South East European Journal of Economics and Business

Volume 20 (2) 2025 • ISSN 2233-1999

UNIVERSITY OF SARAJEVO
School of Economics and Business

COPYRIGHT

The South East European Journal of Economics and Business (SEEJ) focuses on issues important to various economics and business disciplines, with a special emphasis on South East European region. For articles to be considered for the SEE Journal, authors should submit manuscripts electronically, as MS Word attachments through the following web page: seejournal.efsa.unsa.ba/submission. Submissions should include supplementary files with an indication of the author's background or position. Articles are considered for publication if they have not been published or accepted for publication elsewhere and have not been concurrently submitted elsewhere. For more information, please see the Guide for Submission of Manuscripts at the end of each issue or on the SEEJ website.

The South East European Journal of Economics and Business, ISSN 2233-1999, is published by the University of Sarajevo, School of Economics and Business, Trg Oslobodjenja - Alija Izetbegovic 1, 71000 Sarajevo, Bosnia and Herzegovina.

All correspondence should be addressed to The South East European Journal of Economics and Business, University of Sarajevo, School of Economics and Business, Trg Oslobodjenja-Alija Izetbegovic 1, 71 000 Sarajevo, Bosnia and Herzegovina, telephone: 00-387-(0)33-275-900, e-mail: seejournal@efsa.unsa.ba .

Abstracting and Indexing: This Journal is regularly indexed and abstracted by databases:

- Baidu Scholar
- Cabell's Directory
- CEJSH (The Central European Journal of Social Sciences and Humanities)
- Celdes
- CNKI Scholar (China National Knowledge Infrastructure)
- CNPIEC
- EBSCO (relevant databases)
- EBSCO Discovery Service
- EconBiz
- ECONIS
- EconLit
- Elsevier - SCOPUS
- Genamics JournalSeek
- Google Scholar
- International Abstracts in Operations Research
- J-Gate
- JournalTOCs
- KESLI-NDSL (Korean National Discovery for Science Leaders)
- Microsoft Academic
- Naviga (Softweco)
- Primo Central (ExLibris)
- ProQuest (relevant databases)
- ReadCube
- Research Papers in Economics (RePEc)
- ResearchGate
- SCImago (SJR)
- Sherpa/RoMEO
- Summon (Serials Solutions/ProQuest)
- TDNet
- Ulrich's Periodicals Directory/ulrichsweb
- WanFang Data
- Web of Science - Emerging Sources Citation Index
- WorldCat (OCLC)

Contents

South East European Journal of Economics and Business
Volume 20 (2) 2025, vi-viii
DOI: 10.2478/jeb-2025-0026

EDITORIAL

The *South East European Journal of Economics and Business*, Volume 20, Issue 2, brings together eleven research papers that address a wide range of contemporary economic and business challenges across developed, emerging and transition economies. The contributions span diverse thematic areas, including digitalization and remittances, export competitiveness, monetary policy and financial stability, product diversification, artificial intelligence and leadership, higher education and employability, foreign direct investment, public debt sustainability, sustainable consumption and the role of agriculture in economic growth. Covering regions of South East Europe, the Western Balkans, the Eurozone and advanced economies, the research papers employ rich firm-level, country-level, survey and bibliometric data, alongside a broad set of empirical methodologies, including GMM, ARDL, threshold models, gravity frameworks, and mixed-method approaches. Collectively, the papers provide scientific contributions and policy-relevant evidence that enhance understanding of economic development, resilience and structural transformation in a rapidly evolving global context. A short review of these contributions follows.

The first paper is written by Van Bon Nguyen, titled "Digitalization's Effect on International Remittances: The Hindrance of Institutional Quality in Advanced Economies," examines how digitalization influences remittance inflows in developed countries. Using panel data from 34 advanced economies from 2002 to 2021 and GMM estimation, the study finds that digitalization and governance individually promote remittances, but their interaction reduces them. It also shows that trade openness increases remittances, while economic growth has a negative effect, offering important policy implications.

Focusing on the determinants of export performance, the paper by Filip Novinc and Lorena Škuflić, titled "Is Cost Competitiveness a Sufficient Driving Force for Croatian Exports?", analyzes the role of cost competitiveness in shaping Croatian manufacturing exports. Using firm-level panel data from 2002 to 2022 and a first-differences OLS approach, the study finds that unit labor costs significantly influence export activity across firms, though with notable heterogeneity. The results show a non-linear relationship between costs and exports, weaker for low-export-intensity and high-tech firms, and indicate that more productive firms are less sensitive to cost changes, highlighting the growing importance of cost stability and productivity for export competitiveness.

Examining financial stability in a transition economy context, the paper by Rovena Troplini Vangjel, Skënder Uku and Xhevrije Mamaqi-Kapllani, titled "The Dynamic Interplay Between Credit Risk and Monetary Policy in Albania's Banking Sector: A Comprehensive Analysis," explores the relationship between credit risk and monetary policy in Albania's banking sector. Using ARDL modeling and data from 2015 to 2023, the study finds that higher central bank interest rates increase non-performing loans in both the short and long run, while post-crisis measures such as NPL write-offs and loan repayment postponements helped reduce credit risk. The results also show that inflation and managed declines in the loan-to-deposit ratio support credit stability, highlighting the effectiveness of monetary policy in safeguarding banking sector stability.

Addressing firm strategy in financial services, the contribution by Bojan Srbinoski, Klime Poposki and Jasmina Selimovic, titled "Product-Line

Diversification and Financial Performance: The Case of the Macedonian Non-Life Insurance Market" examines how product diversification affects insurer profitability in North Macedonia. Using firm-level data from 2013 to 2022 and IV-2SLS estimation, the study finds a nonlinear relationship between diversification and financial performance, where moderate diversification improves profitability but excessive diversification reduces returns. The results support the coexistence of specialized and diversified insurers and suggest that cautious market liberalization and close risk monitoring are important for sustainable performance.

Taking a meta-analytical perspective, the article by Enis Mulolli and Xhavit Islami, titled "Artificial Intelligence and Digital Leadership: Mapping Research Trends and Thematic Patterns" explores how artificial intelligence has shaped leadership research in the context of digital transformation. Using a bibliometric analysis of 60 articles from 2019 to 2025 the study identifies rapid growth in research output, key authors and sources, and six major thematic clusters, with AI, leadership, and digital transformation as the core theme. The findings also reveal expanding international collaboration and highlight emerging keywords, offering a structured overview of the field and directions for future research.

In the context of evolving labor markets, the paper by Anes Hrnjic, Amila Pilav-Velic, Lejla Dedovic and Nejra Hadžiahmetović-Milisic, titled "The Future of Work in Transition Economies: Integrating AI, Digital Skills, and Employability in Higher Education" examines how higher education can better prepare students for digitally transformed labor markets in transition economies. Using a mixed-methods approach based on survey data and qualitative input from industry professionals, the study finds that combining soft skills, digital competencies and AI tools significantly improves student employability. The results highlight the importance of student autonomy in translating AI use into academic and labor market success, offering practical recommendations for educators and policymakers.

Shifting attention to international investment behavior, the paper by Emre Bilgiç, Fevzi Ölmez, and Ines Kersan Skabic, titled "Is Cultural Distance Beneficial? Evidence from Outward FDI Flows in an Emerging Market Context" examines the role of cultural distance in shaping Türkiye's outward foreign direct investment. Using panel OLS, random effects and quantile regression models on data covering 26 partner countries from 2001 to 2022, the study finds a positive and statistically significant effect of cultural distance on OFDI across all Hofstede cultural dimensions. The results contribute new evidence from an emerging market perspective and emphasize the importance of a contextual approach to understanding how cultural differences influence international investment decisions.

Addressing consumer behavior in the context of sustainability, the paper by Halida Sarajlić, Lordan Kondić and Ana Lincender, titled "Sustainable Consumption Behavior Among Generation Z in Croatia: Understanding Actions and Attitudes in the Context of Global Ecological Challenges," analyzes the determinants of environmentally sustainable behavior among Croatian Generation Z consumers. Based on survey data from 334 respondents and using confirmatory factor analysis and linear regression, the study finds that saving orientation and product reusability positively influence sustainable behavior, while unneeded consumption has no significant effect. The results indicate that Gen Z adopts sustainable practices mainly when they offer economic or practical benefits, providing valuable insights for promoting sustainability in post-transition EU economies.

Focusing on sectoral contributions to growth, the paper by Milka Grbić, Vladan Ivanovic, and Jasna Atanasijević, titled "Long-Run and Short-Run Relationship Between Agricultural Value Added and Economic Growth: Empirical Evidence from Serbia" examines the link between agriculture and economic growth in Serbia. Using the ARDL approach and data from 1995 to 2023, the study finds a positive and statistically significant relationship between agricultural value added and real GDP growth in both the long and short run, with stronger effects in the long term. The results confirm a stable long-run equilibrium and highlight the importance of agricultural development policies for supporting sustainable economic growth.

From a macro-fiscal perspective, the paper by Hajdar Korbi and Avdullah Hoti, titled "The Debt-Growth Relationship in the Western Balkans, Developing Europe, and the Eurozone Economies: Testing for the Existence of a Tipping Point" analyzes whether public debt hinders economic growth beyond certain thresholds. Using a threshold regression model, the study identifies region-specific

debt limits—22.2 percent for the Western Balkans, 37.4 percent for emerging European economies, and 82.6 percent for the Eurozone. The findings highlight that debt-growth dynamics vary across regions, emphasizing the need for tailored fiscal strategies rather than a uniform approach to debt management.

Concluding the issue's focus on international economic integration, the paper by Filip Selamovski, titled "Drivers of Foreign Direct Investment in Developing Countries: Evidence from North Macedonia Using a Gravity Model Approach" analyzes the determinants of foreign direct investment in North Macedonia using a gravity model applied to panel data from 35 countries over the period 2010–2023. The findings indicate that economic size, geographic proximity, economic integration, historical and cultural ties, bilateral investment treaties and double taxation avoidance agreements have a positive impact on FDI stock, reflecting the effectiveness of the country's post-Yugoslav openness and investment zones. In contrast, inflation, political corruption, and innovation do not show a significant influence, highlighting the importance of diversifying FDI sources to enhance resilience and long-term economic stability.

On behalf of Editorial Board
Adnan Efendic, Editor-in-chief

University of Sarajevo,
School of Economics and Business

South East European Journal of Economics and Business
Volume 20 (2) 2025, 1-15
DOI: 10.2478/jeb-2025-0015

DIGITALIZATION'S EFFECT ON INTERNATIONAL REMITTANCES: THE HINDRANCE OF INSTITUTIONAL QUALITY IN ADVANCED ECONOMIES

Van Bon Nguyen

Abstract

Digital technology is crucial in reshaping economies by diminishing transactional barriers and fostering economic expansion. Concurrently, international remittance inflow is a potent tool for poverty alleviation and employment enhancement. The paper's objective is to explore the impact of digitalization on international remittances within advanced economies and to analyze how the level of institutional development influences this relationship. The research utilizes Internet user rates and fixed broadband subscription statistics as indicators of digitalization and the difference GMM estimators for a panel dataset of 34 developed countries from 2002 to 2021. The results present a counter-intuitive that digitalization and governance promote international remittances, but their interaction terms reduce these remittances. Furthermore, trade openness enhances remittances, while economic growth impedes them. From these findings, some policy lessons are suggested to look for insights into the role of institutional quality in the digitalization–international remittances nexus.

