILOSTAT (International Labour Organization [ILO], 2025)

2.2. Methodological Approach

This paper employs a descriptive, comparative, and projection-informed, indicator-based approach. This design was selected because the aim is to identify structural patterns and policy-relevant implications, rather than to establish causal relationships. Accordingly, no econometric models, hypothesis tests, or microdata decompositions were undertaken.

The analysis consists of three distinct, but interconnected, components:

1. Descriptive demographic analysis:Used to identify long-term changes in population size, age structure, ageing intensity, and dependency ratios in Serbia.
2. Comparative analysis:Conducted at two levels: (a) an internal comparison across regions of Serbia to capture territorial disparities, and (b) a selective, illustrative international comparison to provide contextual benchmarks for Serbia.
3. Projection-informed interpretation:Used to assess likely future pressures by interpreting official population projections (SORS, 2024d; UN DESA, 2024), rather than generating independent forecasts.

This clear separation ensures that descriptive, comparative, and forecast-based elements are not conflated.

2.3. Indicators, Definitions, and Time Coverage

To ensure transparency, all key indicators used in this study are defined, sourced, and time-bound in Table 1. Where necessary, the author calculated specific indicators using official underlying data, with clear attribution provided.

Table 1. Indicators, sources, and time coverage

Indicator	Definition/Notes	Source	Period
Median age	Median age of the population (years)	UN DESA (2024)	1970–2024; projections to 2050
Share of population aged 0–14	Percentage of total population aged 0–14	SORS (2024a, 2024b); World Bank (2024b)	2002–2024
Share of population aged 65+	Percentage of total population aged 65 and over	SORS (2024a, 2024b); World Bank (2024b)	2002–2024
Ageing index	Ratio of population aged 65+ to population aged 0–14, expressed as a percentage. _(Calculated by the author using SORS data)_	Author calculation based on SORS (2024b)	2023
Old-age dependency ratio	Number of persons aged 65+ per 100 persons aged 15–64 (%)	World Bank (2024a)	2004–2024
Total dependency ratio	Number of persons aged 0–14 and 65+ per 100 persons aged 15–64 (%)	World Bank (2024b)	2004–2024
Employment rate	Employed persons as a percentage of the population aged 15–64	SORS (2024c)	2023–2024
Unemployment rate	Unemployed persons as a percentage of the labour force aged 15–64	SORS (2024c)	2023–2024
Informal employment	Percentage of total employment classified as informal, including agriculture and non-agriculture breakdowns	SORS (2024c)	2024
Gender gaps in labour market participation	Activity and employment rate gaps between men and women (aged 15–64), where available	SORS (2024c)	2023–2024

To ensure consistency with standard statistical practice, all labour market rates are reported for the population aged 15–64. Demographic indicators are based on official population structures and estimates. Any indicator calculated by the author is explicitly noted in Table 1.

2.4. Analytical Limitations

Several limitations should be acknowledged. First, this paper does not employ causal inference, and all observed associations should be interpreted as structural linkages and policy-relevant implications, not as causal effects. Second, the international comparison is selective and illustrative, intended only for contextualisation. Third, some areas, such as detailed age-by-sector employment, occupational-level ageing, and granular silver economy estimates, cannot be fully examined using publicly available aggregate data. Finally, some cross-tabulations at the district level are limited in availability. Despite these limitations, the combination of official demographic, labour market, and projection data provides a sufficiently robust basis for a policy-oriented analysis of Serbia.

3. DEMOGRAPHIC AGEING IN SERBIA: SCALE AND REGIONAL DISPARITIES

3.1. National Demographic Trends

Serbia has been experiencing a prolonged process of demographic ageing alongside sustained population decline. In 2023, the estimated population of Serbia was 6,623,183, with women accounting for 51.4% and men for 48.6% of the total population (SORS, 2024b). This represents a long-term downward trend.

The age structure has changed considerably over the past two decades. Between 2002 and 2020, the share of the population aged 0–14 declined from 16.1% to 14.3%, while the share aged 65 and over increased from 16.6% to 21.1% (SORS, 2024a). By 2023, persons aged 65+ accounted for 22.3% of the total population, compared to only 14.4% aged 0–14 (SORS, 2024b). This shift indicates that Serbia has reached a stage of advanced population ageing, with older cohorts substantially outnumbering younger cohorts.