Keywords: *digitalization, international remittances, institutional development, advanced economies*

JEL code: *C23, G21, O47*

1. Introduction

In several countries, international remittances play a pivotal role in driving economic development and fostering growth, thereby leaving a positive imprint on the overall economy (Adams Jr and Page 2005). These financial inflows serve as a lifeline for countless households, enabling them to improve their quality of life and alleviate poverty in regions striving to advance. This transformative impact is attributed to the ability of remittances to cover essential daily expenses, facilitate access to education, and support crucial healthcare expenditures (Adams Jr and Page 2005).

Moreover, the significance of international remittances extends beyond their immediate effects. They possess an expenditure multiplier effect that contributes significantly to economic expansion. As households receiving remittances inject these funds into the local retail market, the demand for goods and services rises, leading to a domino effect of job creation and economic stimulation (Ratha 2003). This virtuous cycle of increased consumer spending amplifies the overall economic growth trajectory. The exemplary

Dr. Van Bon Nguyen
Associate Professor of Finance - Banking
Faculty of Finance, Ho Chi Minh University of Banking (HUB)
36 Ton That Dam St., Ward Sai Gon,
Ho Chi Minh City
Vietnam
bonnv@hub.edu.vn; boninguyen@gmail.com
ORCID: 0000-0002-6281-9893

influence of remittance inflows on economic growth can be seen in the experiences of countries like India, Bangladesh, Nepal, and Sri Lanka, as highlighted by Jawaid and Raza (2016). These countries have harnessed the potential of remittances as a powerful driver of their economic progress.

However, it is crucial to acknowledge that several countries face several challenges in effectively harnessing remittances for development. These challenges include underdeveloped financial markets, limited access to credit, and insufficient foreign currency reserves. Nonetheless, remittance inflow distinguishes itself as an exogenous factor, impervious to the domestic economic situation. Unlike other forms of capital, governments do not incur interest payments on remittances, rendering them a stable source of capital that can significantly bolster the balance of payments, particularly in countries grappling with current account deficits (Buch and Kuckulenz 2010). Consequently, international remittances emerge as a potent force for promoting economic development and financial stability in developing nations.

Despite playing a supportive role in the economy, remittances can exert adverse effects. They can cause an appreciation of real exchange rates in economies, resulting in reduced trade competitiveness - a phenomenon often referred to as the "Dutch disease" (Polat and Rodríguez Andrés 2019). To attract more remittance inflows, certain governments have implemented enticing policies. These policies include offering tax exemptions to remittance recipients, removing limits on remittance amounts, eliminating the requirement to channel remittances through the commercial banking system, and permitting recipients to allocate freely remittances for spending or investment purposes. These measures can lead to the dollarization of the economy, which was initially the driving force behind this phenomenon (Luca and Petrova 2008). Dollarization frequently becomes associated with illicit activities within the foreign exchange market. As the illegal foreign exchange market expands within a country, informal remittance inflows tend to increase, as this market facilitates unlawful business practices (Luca and Petrova 2008). Moreover, remittances can foster a psychological dependence among recipients on migrants residing in recipient countries. In some instances, recipients may not utilize the remittances efficiently, thus rendering remittances suboptimal as a source of capital for stimulating economic development (Chami, Fullenkamp, and Jahjah 2005). Enhancements in institutions, as observed by Li and Filer (2007), can reduce transaction expenses, leading to higher levels of international remittances. Digital technology likely offers a fast, convenient, and cost-effective way to transfer money, making it affordable for both senders and recipients. Moreover, it is increasingly becoming more widespread and accessible to a broader range of users. Notably, the findings of Kim (2021) indicate that in nations with robust institutions, remittances are channeled more effectively and efficiently towards fostering financial development compared to countries with less effective institutions.

Meanwhile, the global shift towards digital technology represents an irreversible transformation. Digitalization plays a crucial role in empowering developing economies to reduce income disparities with more developed counterparts. Policymakers have duly acknowledged the critical role of digitalization in ameliorating poverty and income inequality, as underscored in the development agenda. One of the most effective means to afford the underprivileged access to knowledge and the opportunity to enhance their skills for improved income is through the advancement of digital infrastructure. In some countries, the pursuit of digital technology stands as a paramount development objective, especially within the context of e-government. The advent of digital technology has starkly illuminated a digital divide within our society, exposing the fact that those with greater financial means enjoy more extensive access to digital resources compared to their less fortunate counterparts. The fundamental cause of this divide can be traced to the prerequisites of knowledge and financial resources necessary for acquiring digital skills – a significant impediment for individuals with limited income. This challenge is particularly acute in developing countries, where impoverished individuals often contend with meager incomes and must allocate their resources towards necessities such as sustenance and shelter.

Despite the critical importance of the subject, there is a notable scarcity of research dedicated to understanding the impact of digitalization on international remittances. This study aims to address this void in the literature and make a unique contribution by unveiling fresh insights into the contrasting role played by institutional structures. Indeed, research on the impact of digitalization on international remittances is notably limited, particularly in advanced economies. Furthermore, no studies have yet explored the role of institutional quality in the relationship between digitalization and remittances within these countries. To this end, the research investigates the impacts of digitalization, institutional quality, and their interaction on international remittances for advanced countries. The findings in this paper are crucial for deriving valuable policy insights that could guide economic development strategies in developed countries.

We propose the research question and hypotheses as follows:

Research Question: Does institutional quality contribute to the nexus between digitalization and international remittances in advanced countries?

Hypotheses:

H1: Digitalization positively impacts international remittances.

H2: Institutional quality positively influences international remittances.

H3: The interaction between digitalization and institutional quality negatively affects international remittances.

The structure of the paper is as follows: Section 1 introduces the topic, while Section 2 explores global international remittances and the role of digital technology in developing economies. Section 3 presents the theoretical framework and literature review, followed by an explanation of the empirical model and research data in Section 4. The results are presented in Section 5, and Section 6 concludes the paper by summarizing key findings, drawing conclusions, and offering policy recommendations.

2. Some facts on global international remittances and digital technology

2.1. Global international remittances

According to the World Bank (2022), in 2021, remittances in middle-income and low-income economies are expected to reach USD 589 billion, marking a 7.3% increase. In 2020, these economies experienced a 1.7% decline in remittances due to the global economic downturn caused by the COVID-19 pandemic. Remarkably, this is the second consecutive year in which remittance inflows in these economies (excluding China) are projected to surpass the combined total of Foreign Direct Investment (FDI) and Official Development Aid (ODA).

These findings underscore the critical role played by remittance inflows in supporting families' expenditures on essential needs such as healthcare, nutrition, and education in recipient countries. The support provided by migrants to their families in times of need is a significant factor contributing to the growth in remittances. The economic recovery observed in the United States and Europe, driven by employment support programs and fiscal stimulus measures, has further boosted this essential lifeline of support. About 75 percent of remittances are utilized for essentials such as food, medical costs, education fees, and housing expenses (International Fund for Agricultural Development, 2024). According to the United Nations Development Programme (2023), a significant portion of remittances, around 80 to 90 percent, effectively incur indirect taxation through expenditure on goods and services.

The distribution of remittance flows across global regions exhibits significant variations. In the Pacific and East Asia region, remittances are projected to decline by 4% to reach 131 billion USD in 2021. Excluding China, this region saw a modest increase of 1.4% in remittance inflows during 2021, with expectations of a further 3.3% rise in 2022. Notably, the top recipient countries in this region include Tonga (accounting for 43.9% of GDP), Samoa (constituting 21% of GDP), and the Marshall Islands (representing 12.8% of GDP).

Conversely, South Asia experienced an 8% surge in remittances, totaling 159 billion USD in 2021. This growth can be attributed to elevated energy prices, stimulus initiatives, and the economic recovery in the United States. In particular, India and Pakistan witnessed significant increases in remittance inflows, with India experiencing a 4.6% rise to reach USD 87 billion and Pakistan observing a substantial 26% increase, amounting to USD 33 billion.

Remittances in Central Asia and Europe grew by 5.3% in 2021, reaching USD 67 billion. This positive trend is primarily attributed to elevated energy costs and the economic resurgence within the European Union (World Bank, 2022). This noteworthy rebound follows an 8.6% decrease in 2020. In the coming year, remittance inflows to this region are anticipated to continue their upward trajectory, with a projected increase of 3.8% in 2022. Notably, these remittances have equaled or surpassed the combined figures of portfolio investments, Official Development Assistance (ODA), and Foreign Direct Investment (FDI) in 2020 and 2021. Tajikistan and the Kyrgyz Republic emerge as the leading recipients in this region, each receiving remittances exceeding 25% of their respective GDPs.

Moving to the Caribbean and Latin America, remittances are expected to experience a substantial 21.6% surge in 2021, reaching $126 billion. The standout countries in this region in terms of remittance receipts include El Salvador (accounting for 26.2% of GDP), Honduras (comprising 26.6% of GDP), Jamaica (equivalent to 23.6% of GDP), and Guatemala (representing 18% of GDP). Several factors contribute to the robust growth in this region, including the impact of hurricanes Grace and Ida, the ongoing COVID-19 pandemic, and the implementation of social and fiscal assistance programs. Additionally, the recovery

in employment within the hosting economies plays a pivotal role in bolstering these remittance figures. Projections for 2022 indicate a continued positive trajectory, with remittances expected to increase by 4.4%.

Remittances in North Africa and the Middle East are poised to surge by 9.7% in 2021, reaching $62 billion. This remarkable growth can be attributed to the steep rise in oil prices and the economic recovery observed within the European Union, with notable contributions from countries like Spain and France. Within this context, Egypt's remittances are projected to reach 33 billion USD, marking a significant 12.6% increase, while Morocco is expected to receive 9.3 billion USD, reflecting an impressive 25% rise. However, some economies within the region, such as Jordan (at 6.9% of GDP), Djibouti (at 14.8%), and Lebanon (at 0.3%), are expected to witness a decline in remittance flows during 2021. It's worth noting that remittances have become the largest external source of financing, surpassing debt flows, portfolio equity, Foreign Direct Investment (FDI), and Official Development Assistance (ODA). Projections for 2022 indicate a potential decline of 3.6% due to the ongoing impact of the Covid-19 pandemic.