These changes are driven by persistently low fertility, cohort ageing, and sustained migration losses. In 2024, the total fertility rate remained well below replacement level, at approximately 1.61 children per woman (SORS, 2024a). In combination with emigration of younger, working-age persons, these processes have narrowed the demographic base for future labour force entry (Nikitović, 2015).

3.2. International Benchmarks: Contextual Comparison

To situate Serbia's demographic profile, Table 2 provides a selective, illustrative comparison with selected European countries and Japan. This comparison is intended solely for contextual purposes and does not constitute a systematic cross-country evaluation.

Table 2. Selected international benchmarks for ageing indicators (latest available years)

Country/area	Share aged 65+ (%)	Share aged 0–14 (%)	Old-age dependency ratio (%)
Serbia	23.0	14.0	36.0
EU-27	21.0	15.0	34.0
Croatia	22.0	14.0	35.0
Bulgaria	24.0	14.0	38.0
Romania	20.0	16.0	33.0
Hungary	21.0	15.0	34.0
Japan	29.0	12.0	49.0

Note. Data are approximate, based on the latest available World Development Indicators (World Bank, 2024a, 2024b).

As Table 2 shows, Serbia's level of population ageing is comparable to many highly aged European countries. However, unlike many Western European economies, Serbia is experiencing these demographic pressures alongside lower levels of economic development and more limited fiscal capacity, which can constrain its capacity to adapt (Arandarenko, 2011).

3.3. Regional Disparities in Demographic Ageing

Demographic ageing in Serbia is spatially uneven. District-level evidence demonstrates substantial territorial differences in age structure, reflecting variations in fertility, economic opportunity, and internal and international migration. For example, districts in Southern and Eastern Serbia exhibit particularly high levels of ageing and depopulation, while more urbanised areas have comparatively younger age structures.

The Belgrade Region, as the country's economic and administrative centre, benefits from a concentration of education, services, and employment opportunities, making it a net recipient of internal migrants, particularly younger cohorts. By contrast, many peripheral districts experience sustained out-migration of youth and working-age persons, accelerating ageing and population decline (Nikitović, 2015).

These territorial disparities are highly relevant for labour markets. Regions with stronger ageing and depopulation are more likely to experience a shrinking labour supply, recruitment difficulties, weaker local economic bases, and reduced investment attractiveness. In contrast, dynamic urban regions are better positioned to retain and attract human capital. This interaction contributes to cumulative regional divergence across Serbia.

4. LABOUR MARKET OUTCOMES IN AN AGEING SOCIETY

4.1. Current Labour Market Conditions

Recent labour market data for Serbia suggest some aggregate improvements, while underlying demographic pressures persist. According to the Labour Force Survey, for the population aged 15–64, the employment rate reached 66.3% in 2024, and the unemployment rate stood at 8.9% (SORS, 2024c). These figures represent a marked improvement compared to earlier periods of high unemployment.

However, improving headline indicators can coexist with a shrinking working-age population. In ageing and depopulating societies, labour market tightening can occur in specific occupations, sectors, and localities, even when national unemployment rates decline.

Informal employment remains an important structural feature of the Serbian labour market. In 2024, informal employment accounted for 11.9% of total employment, with a much higher rate in agriculture (48.5%; SORS, 2024c). This is particularly important in the context of ageing, as informal work is often associated with weaker social protection, limited pension accrual, and greater economic vulnerability, especially for older workers in rural areas.

4.2. Labour Supply and Workforce Replacement

Demographic ageing has clear implications for labour supply and workforce renewal in Serbia. As smaller birth cohorts enter working age and larger cohorts reach retirement age, the ratio of labour market entrants to leavers becomes increasingly unfavourable. This creates growing replacement pressures across the economy.

These pressures are not uniform. Urban centres with stronger labour demand may partially offset demographic decline through internal migration, while peripheral regions have far fewer mechanisms for replenishing their labour force. Furthermore, replacement challenges are often most acute in occupations requiring long periods of training, specialist knowledge, or extensive practical experience.

4.3. Regional Labour Market Differences

Labour market outcomes in Serbia closely reflect regional demographic structures. The Belgrade Region consistently demonstrates stronger employment performance and labour market dynamism, while regions such as Southern and Eastern Serbia experience weaker economic activity, higher out-migration, and more severe ageing (Arandarenko, 2011; Nikitović, 2015).

These patterns suggest a mutually reinforcing cycle: demographic decline and ageing reduce the local labour supply, discourage investment, and weaken service provision, while weak economic opportunities accelerate out-migration of younger persons. This cumulative process risks deepening territorial inequalities if left unaddressed.