Meanwhile, in Sub-Saharan Africa, remittances experienced a notable 6.2% increase in 2021, reaching $45 billion. The standout countries in this region in terms of remittance receipts include the Gambia (constituting 33.8% of GDP), Lesotho (comprising 23.5% of GDP), Cabo Verde (representing 15.6% of GDP), and Comoros (accounting for 12.3% of GDP). Looking ahead to 2022, remittances in this region are expected to continue their positive trajectory, with a projected increase of 5.5%, driven by the recovery in Europe and the United States.Top of Form

2.2. Global digital technology

Digital technology provides a swift, convenient, and affordable method for money transfers, benefiting both senders and recipients. Furthermore, it is rapidly becoming more widespread and accessible to a broader range of users. Therefore, this subsection will mention global digital technology.

According to ITU (2022), mobile phone ownership surpasses internet usage in nearly all regions, albeit with a narrowing gap. This shift is evident in the swift rise of mobile broadband subscriptions, which are rapidly catching up to mobile cellular subscriptions, previously at a plateau. The statistics reveal that the younger generation is the driving force behind this connectivity surge, with 75% of individuals aged 15-24 now online, compared to 65% of the rest of the population. Although the gender gap in internet usage is slowly shrinking, there is a growing imbalance in the distribution of non-users, with women disproportionately underrepresented.

Compared to the prior year, the affordability of basic fixed and mobile broadband services improved in 2022. Nevertheless, a substantial global disparity in affordability persists. According to ITU's 2022 report, individuals residing in low-income economies must allocate more than 9% of their income to the most budget-friendly mobile broadband option, which is more than six times the global average cost.

The release of the Fifth United Nations Conference on the Least Developed Countries (LDC) report highlights a compilation of crucial indicators about information and communications technology (ICT). This data spans from 2011 and serves to illustrate the advancements achieved by LDCs through the Istanbul Program of Action, as agreed upon during LDC-IV in 2022 (ITU, 2022). Furthermore, the report provides an update on the progress of SDG Target 9c, which aims to enhance ICT access and advocate for universal and affordable internet access in LDCs by 2020.

Based on the analysis, it seems highly unlikely that Least Developed Countries (LDCs) will achieve universal and meaningful connectivity, which entails providing everyone with access to a secure, enriching, productive, satisfying, and reasonably priced online experience. As of 2022, only 36% of the population in LDCs had internet access, a figure significantly lower than the global average of 66%. Furthermore, 17% of LDC residents lacked access to fixed or mobile broadband networks, resulting in a significant access gap.

The usage gap, constituting 47% of the population offline, faces additional barriers to internet access, particularly the high cost of ICT services. In LDCs, the cost of internet access is higher than in any other region. An example highlighting the lack of affordability of mobile broadband in many LDCs is that a standard mobile broadband package, including a 2 GB monthly data allowance, can consume nearly 6% of the average income in these countries. This percentage is roughly four times higher than the global standard price of 1.5%. According to the UN Broadband Commission's affordability target of 2%, only two LDCs meet this criteria.

3. Theoretical background

3.1. Theoretical framework

According to Emara and Zhang (2021), the action of foreign workers sending money back to their home countries is commonly referred to as "remittance

inflow." These monetary inflows play a pivotal role as a source of financial support for developing nations, often rivaling the scale of international aid programs. For countries heavily reliant on exporting their labor force, these remittances can constitute a substantial share of their international capital flow. As countries have increasingly adopted financial openness and economic liberalization, governments have relaxed restrictions on remittances, resulting in the rise of new and alternative channels for migrants to transfer foreign currency. Consequently, the number of individuals sending remittances has increased, supplementing traditional global remittance methods, as highlighted by Emara and Zhang (2021).

Recently, digital technology has gained prominence as a favorable option due to its inherent advantages. Tabit and Moussir (2016) point out that digitization can enhance the accessibility of financial services, thereby positively impacting remittances. These remittances are acknowledged as a substantial fund for developing countries, often surpassing official aid and foreign direct investment. Rodima-Taylor and Grimes (2019) emphasize that the evolution of digital financial services provides an opportunity to reduce costs and promote financial inclusion by facilitating easier access to financial services. The high cost of remitting funds in South-South transactions is primarily attributed to limited competition in the remittance market within the countries of origin and destination. Transactional costs play a pivotal role in shaping international remittances, and any reduction in these costs could boost workers' willingness to send remittances, as indicated by Ratha and Shaw (2007). Engbersen and Dekker (2014) and Withaeckx, Schrooten, and Geldof (2015) propose that digitization in telecommunication services can lower communication expenses, enhance flexibility, and improve accessibility. These advantages could, in turn, strengthen the connection between migrants and their families. In the meantime, institutional quality can positively influence international remittances as suggested by Lartey and Mengova (2016) and Ajide and Raheem (2016). Specifically, Lartey and Mengova (2016) offer empirical evidence showing that improvements in the quality of institutions tasked with monetary policy implementation lead to increased remittances, with the impact growing stronger as the institutions' quality enhances. Therefore, the relationship between digitalization and remittances can be shaped by institutional quality. On one hand, improvements in institutions can lower transaction costs as noted by (Li and Filter, 2007), resulting in increased international remittances. However, it can foster robust development and healthy competition among digital technology platforms, potentially leading to dominance and monopolization of digital technology in advanced countries. Digital-based enterprises play a pivotal role in determining the costs associated with remittance transfers and receipts, potentially driving up transaction expenses. Furthermore, unlike developing economies, developed countries often have an institutional environment characterized by high taxation on remittance flows. Consequently, the interaction between institutional quality and digitalization can diminish international remittances.

3.2. Literature review

Recent studies by Emara and Zhang (2021) and Gascón, Larramona, and Salvador (2023) on the impact of digitalization on remittances highlight the transformative potential of digital advancements in money transfers. These studies emphasize the effectiveness and cost-efficiency of digital channels for remittance transactions, pointing to digitalization as a promising avenue for facilitating remittances. The findings strongly advocate for the adoption of digital technology by governments and financial institutions, suggesting that embracing these innovations can enhance the attractiveness of remittance flows. This not only benefits senders and recipients but also contributes to the broader economic well-being of the country.

Emara and Zhang (2021) employed the two-step system GMM estimator to analyze data from 2004 to 2018, encompassing 34 countries across various stages of development. Their research unveiled a distinctive inverted U-shaped relationship between digital advancement and remittance flows, demonstrating statistical significance precisely at a particular threshold. Furthermore, the study highlighted that both economic growth and trade openness exerted a positive influence on the volume of remittances. Meanwhile, Lyons, Kass-Hanna, and Fava (2022) examined the 2017 World Bank Global Findex database within the context of the 16 largest emerging economies. Their findings revealed that countries with robust digital payment systems, exemplified by China and South Africa, exhibit a greater inclination to initiate and receive remittances using mobile devices or financial institutions. In addition, their research unearthed a positive correlation between the utilization of digital financial services and the likelihood of remittance transactions occurring through mobile phones and financial institutions. Recently, Gascón, Larramona, and Salvador (2023) employed the 2016 Multi-purpose Household Survey (EHPM16) and a two-step selection model to evaluate how digitalization has influenced

remittances in El Salvador. The findings indicate a significant increase in the probability of households receiving remittances due to digitalization. Nevertheless, it is worth noting that digitalization does not impact the actual amount of remittances received by these households.

Research into the factors that influence remittances examines a broad range of elements. Notably, remittance inflows assume a substantial significance, especially in the early stages of economic development, as they offer an extra source of income or investment opportunities for individuals residing in middle-income countries (Yoshino, Taghizadeh-Hesary, and Otsuka 2020). Aydas, Metin-Ozcan, and Neyapti (2005) utilized OLS regression to analyze a time series dataset from 1965 to 1993 in Turkey. Their findings indicate that remittances are negatively influenced by factors such as inflation, market premiums, and military regimes, while they are positively impacted by economic growth and exchange rate fluctuations. In a parallel fashion, Castillo-Ponce, Hugo Torres-Preciado, and Luis Manzanares-Rivera (2011) employ the Vahid and Engle methodology to analyze a time series dataset spanning from 1991 to 2008 in El Salvador. Their findings reveal that remittances are positively influenced by factors such as employment in California, money supply, and interest rate differentials. However, they observe that economic growth exerts a negative impact on remittances. In the interim, in their study spanning from 1980 to 2015 using a time series dataset in Egypt, Akçay and Karasoy (2019) applied the autoregressive distributed lag (ARDL) bounds test. Their findings highlight that inflation, economic growth, oil prices, and financial development contribute to an uptick in remittance inflows, while the exchange rate exerts a diminishing effect on these inflows. Yoshino, Taghizadeh-Hesary, and Otsuka (2020) employ a two-step difference Generalized Method of Moments (GMM) estimation approach to analyze data from 22 middle-income Asia-Pacific economies from 2002 to 2015. Their findings reveal that differences in income levels between sending and receiving countries, higher levels of education, and greater trade openness positively influence remittance flows. However, FDI and high unemployment rates tend to hinder the flow of remittances. Recently, Jijin, Mishra, and Nithin (2022) utilized the ARDL bounds testing approach to analyze a quarterly time series dataset spanning from the second quarter of 1996 to the fourth quarter of 2019 in India. Their findings indicate that economic growth and oil prices improve remittances, while the exchange rate has a negative effect, leading to a reduction in remittances.

From the literature perspective, particularly highlighted by Emara and Zhang (2021) and Gascón, Larramona, and Salvador (2023), there exists a notable absence of studies integrating institutional quality into the examination of the digitalization-international remittances relationship. Moreover, no existing research addresses this topic specifically within advanced country contexts. Therefore, this study aims to fill these gaps in the literature by investigating the role of institutional quality in shaping the digitalization-international remittances nexus, focusing particularly on advanced economies.

4. Methodology

4.1. Empirical model

Based on the work of Emara and Zhang (2021), the empirical equation has been revised as follows:

$$REM_{ij} = \lambda_0 + \lambda_1 REM_{ij\text{-}1} + \lambda_2 DIG_{ij} + \lambda_3 GO_{ij} + \lambda_4 (REM \times GO)_{ij} + Y_{ij}\lambda' + \tau_i + \psi_{ij} \quad (1)$$

where subscript *i* and *j* are the indexes of country and time, respectively. REM_{ij} is personal remittances (% GDP), $REM_{ij\text{-}1}$ is the initial value of remittances, DIG_{ij} is Individuals using the Internet (INN) or Fixed broadband subscriptions (BRO), proxies for digitalisation, GO_{ij} is governance indicator, and $(REM*GO)_{ij}$ is the interaction between remittances and governance indicators. Y_{ij} contains trade openness, economic growth, and inflation as control variables; τ_i efers to a country-specific effect that is time-invariant and not directly observable, and ψ_{ij} is a term of error that is specific to the observation; λ_0, λ_1, λ_2, λ_2, λ_3, λ_4, and λ' are estimated coefficients. In this study, an extensive review of relevant literature was conducted to pinpoint the control variables suitable for inclusion in the empirical model. The scholarly sources considered in this review encompass the works of Aydas, Metin-Ozcan, and Neyapti (2005), Castillo-Ponce, Hugo Torres-Preciado, and Luis Manzanares-Rivera (2011), Lartey and Mengova (2016), Akçay and Karasoy (2019), Emara and Zhang (2021), and Jijin, Mishra, and Nithin (2022) in the context of economic growth. Additionally, for the assessment of trade openness, references were drawn from Lartey and Mengova (2016), Yoshino, Taghizadeh-Hesary, and Otsuka (2020), and Emara and Zhang (2021). Lastly, in relation to inflation, insights were gathered from Aydas, Metin-Ozcan, and Neyapti (2005), Lartey and Mengova (2016), and Akçay and Karasoy (2019).

We have employed difference GMM estimators to compute the estimates for Equation (1), as these estimators effectively address four significant issues. To begin with, certain concrete factors like economic growth, digitalization, and inflation might act as endogenous regressors because they may have a bi-directional relationship with international remittances. Secondly, there may be unobservable characteristics in τ_i (fixed effects) that are correlated with the independent variables. Thirdly, the presence of GIN_{ij-1} can lead to high serial correlation in the data. Lastly, our dataset encompasses a relatively large number of countries (34) with a limited observation period (20). It drops out the utilization of random effects models, fixed effects models, OLS regression, and IV-2SLS estimators unsuitable, as they could introduce biased and inconsistent coefficient estimates.

Holtz-Eakin, Newey, and Rosen (1988) initially advocated for the adoption of the Generalized Method of Moments (GMM) Arellano and Bond (1991) estimator, which employs all variables in the form of the first difference in Equation (1) to eliminate fixed effects (τ_i). This estimator is commonly known as the Difference GMM estimator (DGMM). However, there is a challenge when applying the one-step DGMM (1DGMM) and the two-step DGMM (2DGMM) in small samples, as the number of instrumental variables increases quadratically with the growth of the time dimension, surpassing the number of panel units, as noted by Roodman (2009). Roodman (2009) proposes a practical guideline to address this issue. For the validity of instruments, Hansen and Sargan tests are utilized to detect endogenous phenomena, while Arellano-Bond tests AR(2) are employed to assess the serial correlation of errors in the first difference. Specifically, 1DGMM relies on Sargan and AR(2) tests, while 2DGMM employs Hansen and AR(2) tests.

4.2. Research data

In this research, we employ a dataset including personal remittances, internet usage rates, fixed broadband subscriptions per 100 individuals, real GDP per capita, trade openness, inflation, and governance indicators sourced from the World Bank. Our study focuses on a sample of 34 advanced economies[1] observed from 2002 to 2021.

Table A presents dataset information, while Table B and Table C illustrate descriptive statistics. The data in Table C indicate that advanced economies exhibit strong governance. Furthermore, Table D and Table E depict correlation matrices. In Table D, the findings indicate a positive connection between trade openness and international remittances, while economic growth shows a negative relationship with international remittances. Additionally, Table E underscores that correlation coefficients between various governance dimensions exceed 0.8, suggesting collinearity concerns. Consequently, it is advisable to utilize these variables independently in empirical equations to mitigate issues related to multicollinearity.

5. Results

5.1. 2DGMM estimates

Tables 1A and 1B display the 2DGMM estimates for the baseline regression (excluding the interaction term), whereas Tables 2A and 2B present the 2SGMM estimates for the full model (including the interaction term). Specifically, Tables 1A and 2A showcase the outcomes related to Internet users, while Tables 1B and 2B provide insights into fixed broadband. Each column within these tables corresponds to a distinct governance indicator. The results in all tables for all six governance indicators show consistent outcomes. It is worth noting that the paper acknowledges the endogeneity of digitalization (Internet users/fixed broadband) in all estimation procedures. So, it adopts the gmm style, employing digitalization as an instrumented regressor. Meanwhile, it utilizes remittances, governance, economic growth, trade openness, and inflation as instrumental regressors in the iv style.

Without the interaction term (Table 1A and Table 1B), the various models' findings indicate that digitalization and governance play a role in fostering international remittances. However, when we introduce the interaction term (Table 2A and Table 2B), these findings remain unchanged. In other words, digitalization and governance still positively affect international remittances, but the interaction term introduces a contrasting effect. These results validate the proposed hypotheses, confirming that institutional quality significantly influences the digitalization-international remittances nexus to the research question. It suggests that while digitalization improves international remittances, its positive impact is weakened by governance-related factors.

The advantages of digitalization for international remittances are significant. Digital technology offers a fast, convenient, and cost-effective way to transfer money, making it accessible to both senders and receivers at a relatively low cost. Moreover, digital technology is becoming increasingly universal and available to anyone who wants to use it. So, affordable and easy access to digital technology motivates overseas workers to send more remittances to their families in

Table 1A. Digitalisation, governance, and international remittances: baseline

Digitalisation = Individuals using the Internet (% of population)

Dependent variable: International remittances (% GDP)

Variables	GO1	GO2	GO3	GO4	GO5	GO6
Remittances (-1)	0.078	0.016	0.196***	-0.050	-0.068	0.117***
	(0.046)	(0.049)	(0.042)	(0.056)	(0.048)	(0.033)
Internet users	0.008***	0.005***	0.004**	0.007***	0.007***	0.005***
	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
Governance	0.171***	0.135***	0.035*	0.079***	0.166***	0.085***
	(0.035)	(0.046)	(0.020)	(0.029)	(0.059)	(0.033)
Economic growth	-0.009***	-0.007***	-0.006***	-0.010***	-0.009***	-0.006***
	(0.001)	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)
Trade openness	0.001**	0.001***	0.001***	0.001**	0.001*	0.001***
	(0.0005)	(0.0004)	(0.0004)	(0.0005)	(0.0005)	(0.0003)
Inflation	0.011**	0.000	0.000	0.008	0.008	-0.002
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.004)
Instrument	23	24	25	24	23	25
Country/Observation	34/510	34/510	34/510	34/510	34/510	34/510
AR(2) test	0.963	0.980	0.968	0.928	0.924	0.966
Sargan test	0.350	0.572	0.620	0.328	0.379	0.678
Hansen test	0.552	0.740	0.699	0.380	0.396	0.779

Note: *** denotes a 1% significance level, ** 5% significance level, and * 10% significance level.

Source: the author

Table 1B. Digitalisation, governance, and international remittances: baseline

Digitalisation = Fixed broadband subscriptions (per 100 people)

Dependent variable: International remittances (% GDP)

Variables	GO1	GO2	GO3	GO4	GO5	GO6
Remittances (-1)	-0.095***	-0.083**	0.132***	-0.299***	-0.159***	0.081
	(0.034)	(0.041)	(0.034)	(0.081)	(0.036)	(0.053)
Fixed broadband	0.002***	0.002***	0.001***	0.002**	0.002***	0.002***
	(0.0006)	(0.0006)	(0.0003)	(0.0008)	(0.0006)	(0.0004)
Governance	0.081**	0.149***	0.118**	0.500***	0.239***	0.199***
	(0.035)	(0.044)	(0.057)	(0.139)	(0.091)	(0.066)
Economic growth	-0.006***	-0.007***	-0.004***	-0.011***	-0.005***	-0.006***
	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)
Trade openness	0.001***	0.001***	0.001***	0.001***	0.000**	0.000**
	(0.0003)	(0.0003)	(0.0003)	(0.0006)	(0.0003)	(0.0002)
Inflation	0.003	0.000	-0.001	0.000	0.004	0.000
	(0.003)	(0.003)	(0.003)	(0.005)	(0.003)	(0.003)
Instrument	23	24	25	24	23	26
Country/Observation	34/510	34/510	34/510	34/510	34/510	34/510
AR(2) test	0.893	0.924	0.975	0.620	0.835	0.961
Sargan test	0.568	0.771	0.767	0.834	0.759	0.604
Hansen test	0.787	0.609	0.617	0.869	0.648	0.742

Note: *** denotes a 1% significance level, ** 5% significance level, and * 10% significance level.

Source: the author

Table 2A. Digitalisation, governance, and international remittances: full model

Digitalisation = Individuals using the Internet (% of population)

Dependent variable: International remittances (% GDP)

Variables	GO1	GO2	GO3	GO4	GO5	GO6
Remittances (-1)	0.048	0.054**	0.292***	0.207***	0.329***	-0.061***
	(0.029)	(0.024)	(0.033)	(0.029)	(0.012)	(0.007)
Internet users	0.013***	0.027***	0.012***	0.013***	0.032***	0.018***
	(0.003)	(0.003)	(0.002)	(0.003)	(0.005)	(0.004)
Governance	0.507***	1.196***	0.555***	0.570***	1.821***	0.836***
	(0.159)	(0.175)	(0.179)	(0.163)	(0.295)	(0.313)
Internet users*governance	-0.004**	-0.014***	-0.007***	-0.006***	-0.020***	-0.010***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)
Economic growth	-0.009***	-0.011***	-0.009***	-0.006***	-0.006***	-0.012***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Trade openness	0.001***	0.001***	0.0007**	0.001***	0.001***	0.003***
	(0.000)	(0.000)	(0.0003)	(0.000)	(0.000)	(0.000)
Inflation	0.009***	0.016***	0.014***	0.009**	0.005*	0.004***
	(0.003)	(0.003)	(0.003)	(0.004)	(0.002)	(0.001)
Instrument	31	31	31	31	32	32
Country/Observation	34/510	34/510	34/510	34/510	34/510	34/510
AR(2) test	0.945	0.974	0.948	0.989	0.953	0.906
Sargan test	0.114	0.362	0.705	0.134	0.325	0.112
Hansen test	0.652	0.443	0.394	0.663	0.499	0.639

Note: *** denotes a 1% significance level, ** 5% significance level, and * 10% significance level.

Source: the author

Table 2B. Digitalisation, governance, and international remittances: full model

Digitalisation = Fixed broadband subscriptions (per 100 people)

Dependent variable: International remittances (% GDP)

Variables	GO1	GO2	GO3	GO4	GO5	GO6
Remittances (-1)	-0.013	-0.083***	-0.026	-0.087***	-0.067***	-0.083***
	(0.023)	(0.023)	(0.026)	(0.031)	(0.023)	(0.004)
Fixed broadband	0.004***	0.010***	0.005***	0.008***	0.007***	0.005***
	(0.000)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)
Governance	0.499***	2.187***	1.000***	1.363***	1.335***	0.740***
	(0.176)	(0.350)	(0.276)	(0.501)	(0.203)	(0.243)
Fixed b. band*governance	-0.001**	-0.006***	-0.002***	-0.003***	-0.003***	-0.002***
	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.000)
Economic growth	-0.008***	-0.008***	-0.010***	-0.011***	-0.009***	-0.009***
	(0.012)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Trade openness	0.000**	0.001***	0.000	0.000**	0.000	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Inflation	0.008**	0.005**	0.012***	0.011***	0.009***	0.006***
	(0.003)	(0.002)	(0.004)	(0.003)	(0.002)	(0.002)
Instrument	31	31	31	31	32	32
Country/Observation	34/510	34/510	34/510	34/510	34/510	34/510
AR(2) test	0.938	0.943	0.960	0.877	0.901	0.915
Sargan test	0.635	0.675	0.273	0.361	0.506	0.798
Hansen test	0.820	0.866	0.757	0.575	0.695	0.747

Note: *** denotes a 1% significance level, ** 5% significance level, and * 10% significance level.