4.4. Gender Dimensions of Ageing and Labour Market Participation

Gender is a critical dimension of both ageing and labour market participation. Women tend to live longer than men, contributing to the feminisation of older age groups (UN DESA, 2024). At the same time, structural gender inequalities persist in the Serbian labour market.

Available LFS data indicate persistent gender gaps in activity and employment. For example, despite recent improvements, women's labour market participation remains below that of men, reflecting ongoing barriers related to unpaid care responsibilities, occupational segregation, career interruptions, and gender pay disparities (SORS, 2024c). In an ageing society, underutilising women's labour potential represents a significant constraint on overall labour supply.

Furthermore, these inequalities have long-term consequences for income security in later life. Lower lifetime earnings, interrupted careers, and concentration in lower-paid sectors can result in weaker pension entitlements for women (Government of the Republic of Serbia, 2023). Addressing gender inequalities is therefore essential for both gender equality and for strengthening labour supply, pension adequacy, and social sustainability in an ageing population.

5. OLDER PERSONS, SECTORAL ISSUES, AND THE SILVER ECONOMY

5.1. Older Workers and Sectoral Ageing

Extending working lives is likely to become increasingly important in Serbia as labour supply constraints intensify. Older workers can help mitigate replacement pressures, provided that appropriate workplace conditions, health supports, and flexible arrangements are in place.

Sectoral patterns are particularly important. Agriculture consistently exhibits an older workforce profile, especially in rural areas affected by youth out-migration. This is compounded by high levels of informal employment in agriculture (48.5% in 2024; SORS, 2024c), which can limit pension coverage and social protection for older agricultural workers.

In other sectors, the retirement of experienced workers may create skill bottlenecks, particularly in occupations requiring tacit knowledge, technical expertise, or long-term on-the-job training. However, it should be noted that a full, granular assessment of age-by-sector and age-by-occupation distributions is not currently available from publicly accessible aggregate sources. For this reason, this discussion is necessarily indicative and highlights the need for more detailed, disaggregated labour market data.

5.2. The Silver Economy

While population ageing is often framed in terms of fiscal pressures, it also presents important economic opportunities through the silver economy. The silver economy encompasses economic activities related to the production, consumption, and services for older persons, as well as their continued contributions to the labour market (Government of the Republic of Serbia, 2023).

From a labour market perspective, age-friendly workplaces, flexible working arrangements, phased retirement, and lifelong learning can enable willing and able older workers to remain economically active for longer. Beyond labour supply, growing demand for health care, long-term care, assistive technologies, adapted housing, and leisure services for older populations can stimulate employment and entrepreneurship across multiple sectors.

Older persons also represent a valuable source of human capital, including institutional knowledge, mentoring capacity, and professional experience. Policies that recognise and mobilise these assets, rather than focusing solely on dependency, are better aligned with Serbia's long-term economic sustainability. In this regard, the _Strategy for Active and Healthy Ageing in the Republic of Serbia for the Period 2024–2030_ provides an important institutional framework for integrating labour market participation, health, and social inclusion (Government of the Republic of Serbia, 2023).

6. PROJECTIONS AND FUTURE LABOUR MARKET PRESSURES

This section is based solely on the interpretation of official population projections, not on the generation of independent forecasts. The analysis draws on the official population projections of the Statistical Office of the Republic of Serbia for 2022–2052 (SORS, 2024d) and the United Nations World Population Prospects 2024 (UN DESA, 2024).

These official projections indicate that Serbia will continue to experience population decline and further demographic ageing over the coming decades. They suggest a sustained increase in median age, a declining share of the working-age population (15–64), and a continued rise in the old-age dependency ratio. Furthermore, territorial polarisation is expected to persist, with major urban centres likely to retain greater demographic resilience, while many peripheral regions are projected to experience more rapid ageing and depopulation (SORS, 2024d; UN DESA, 2024).

Based on these projections, several key labour market pressures can be anticipated:

4. Constrained labour supply:Smaller entry cohorts and larger retirement cohorts are likely to reduce the overall size of the labour force, absent significant increases in participation rates or changes in migration patterns.
5. Workforce replacement bottlenecks:Sectors and occupations with ageing workforces may face increasing difficulties replacing retiring workers, particularly in regions already experiencing labour shortages.
6. Widening regional disparities:More dynamic urban regions are likely to adapt more successfully, while peripheral regions may experience cumulative cycles of depopulation, labour market stagnation, and weakened service provision.
7. Increased pressure on pension and social protection systems:A rising old-age dependency ratio will place growing pressure on the balance between contributors and beneficiaries, with implications for fiscal sustainability and intergenerational equity (Lee & Mason, 2011).
8. Human capital risks:Continued emigration of younger and skilled persons would exacerbate labour supply constraints and undermine long-term human capital reproduction (Arandarenko, 2011).