Source: the author

their original countries. Empirical evidence provided by Lyons, Kass-Hanna, and Fava (2022) and Gascón, Larramona, and Salvador (2023) suggests that digital technology enhances the probability of remittance transfers. In the meantime, the enhancement of institutional frameworks is of paramount importance in stimulating international remittances. Such improvements can effectively reduce transaction costs and promote economic endeavors (Li and Filer, 2007). Remittances are a vital source of capital for economic development, prompting governments to continually enhance and reform policies and regulations (institutional quality) to attract and increase these inflows. Su et al. (2021) indicate that maintaining high institutional quality is essential in enabling the transformation of remittance inflows into productive investments that foster long-term economic growth for countries. These conclusions align with earlier studies conducted by Lartey and Mengova (2016) and Ajide and Raheem (2016).

The interaction between digitalization and governance presents a complex challenge to international remittances. While advancements in digital infrastructure and governance frameworks can create opportunities for a more competitive environment, particularly for digital-based enterprises, the overall impact on remittance flows is not entirely positive. In the short term, increased competition within this landscape could drive down the costs of economic transactions, including sending and receiving remittances. Low costs would be a significant benefit, making it more affordable for individuals to transfer money across borders. However, this initial phase of competition may not be sustainable in the long run. As the market matures, smaller businesses may struggle to keep up with larger, more established firms, leading to consolidations. Over time, this could result in a few dominant players gaining monopolistic control over the remittance market. These large enterprises would then have the power to set prices at their discretion, potentially driving up the costs of remittance services once again. In addition, the impact of taxation policies, particularly in developed countries, further complicates the remittance landscape. These countries often impose high taxes on remittance transfers, which can significantly reduce the total amount of money received by recipients. This not only diminishes the financial benefits for the recipients but also exacerbates economic disparities between the sending and receiving countries.

The findings of this research underscore the necessity of shaping the institutional landscape to curtail the dominance of digital enterprises through unfettered competition. The institutional framework should be designed to foster fair competition among digital businesses while preventing monopolistic tendencies. It demonstrates that a strategic focus on institutional development within digital technology platforms not only lowers transaction costs for digital-based economic activities but also safeguards against a reduction in international remittances.

The paper notes the negative impact of economic growth and the positive influence of trade openness on international remittances. Economic growth increases individuals' earnings, signifying an enhancement in their quality of life. Migrant workers abroad often send international remittances to support their families with everyday expenses, healthcare, education, and even to foster job opportunities. Nonetheless, as living standards improve in the recipient nation, the volume of remittances may dwindle, a phenomenon corroborated by Castillo-Ponce, Hugo Torres-Preciado, and Luis Manzanares-Rivera (2011).

In contrast, the adoption of an open trade policy can create favorable conditions for the transfer of remittances from overseas to the home country. These advantages encompass reduced remittance transfer costs, higher remittance amounts, and simplified legal procedures. As a result, promoting trade openness can act as a catalyst for increasing international remittances, as demonstrated by studies conducted by Lartey and Mengova (2016), Yoshino, Taghizadeh-Hesary, and Otsuka (2020), and Emara and Zhang (2021).

5.2. Robustness check: 1DGMM estimates

The study utilizes 1DGMM to assess the resilience of 2DGMM estimations. The outcomes reported in Table 3A pertain to Internet users, while those in Table 3B relate to fixed broadband users. In line with the findings from the 2DGMM estimations, the results indicate that international remittances experience a positive impact from digitalization and governance. However, it is noteworthy that the interaction term between these factors has a diminishing effect on remittances. Additionally, economic growth is observed to have a decreasing influence on international remittances.

6. Conclusion

Digital technology is gaining increasing significance, with numerous experts foreseeing a gradual transition from conventional to digital economies in the forthcoming years. However, it is imperative to recognize that the institutional framework can yield unforeseen repercussions in the case of digital technology, particularly concerning international remittances.

Table 3A. Digitalisation, governance, and international remittances: full model

Digitalisation = Individuals using the Internet (% of population)

Dependent variable: International remittances (% GDP)

Variables	GO1	GO2	GO3	GO4	GO5	GO6
Remittances (-1)	0.413**	0.410**	0.399**	0.498***	0.244	-0.070
	(0.199)	(0.197)	(0.182)	(0.187)	(0.148)	(0.054)
Internet users	0.034**	0.059***	0.016***	0.056**	0.049**	0.060**
	(0.015)	(0.018)	(0.005)	(0.027)	(0.023)	(0.028)
Governance	1.919**	3.127***	0.734*	3.142**	2.823**	3.499*
	(0.873)	(1.016)	(0.421)	(1.611)	(1.399)	(1.936)
Internet users*governance	-0.020**	-0.038***	-0.010**	-0.037**	-0.031**	-0.043*
	(0.010)	(0.012)	(0.005)	(0.019)	(0.016)	(0.023)
Economic growth	-0.013***	-0.013***	-0.013***	-0.009**	-0.012***	-0.020***
	(0.004)	(0.001)	(0.004)	(0.004)	(0.003)	(0.004)
Trade openness	0.000	0.000	0.000	0.001	0.001	0.004
	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)
Inflation	0.019	0.023**	0.026**	0.014	0.009	0.009
	(0.012)	(0.011)	(0.012)	(0.012)	(0.011)	(0.010)
Instrument	31	31	31	31	32	34
Country/Observation	34/510	34/510	34/510	34/510	34/510	34/510
AR(2) test	0.981	0.597	0.758	0.949	0.892	0.812
Sargan test	0.122	0.352	0.489	0.428	0.110	0.108

Note: *** denotes a 1% significance level, ** 5% significance level, and * 10% significance level.

Source: the author

Table 3B. Digitalisation, governance, and international remittances: full model

Digitalisation = Fixed broadband subscriptions (per 100 people)

Dependent variable: International remittances (% GDP)

Variables	GO1	GO2	GO3	GO4	GO5	GO6
Remittances (-1)	-0.078	-0.192	0.023	-0.078	-0.224	-0.196
	(0.048)	(0.150)	(0.169)	(0.048)	(0.148)	(0.172)
Fixed broadband	0.011***	0.016***	0.008**	0.011***	0.010***	0.018***
	(0.002)	(0.006)	(0.004)	(0.002)	(0.003)	(0.007)
Governance	1.807**	3.477**	1.592	1.807**	2.170**	4.195*
	(0.819)	(1.593)	(1.427)	(0.819)	(0.935)	(2.317)
Fixed b. band*governance	-0.004**	-0.009**	-0.004	-0.004**	-0.005**	-0.012*
	(0.002)	(0.004)	(0.004)	(0.002)	(0.002)	(0.006)
Economic growth	-0.018***	-0.016***	-0.016***	-0.018***	-0.016***	-0.016***
	(0.002)	(0.003)	(0.039)	(0.002)	(0.003)	(0.003)
Trade openness	0.000	0.000	0.000	0.000	0.002	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
Inflation	0.021**	0.013	0.025***	0.021**	0.010	0.011
	(0.009)	(0.008)	(0.009)	(0.009)	(0.009)	(0.009)
Instrument	33	32	31	33	33	33
Country/Observation	34/510	34/510	34/510	34/510	34/510	34/510
AR(2) test	0.708	0.629	0.975	0.819	0.385	0.600
Sargan test	0.102	0.684	0.273	0.102	0.569	0.170

Note: *** denotes a 1% significance level, ** 5% significance level, and * 10% significance level.

Source: the author

While digital technology undeniably has the potential to bolster international remittances, the institutional framework can unpredictably shape the trajectory of digital technology, consequently influencing international remittances. Given these circumstances, this study employs 1DGMM and 2DGMM methodologies to assess the impact of digitalization and governance, as well as their interplay, on international remittances, using a panel dataset encompassing 34 advanced economies from 2002 to 2021. The results uncover that digitalization and effective governance positively impact international remittances, whereas the interaction between these factors has a counteractive effect. Furthermore, economic growth exhibits a negative correlation with international remittances, whereas trade openness demonstrates a positive association.

These findings provide key policy insights for governments in advanced economies seeking to boost growth through international remittances:

(1) Institutional Priorities: Instead of merely promoting competition, institutional reforms should remove barriers hindering digital platform expansion. Aligning with New Institutional Economics (NIE), this approach lowers transaction costs, fostering innovation and efficiency, particularly in financial and remittance transactions.

(2) Digital Transformation: Digital infrastructure is crucial for maximizing remittance benefits, reinforcing Schumpeterian growth theory, which links technological progress to long-term economic development. Governments should treat digital investments as core growth policies, using tax incentives and regulatory support to enhance remittance flows.

(3) Global Positioning: More efficient remittance systems can strengthen advanced economies' international influence, as remittances act as financial stabilizers for recipient countries. Dependency theory suggests wealthier countries shape economic dynamics, making seamless remittance transactions a strategic tool for financial inclusion and international engagement.

(4) Workforce Development: A digitally skilled workforce, as emphasized by human capital theory, enhances competitiveness in the global digital economy. Governments should invest in education and upskilling programs to support financial technology advancements and attract remittance-related financial flows.

In this study, we use World Bank data on Internet usage and fixed broadband subscriptions as proxies for digitalization due to their availability. However, future research could incorporate additional measures such as secure Internet servers and mobile cellular subscriptions from the World Bank database. Moreover, more comprehensive digital metrics - such as Digital Economy Metrics, Digital Society Metrics, Digital Industry Metrics, Digital Enterprise Metrics, Digital Client Metrics, and Digital Investment Metrics, as identified by Kotarba (2017) - should be utilized when available.

Regarding the difference GMM estimators, the past values of persistent variables often provide limited predictive power for future changes, weakening their effectiveness as instruments. Future studies should consider advanced estimation techniques such as panel quantile regression, pooled mean group estimation (PMG), or Cross-Sectional AutoRegressive Distributed Lag (CS-ARDL) for robust analysis to address this issue.

To deepen our comprehension of the connection between digitalization and international remittances, it is advisable for forthcoming research to undertake a comparative analysis of the impact of institutional quality on this phenomenon within both developed and developing economies.

Endnotes

[1] Australia, Austria, Belgium, Canada, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Japan, Korea, Rep., Latvia, Lithuania, Luxembourg, Malta, Netherlands, New Zealand, Norway, Portugal, Singapore, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, United Kingdom, and the United States.

Acknowledgement
This work is funded by Ho Chi Minh University of Banking (HUB).

References

Adams Jr, R. H. and Page, J. 2005. Do international migration and remittances reduce poverty in developing economies? World development 33 (10): 1645-1669.

Ajide, K. B. and Raheem, I. D. 2016. The institutional quality impact on remittances in the ECOWAS sub-region. African Development Review 28 (4): 462-481.

Akçay, S. and Karasoy, A. 2019. Determinants of remittances in Egypt: Do macroeconomic instability and oil price matter? International Migration 57 (5): 142-160.

Arellano, M. and Bond, S. 1991. Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. The Review of Economic Studies 58 (2): 277-297.

Aydas, O. T., Metin-Ozcan, K. and Neyapti, B. 2005. Determinants of workers' remittances: the case of Turkey. Emerging Markets Finance and Trade 41 (3): 53-69.

Buch, C. M. and Kuckulenz, A. 2010. Worker remittances and capital flows to developing economies. International Migration 48 (5): 89-117.

Castillo-Ponce, R. A., Hugo Torres-Preciado, V. and Luis Manzanares-Rivera, J. (2011). Macroeconomic determinants of remittances for a dollarized economy: the case of El Salvador. Journal of Economic Studies 38 (5): 562-576.

Chami, R., Fullenkamp, C. and Jahjah, S. 2005. Are immigrant remittance flows a source of capital for development? IMF Staff Papers 52 (1): 55-81.

Emara, N. and Zhang, Y. 2021. The non-linear impact of digitization on remittances inflow: Evidence from the BRICS. Telecommunications Policy 45 (4): 102112.

Engbersen, G. and Dekker, R. 2014. How social media transform migrant networks and facilitate migration. Global Networks 4 (64): 1–19.

Gascón, P., Larramona, G. and Salvador, M. 2023. The impact of digitalisation on remittances. Evidence from El Salvador. Telecommunications Policy 47 (4): 102500.

Holtz-Eakin, D., Newey, W. and Rosen, H. S. 1988. Estimating vector autoregressions with panel data. Econometrica 56 (6): 1371-1395.

ITU (2022). Measuring digital development: Facts and Figures 2022. https://www.itu.int/en/ITU-D/Statistics/Pages/facts/default.aspx [Accessed online 24 April 2023].

International Fund for Agricultural Development (2024). 14 reasons why remittances are important. https://www.ifad.org/en/web/latest/-/14-reasons-why-remittances-are-important. [Accessed online 26 August 2024]

Jawaid, S. T. and Raza, S. A. 2016. Effects of workers' remittances and its volatility on economic growth in South Asia. International Migration 54 (2): 50-68.

Jijin, P., Mishra, A. K. and Nithin, M. 2022. Macroeconomic determinants of remittances to India. Economic Change and Restructuring 55 (2): 1229-1248.

Kotarba, M. 2017. Measuring Digitalization Key Metrics. Foundations of Management 9 (1): 123-138.

Kim, J. 2021. Financial development and remittances: The role of institutional quality in developing countries. Economic Analysis and Policy 72: 386-407.

Lartey, E. K. and Mengova, E. 2016. Does institutional quality in developing countries affect remittances? The Journal of Developing Areas 50 (1): 59-76.

Li, S. and Filer, L. 2007. The effects of the governance environment on the choice of investment mode and the strategic implications. Journal of world Business 42 (1): 80-98. https://doi.org/10.1016/j.jwb.2006.11.006

Luca, A. and Petrova, I. 2008. What drives credit dollarization in transition economies? Journal of Banking & Finance 32 (5): 858-869.

Lyons, A. C., Kass-Hanna, J. and Fava, A. 2022. Fintech development and savings, borrowing, and remittances: A comparative study of emerging economies. Emerging Markets Review 51: 100842. https://doi.org/10.1016/j.ememar.2021.100842

Polat, B. and Rodríguez Andrés, A. 2019. Do emigrants' remittances cause Dutch disease? A developing economies case study. The Economic and Labour Relations Review 30 (1): 59-76.

Ratha, D. 2003. Workers' remittances: an important and stable source of external development finance. Global Development Finance. https://documents1.worldbank.org/curated/ar/698051468128113998/310436360_20050014094932/additional/multi0page.pdf

Ratha, D. and Shaw, W. 2007. South-South migration and remittances. World Bank Working Paper 102: 1–10.

Rodima-Taylor, D. and Grimes, W. 2019. International remittance rails as infrastructures: Embeddedness, innovation and financial access in developing economies. Review of International Political Economy 26 (5): 839–862.

Roodman, D. 2009. How to do xtabond2: An introduction to difference and system GMM in Stata. The Stata Journal 9 (1): 86-136.

Su, C. W., Sun, T., Ahmad, S. and Mirza, N. 2021. Does institutional quality and remittances inflow crowd-in private investment to avoid Dutch Disease? A case for emerging seven (E7) economies. Resources Policy 72: 102111.

Tabit, S. and Moussir, C.-E. 2016. Macroeconomic determinants of migrants' remittances: Evidence from a panel of developing countries. International Journal of Business and Social Research 6 (7): 1.

United Nations Development Programme (2023). How the money flows: Six major trends for remittances. https://www.undp.org/eurasia/blog/how-money-flows-six-major-trends-remittances [Accessed online 26 August 2024]

Withaeckx, S., Schrooten, M. and Geldof, D. 2015. Living across borders: The everyday experiences of Moroccan and Brazilian transmigrants in Belgium. Crossings: Journal of Migration & Culture 6 (1): 23–40.

World Bank (2022). Remittance Flows Register Robust 7.3 Percent Growth in 2021. https://www.worldbank.org/en/news/press-release/2021/11/17/remittance-flows-register-robust-7-3-percent-growth-in-2021 [Accessed online 16 March 2022].

Yoshino, N., Taghizadeh-Hesary, F. and Otsuka, M. 2020. Determinants of international remittance inflow in Asia-Pacific middle-income countries. Economic Analysis and Policy 68: 29-43.

Appendix

Table A. Data description

Variable	Definition	Type	Source
International remittances (REM)	"Personal remittances consist of compensation of employees and personal transfers (% GDP)"	%	World Bank
Individuals using the Internet (INN)	"Internet users are individuals who have used the Internet (from any location) in the last 3 months. The Internet can be used via a computer, mobile phone, personal digital assistant, games machine, digital TV,..."	%	World Bank
Fixed broadband subscriptions (per 100 people) (BRO)	"Fixed broadband subscriptions refers to fixed subscriptions to high-speed access to the public Internet (a TCP/IP connection), at downstream speeds equal to, or greater than, 256 kbit/s."	log	World Bank
Economic growth (GDP)	"GDP per capita (constant 2015 US$)"	log	World Bank
Trade openness	"The sum of exports and imports of goods and services measured as a share of gross domestic product."	%	World Bank
Inflation (INF)	"Inflation, consumer prices (annual %)"	%	World Bank
Regulatory Quality (GO1)	Governance indicators	level	World Bank
Rule of Law (GO2)			
Voice and Accountability (GO3)			
Control of Corruption (GO4)			
Government Effectiveness (GO5)			
Political Stability (GO6)			

Table B. Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
REM	2,040	5.434	7.272	0	50.101
INN	2,040	27.132	24.928	0	100
BRO	2,040	4.461	7.032	0.0001	37.575
GDP	2,040	5,012.742	7,970.547	267.319	77,544.030
OPE	2,040	76.181	33.238	11.855	210.400
INF	2,040	6.591	15.936	-72.729	557.201

Table C. Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
GO1	2,040	-0.479	0.593	-1.672	1.662
GO2	2,040	-0.398	0.585	-1.809	1.254
GO3	2,040	-0.355	0.755	-2.810	1.422
GO4	2,040	-0.355	0.642	-2.348	1.536
GO5	2,040	-0.467	0.590	-1.870	1.348
GO6	2,040	-0.384	0.770	-2.259	1.311

Table D. The matrix of correlation

	REM	INN	BRO	GDP	OPE	INF
REM	1					
INN	-0.024	1				
BRO	0.011	0.792***	1			
GDP	-0.197***	0.636***	0.677***	1		
OPE	0.179***	0.138***	0.136***	0.219***	1	
INF	-0.004	-0.061***	-0.056***	-0.055***	-0.017	1

Note: *** denotes a 1% significance level, ** 5% significance level, and * 10% significance level.

Table E. The matrix of correlation

	GO1	GO2	GO3	GO4	GO5	GO6
GO1	1					
GO2	0.791***	1				
GO3	0.565***	0.470***	1			
GO4	0.708***	0.822***	0.401***	1		
GO5	0.864***	0.845***	0.591***	0.792***	1	
GO6	0.596***	0.537***	0.419***	0.640***	0.632***	1

Note: *** denotes a 1% significance level, ** 5% significance level, and * 10% significance level.

South East European Journal of Economics and Business
Volume 20 (2) 2025, 16-33
DOI: 10.2478/jeb-2025-0016

IS COST COMPETITIVENESS A SUFFICIENT DRIVING FORCE FOR CROATIAN EXPORTS?

Filip Novinc, Lorena Škuflić

Abstract

This paper examines the extent to which Croatia relies on a cost-based export strategy by analyzing the link between cost competitiveness, measured by unit labor cost (ULC) and exports of manufacturing firms from 2002 to 2022. Using a panel first-differences OLS approach, the study finds that cost competitiveness significantly shapes export activity of firms of all sizes and technological intensities, but with considerable heterogeneity. The results show a non-linear relationship between ULC and exports that is not asymmetrical. The relationship is weaker for firms with lower export intensity and for high-tech firms. Higher ULC is associated with greater export sensitivity and lower productivity, confirming that export sensitivity is lower for more productive firms. In the future, a further strengthening of the link between costs and exports can be expected, i.e. exports will react more sensitively to cost fluctuations. As a result, price and cost stability will become even more crucial. Overall, this analysis provides the most comprehensive study to date on how cost factors affect Croatian merchandise exports, implying that boosting product quality and productivity can reduce cost pressures and promote long-term competitiveness.

JEL classification: *F14, L25, L60, D24*

Key words: *cost competitiveness, manufacturing industry, exports, unit labour cost*

1. Introduction

As a small, open economy with strong trade and financial integration, Croatia relies on exports to demonstrate its competitiveness. Export growth is particularly effective when it is based on technologically advanced products with higher added value, due to favorable spillover effects. Nevertheless, Croatian exports have long remained modest, partly due to an export structure dominated by labor- and resource-intensive goods, where price and cost factors have a significant impact on export performance.