7. CONCLUSION AND POLICY IMPLICATIONS

This paper has analysed demographic ageing trends in Serbia and their implications for labour market developments. The evidence indicates that advanced population ageing, combined with depopulation, low fertility, and selective migration, is associated with structural labour market challenges. These include a narrowing labour supply base, increasing workforce replacement needs, pronounced regional disparities, and persistent gender inequalities.

Although aggregate labour market indicators have improved in recent years, these short-term improvements should not obscure the long-term structural pressures arising from demographic change. Furthermore, the spatially uneven nature of ageing means that national-level averages mask significant territorial divergence between urban centres and peripheral regions.

To address these challenges, a coordinated, multidimensional policy response is required. Key policy implications include:

Productivity-led growth:Prioritise investments in technology, innovation, and organisational improvements to reduce over-reliance on labour quantity.
Extending working lives:Promote healthy, active ageing and age-friendly workplaces, supported by flexible working arrangements, phased retirement, and occupational health measures.
Gender equality in the labour market: Expand affordable childcare, parental leave policies, and measures to close gender pay gaps, reduce occupational segregation, and support career continuity for women.
Lifelong learning and skills development:Invest in upskilling, reskilling, and knowledge transfer programmes to address skill bottlenecks and retain institutional knowledge.
Migration management and human capital retention:Develop targeted policies to retain skilled younger workers and to attract talent to regions facing acute shortages, while ensuring effective integration.
Balanced regional development:Implement place-based strategies to strengthen economic diversification, infrastructure, education, and public services in ageing and depopulating peripheral regions.

Strengthen the silver economy:Support the development of goods, services, and employment opportunities linked to older populations, while recognising the productive contributions of older workers.

Ultimately, the success of Serbia's response to demographic ageing will depend on integrating these measures across employment, education, health, migration, gender, and regional development policies. Such an integrated approach is essential for ensuring long-term labour market resilience, social cohesion, and economic sustainability.

REFERENCES

Arandarenko, M. (2011). *Tržište rada u Srbiji: Trendovi, institucije, politike* [Labour market in Serbia: Trends, institutions, policies]. Faculty of Economics, University of Belgrade.

Bloom, D. E., Canning, D., & Fink, G. (2010). Implications of population ageing for economic growth. *Oxford Review of Economic Policy, 26*(4), 583–612. https://doi.org/10.1093/oxrep/grq038

Government of the Republic of Serbia. (2023). *Strategija aktivnog i zdravog starenja u Republici Srbiji za period od 2024. do 2030. godine* [Strategy for active and healthy ageing in the Republic of Serbia for the period 2024–2030]. Službeni glasnik Republike Srbije, 84.

International Labour Organization. (2025). *ILOSTAT country profile: Serbia*. https://ilostat.ilo.org/

Lee, R., & Mason, A. (Eds.). (2011). *Population ageing and the generational economy: A global perspective*. Edward Elgar.

Nikitović, V. (2015). Population ageing trends in Serbia from the beginning of the 21st century and prospects until 2061: Regional aspect. *Zbornik Matice srpske za društvene nauke, 151*, 185–200.

Statistical Office of the Republic of Serbia. (2024a). *Demographic yearbook of the Republic of Serbia 2024*. https://www.stat.gov.rs/

Statistical Office of the Republic of Serbia. (2024b). *Estimated population, 2023* (Communication No. 179). https://www.stat.gov.rs/

Statistical Office of the Republic of Serbia. (2024c). *Labour Force Survey, 2023–2024*. https://www.stat.gov.rs/

Statistical Office of the Republic of Serbia. (2024d). *Population projections of the Republic of Serbia, 2022–2052*. https://www.stat.gov.rs/

United Nations, Department of Economic and Social Affairs, Population Division. (2024). *World population prospects 2024: The 2024 revision*. https://population.un.org/wpp/

World Bank. (2024a). Age dependency ratio, old (% of working-age population) – Serbia. *World Development Indicators*. https://data.worldbank.org/indicator/SP.POP.DPND.OL?locations=RS

World Bank. (2024b). *World development indicators: Population structure and demographic indicators*. https://wdi.worldbank.org/