Accordingly, this paper examines the impact of changes in cost competitiveness – measured by the key indicator of unit labor cost (ULC) – on Croatian manufacturing exports at the firm level with the aim of identifying the main causes of the country's low competitiveness at the macro level. ULC refers to labor cost per unit of output and thus includes both cost

Filip Novinc, PhD (Corresponding author)
Teaching and Research Assistant
Faculty of Economics and Business Zagreb,
University of Zagreb
Address: Trg J. F. Kennedy 6, 10000 Zagreb
Republic of Croatia
E-mail: fnovinc@net.efzg.hr
ORCID: 0000-0003-0500-1021

Lorena Škuflić, PhD
Full Profesor
Faculty of Economics and Business Zagreb,
University of Zagreb
Republic of Croatia
E-mail: lskuflic@net.efzg.hr
ORCID: 0000-0002-2978-2902

and productivity data, the latter being an important dimension of non-price competitiveness (Giordano and Zollino 2016). As the ULC captures both price and non-price aspects of competitiveness, it has a strong explanatory power for exports (Keil 2024).

The analysis focuses on companies in the manufacturing sector, as this sector generates on average more than 80% of the country's total merchandise exports. Numerous researchers have analysed the importance of price (cost) competitiveness in the Croatian economy, mostly using sectoral and aggregate data, but their results remain mixed. This study provides the most comprehensive insight into the relationship between ULC and exports in the domestic and foreign literature to date, using a comprehensive firm-level panel dataset spanning two decades (2002 – 2022).

Unlike previous studies, it explicitly analyses the heterogeneous effects of ULC across different firm sizes, export and technology intensities and productivity levels – dimensions that are largely unexplored in both the Croatian and foreign literature. Furthermore, this work provides the first empirical evidence of non-linearities in the relationship between ULC and exports at the firm level, thus deepening the understanding of export dynamics and competitiveness. Additionally, the thesis contributes to international research by building on and deepening lines of enquiry in the international trade literature that emphasise heterogeneous firms (Bernard, Jensen, and Lawrence 1995) and productivity as the central role of firm export performance (Melitz 2003).

By adopting a microeconomic perspective and using disaggregated data, this study examines several dimensions of the relationship between cost competitiveness and exports at the firm level that have not been analyzed in this depth before. These questions are examined empirically in the third chapter. Chapter two presents the theoretical framework, methodology and data used in the study. Chapter four discusses the results, makes policy recommendations and highlights the limitations of the study.

2. Theoretical background

Competitiveness is a multidimensional concept that is crucial for sustainable growth and development. It operates simultaneously at the firm, sector and national levels, but originates at the micro level – without competitive firms, industries and economies cannot thrive. At the firm level, competitiveness includes market share, product quality and innovation; at the macro level, it includes productivity, income growth, living standards and the ability to generate income in foreign markets. These dimensions are interconnected – only firms capable of producing competitive products can sustain export success at the national level.

Achieving and maintaining such performance is becoming increasingly difficult in the face of global competition, especially given the rapid industrial rise of emerging economies and the innovation-driven strategies of advanced ones. In highly developed economies, non-price factors tend to dominate competitive dynamics, although cost-based indicators (particularly ULC), remain relevant for both price and non-price dimensions of international competitiveness (Škuflić, Šokčević, and Bašić 2024).

ULC, defined as total labor costs per unit of output, can increase prices and lower domestic and foreign sales. However, Kaldor's paradox shows that higher growth is often accompanied by rising labor costs (Kaldor 1978), implying that low wages or currency manipulation alone cannot maintain competitiveness. Instead, long-term success depends on productivity increases, innovation and operational efficiency (Škuflić 2000). Moreover, in a globalized environment with highly mobile production factors, domestic demand plays a limited role. Various scholars describe competitiveness as the effective use of resources to achieve profit and prosperity in global markets (Garelli 2006; Porter 1985; Ernst 2004; Buckley, Pass, and Prescott 1988).

To summarize, competitiveness can be assessed in terms of growth rates in income or sales and expansion of market share. However, it is a great challenge to identify the exact channels through which such improvements are achieved or to determine the factors that can improve competitiveness both in the short term and maintain it in the long term. Each country that has been successful has done so in a way that reflects its unique historical context and prevailing international conditions, making direct replication ineffective. Accordingly, this paper examines ULC and its relationship to Croatian exports and the extent of its influence on exporters' competitiveness. The results can inform the design of targeted industrial and innovation policies aimed at improving competitiveness.

The analytical foundation of this paper is based on new trade theory and the literature on heterogeneous firms literature, which emphasize that firm-level productivity and cost structures determine export behavior (Melitz 2003; Bernard, Jensen, and Lawrence 1995). In this framework, cost competitiveness, proxied by ULC, influences not only firms' pricing strategies but also their market access and survival in competitive international markets. The endogenous relationship

between productivity, factor costs and export performance implies that cost competitiveness is not an isolated factor but is embedded in broader firm capabilities and structural conditions, emphasizing the need to consider price and non-price dimensions of competitiveness together.

2.1. Methodology

To examine the relationship between cost competitiveness – measured by unit labor cost (ULC), and exports of Croatian manufacturing firms, this study uses a first-difference ordinary least squares (OLS) estimator:

$$\Delta y_{it} = \alpha \cdot \Delta ULC_{it} + \Delta \boldsymbol{x}'_{it}\boldsymbol{\beta} + \mu_s + \mu_t + \Delta\varepsilon_{it}, \quad i=1,...,N, \quad t=1,...,T \tag{1}$$

where Δ denotes first differences, N is the number of cross-sectional units (firms), T is the number of time periods (years), y is the dependent variable, $\boldsymbol{x}'_{it}$ is a $1 \times K$ vector of regressors, $\boldsymbol{\beta}$ is a $K \times 1$ vector of parameters, μ_s is a time-invariant variable representing the fixed effect for the sector in which the firm operates (based on the first two digits of the NACE2 classification), μ_t is a time fixed effects common to all firms in a given year, ε_{it} is the idiosyncratic error term.

Endogeneity of the ULC necessitates using estimators including generalized method of moments (GMM). However, the GMM has disadvantages as instruments in first-difference specifications can be weak. By contrast, a system GMM estimator is recommended for highly persistent variables (as in our case) since the difference estimator has poor finite sample properties. However, the system GMM estimator must satisfy the Blundell–Bond condition – if it is violated, the coefficient estimates are inconsistent (Blundell and Bond 1998). This assumption presupposes that the firms are in equilibrium at the beginning of the analysed period, which seems rather unrealistic.

Since this study attempts to identify heterogeneous relationships between exports and ULC via interaction terms, GMM is unsuitable. Weak instruments and high standard errors using GMM makes it difficult to detect significant effects even if they exist. Moreover, studies investigating the relationship between ULC and exports using a first-difference model and OLS provide similar results to GMM (see e.g. Carlin, Glyn, and Van Reenen 2001; Decramer, Fuss, and Konnings 2016). Consequently, we use a first-difference OLS model to estimate the relationship between ULC and exports at the firm level.

We recognise the possible endogeneity of ULC arising from the simultaneity of export performance and productivity at the firm level. Although our identification strategy mitigates some bias, alternative approaches could strengthen the causal inferences. In particular, lagged values of ULC or external shocks, such as energy prices, regulatory changes or sector-specific input costs, could serve as instruments. However, the lack of exogenous cost shifting factors at company level limit their application. Nevertheless, future research could benefit from the inclusion of such instruments, especially if credible external shocks or policy discontinuities can be identified and used for causality estimation.

Several changes were made to test robustness, including redefining the dependent variable (using the firm's sectoral export share instead of total exports), removing certain regressors, and restricting the sample to firms with fewer than 20 employees. This ensures validity for very small firms, whose number and contribution to manufacturing exports has increased significantly over the last decade. In addition, all specifications are estimated for two periods: 2002–2013 and 2013–2022 (before and after Croatia's EU accession) to check whether the conclusions hold in both periods. Additional robustness checks are available on request.

2.2. Data

The data used in this analysis (2002 – 2022) come from the Financial Agency of the Republic of Croatia (FINA), Eurostat and the World Bank. The year 2002 was chosen because there were significant methodological changes that prompted firms to submit their annual financial records to FINA, so number of firms increased sharply in 2002 (Valdec and Zrnc 2015). The dependent variable is exports (X), measured by revenue from foreign sales, or the share of exports (XMS), defined as the share of a company in the total exports of its NACE2 sector. The key regressor is unit labor cost (ULC), representing the ratio of personnel expenditure to total revenue. Other regressors are the number of employees (L), tangible capital (K), intangible capital (NK) and unit material cost (UMC), measured as the ratio of material expenditure to total revenue.

Exports are normalized by a price index for foreign products (based on the NACE2 classification), while material (K) and non-material capital (NK) are deflated by the Croatian GDP deflator. The number of employees (L) controls for firm size, and UMC takes into account the non-wage labor costs of domestic and imported inputs. Material capital (K) can boost exports while increasing the share of capital in production, which lowers ULC. It also captures R&D efforts (Griliches and Mairesse 1995) and approximates technological progress, indirectly influencing ULC through

labor productivity. Nevertheless, some factors are not captured by the deflators and therefore remain unreflected in the measured productivity (Carlin, Glyn, and Van Reenen 2001). For instance, if higher prices reflect better product quality, deflating these values may misleadingly indicate lower productivity. Therefore, non-material capital (NK) is included to address this issue.

All variables are transformed with natural logarithms. Since the FINA database is based on self-reporting by companies, the data quality is poorest for the smallest firms. Consequently, observations with sales lower than one thousand euros and/or zero employees are excluded, and all negative or implausibly large numerical values are replaced by missing values. In this adjusted dataset, foreign sales (exports) account for 99,39% of the total sample exports, maintaining the representativeness of the analysis.

3. Assessment of the export competitiveness of Croatia

Croatia's position in the international competitiveness rankings remains relatively weak compared to its European competitors. In 2019, the country ranked 63rd in the Global Competitiveness Index (GCI), behind the Czech Republic, Poland and Slovenia. Although there have been improvements in overall competitiveness since 2013, export competitiveness remains limited.

Compared to other new EU member states, the share of Croatian goods exports in GDP is still relatively low. Much of Croatia's increasing openness is due to tourism rather than exports of goods. Other new member states started with a more favorable export position and have since widened the gap. For example, in 2022 Slovenia, despite being a smaller country, reached almost five times Croatia's share of EU imports (1.51% vs. 0.33%) and more than four times its share of global imports (0.42% vs. 0.09%; Eurostat 2024).

In addition, the composition of Croatian goods exports is significantly less favourable than that of comparable economies. In 2013, for example, the share of food, beverages, tobacco, raw materials, mineral fuels, lubricants and chemical products in Croatia's export mix was higher than in the above-mentioned comparator countries, while the share of machinery and transport equipment (which usually generate higher value added) wasn't even half as high. A similar pattern continued in 2022, with the exception of a lower share of chemical products.

Since manufacturing accounts for the largest share of Croatia's merchandise exports and usually comprises more complex products than raw materials or agricultural products, the competitiveness of manufacturing is central to the country's overall export competitiveness. Unfortunately, Croatia is also here lagging behind. In 2013, low-tech goods accounted for 56% of manufacturing exports, compared to 40% in comparable countries, while medium-tech exports accounted for 32%, significantly less than 48% in the peer group. High-tech exports accounted for around 12% in both Croatia and the comparison group. Unfortunately, there was no significant shift until 2022 (World Bank 2024). These patterns of unfavourable export structure and market shares indicate low export competitiveness, which is examined in more detail in the following sections of this study.

3.1. Baseline estimation and non-linearity assessment

Based on the premise that Croatian exports are predominantly low-tech, the relationship between unit labor cost (ULC) and firms' export activity was examined (see Table 1). In all specifications, the ULC coefficient lies between –0.672 and –0.764, significant at the 1% level. On average, a 1% acceleration in ULC growth is associated with a 0.672% to 0.764% deceleration in export growth. ULC significantly predicts both export shares (XMS) and total exports (X) throughout the period, both before and after EU accession and for very small firms (20< employees). In addition, employees (L), material capital (K) and unit material cost (UMC) significantly predict exports (X). The importance of UMC and ULC underlines the important role of cost competitiveness in shaping the export performance of manufacturing firms.

The original log-linear specifications assume a negative link between ULC and exports, but non-linear relationships can result from greater cost pass-through or thin profit margins where additional price increases sharply reduce sales. When ULC is high (low), prices may be uncompetitive (competitive), cost pass-through can be greater (lower), and some products may already have low (high) profitability. Under these conditions, the price elasticity of demand is higher (lower), and any further price increase (decrease), especially in the absence of market power, can significantly (marginally) reduce sales, increasing the sensitivity of exports to ULC.

This leads to a non-linear link, with exports reacting more strongly to cost changes at higher cost levels. Appendix 1 confirms this through the negative coefficients for the squared ULC term and the interaction between ULC changes and their initial level: the

Table 1. Baseline estimation

	(1) baseline	(2) no UMC and NK	(3) L < 20	(4) before 2013.	(5) after 2013.	(6) y = ΔXMS
ΔULC	**-0.722*** **	**-0.737*** **	**-0.672*** **	**-0.685*** **	**-0.753*** **	**-0.764*** **
	[0.022]	**[0.023]**	**[0.026]**	**[0.037]**	**[0.027]**	**[0.043]**
ΔL	0.783***	0.796***	0.692***	0.844***	0.703***	0.790***
	[0.021]	[0.021]	[0.027]	[0.031]	[0.029]	[0.026]
ΔK	0.049***	0.049***	0.043***	0.035***	0.059***	0.038***
	[0.007]	[0.007]	[0.009]	[0.012]	[0.010]	[0.014]
ΔUMC	-0.129***		-0.131***	-0.117**	-0.140***	-0.161***
	[0.025]		[0.031]	[0.046]	[0.028]	[0.049]
ΔNK	0.006*		0.001	0.007	0.006	0.001
	[0.004]		[0.008]	[0.006]	[0.005]	[0.007]
N	47867	47900	26126	19191	26549	48443
R^2	0.125	0.124	0.104	0.134	0.120	0.047

Source: authors' calculations

Note: Clustered standard errors in brackets. ***, ** and * denotes statistical significance at the 1%, 5% i 10%. All specifications include time and sector fixed effects. Δ = first difference, ULC = unit labour cost, L = number of employees, K = material capital, UMC = unit material cost, NK = non-material capital, N = observations, R^2 coefficient of determination, y = dependent variable, XMS = export market share

higher the ULC, the greater the export sensitivity to cost shifts.

Apart from the non-linearity, the relationship between exports and ULC can also be asymmetrical, i.e. an identical change in ULC does not necessarily cause an equally strong but opposite export reaction. One reason for this is downward price rigidity: Empirical evidence shows that prices rise faster and more strongly when cost increase than they fall when costs decrease (Peltzman 2000).

A second reason for asymmetric export reactions is the upward rigidity of quantities. Rapid expansion of production and sales volumes is difficult due to capacity constraints, resource availability and higher adjustment costs. Companies also have to accept various sunk costs when entering new foreign markets. These include setting up new distribution networks, investing in marketing, product adaptation, and staff training (Valdec and Zrnc 2015). Consequently, it is easier to reduce sales and exports when ULC is rising than to increase them when ULC is falling. Exports could therefore react more strongly to an increase in ULC than to a decrease, at least in the short term.

Appendix 2 examines this issue. Specifications (1) – (6) test whether an interaction between ULC and a dummy for falling ULC (ULC_fall) shows asymmetry, but the results are not statistically significant. Since such asymmetry may only occur for large cost shifts, specifications (7) – (12) look at the largest ULC declines (lowest decile) also finding no significance. The relationship between ULC and exports thus appears to be non-linear, but not asymmetric.

3.2. Company size and the stability of the link

The results in Table 1 assume a uniform export elasticity for all firm sizes. However, small Croatian firms adjust their prices less frequently, suggesting that firm size affects price flexibility (Kunovac and Pufnik 2012), so the relationship between ULC and exports may vary by firm size. In addition, more productive (often medium and large) firms adjust their profit margins more robustly to cost shocks than less productive (often smaller) firms (Melitz and Ottaviano 2008), which may also impact export sensitivity. Since there are relatively few highly productive (usually larger) and many less productive (smaller) firms in Croatia (a pattern observed in other countries aswell), the elasticity of exports with respect to ULC by firm size is examined.

Appendix 3 shows that medium and large firms exhibit higher export sensitivity (specifications (1) – (2)) before but not after Croatia's EU accession (specifications (3) – (4)). The results also indicate that export sensitivity to ULC rises with firm size – measured by employees (L) or total revenue (TR) but only before accession to the Single Market (specifications (6) – (11)). The absolute value of the ULC coefficient

is higher after EU accession, indicating a stronger export response to ULC (confirmed by Appendix 4). The interaction term between ULC and the EU accession dummy (taking value 1 after 2013) is negative and statistically significant in three out of four specifications. The results in the Appendix 4 also confirm that following the EU accession export elasticity has increased for small companies, while it has fallen sharply for large firms. After joining the EU, small firm export sensitivity seems to be enchanced, while the opposite is true for large enterprises.

3.3. The role of technology level

Technology intensity can also affect the link between exports and cost competitiveness. High-technology sectors invest more in R&D than low-tech sectors, so increasing ULC may reflect higher product quality or human capital rather than increased production costs. Consequently, export performance in these sectors is more dependent on product quality, innovation and consumer preferences. By contrast, low-tech sectors compete primarily on price, highlighting importance of cost effectiveness.

Appendix 5 shows that the ULC and UMC coefficients are significant for all technology levels, including high-tech, underlining the importance of cost for export performance regardless of technology intensity. However, the absolute value of the ULC coefficient is lower in high-tech sectors, suggesting that labor costs are less important for exports there. Conversely, medium-high tech sectors show a stronger correlation between costs and exports. Kiel (2024) also concludes that medium-high tech sectors exhibit the highest output sensitivity to ULC in major EU economies.

A disaggregated analysis (results available upon request) confirms that ULC is a significant export predictor in every manufacturing sector, ranging from –0.474 in sector C27 (manufacture of electrical equipment) to –1.439 in sector C12 (manufacture of tobacco products). The unweighted average ULC coefficients for low, medium-low, medium-high and high technology sectors are –0.721, –0.708, –0.803 and –0.650, respectively, confirming that the coefficient is slightly larger in the medium- high tech sector, while it is lower in the high-tech sector, which is consistent with the estimates in Appendix 5.

The results also suggest that rising labor costs increase export sensitivity in all sectors except the high-tech sector (results available upon request), and the same pattern holds for the share of labor costs in total expenditure. In the high-tech sectors, higher labor costs appear to be associated with a more skilled workforce, so an increase in ULC does not undermine competitiveness.

3.4. Total factor productivity

Total factor productivity (TFP) measures shifts in production efficiency, i.e., producing more output with a given set of resources or the same output with fewer resources. Research shows that firms with high productivity adjust their profit margins more easily in response to cost shocks (Melitz and Ottaviano 2008), which might reduce their export elasticity with respect to ULC. These firms' exports are also less sensitive to real exchange rates (Berthou and Dhyne 2018; Demian and di Mauro 2015; Berman, Martin, and Mayer 2012), indicating that export elasticity decreases as productivity increases. For example, the least productive 20% of firms can have an export elasticity up to eight times higher than the most productive 20% (Berthou and Dhyne 2018).

In Appendix 6, we calculate TFP as in Dvouletý and Blažkova (2022) and compare the 10% most productive firms (top TFP decile) with the 10% least productive firms (bottom TFP decile). The results (Appendix 6, specification (7)) show a notable but smaller gap than that observed for the real exchange rate elasticity. For the least productive firms, the ULC coefficient is –0.978, while for the most productive firms it is almost cut in half (–0.572). Thus, a 1% increase in ULC growth correlates with a 0.572% slowdown in export growth for the most productive firms, compared to 0.978% for the least productive. Other results in Appendix 6 suggest that the sensitivity of exports to ULC rises with firm productivity, but is limited to the period after EU accession and does not apply to export market shares.

3.5. Export intensity

Export sensitivity can vary with export intensity. Companies whose output is more strongly oriented towards foreign markets can be more sensitive to cost pressure, since foreign markets are usually more competitive. This is highlighted in Appendix 7 – export sensitivity increases with export intensity, meaning that exports are more sensitive to cost shifts not only in absolute terms but also in relative terms. Higher export intensity implies greater exposure to international markets, which are usually more competitive than domestic markets. The elasticity of output sold abroad can therefore react more sensitively to costs and prices.

This is significant since in our sample, about 15%

of the firms with the highest export intensity (90 – 100% of revenues from exports) generate almost a third of the total export revenue of all manufacturing firms. An idiosyncratic shock to these companies could disproportionately affect domestic exports and the economy. Maintaining the stability of largest exporting companies is therefore critical to stabilising exports and avoiding harsh contractions in the future.

4. Discussion of the results and research limitations

The empirical analysis conducted in this study shows a strong negative relationship between cost competitiveness measured by ULC and exports of Croatian manufacturing firms, emphasizing the importance of cost factors in shaping export performance. The relationship between ULC and exports is non-linear, but not asymmetric. The non-linearity of export elasticity is consistent with the simulations in Dekle, Jeongy, and Ryoo (2007), who show that the sensitivity of output to the real effective exchange rate can be either low or high. If the productivity of a particular product is low and approaches the threshold at which exports become unprofitable, a negative shock may cause exports of that product to cease, resulting in a high elasticity. Conversely, the elasticity is lower for products that already have a higher productivity and are actively exported.

While previous literature suggests that downward price rigidity and capacity constraints could lead to asymmetric export responses to rising or falling ULC, our empirical results do not support this hypothesis. The lack of a statistically significant asymmetry indicates that such frictions may exist, but on average are not strong enough to generate a different sensitivity of exports to cost increases and decreases.

Our results suggest that, on average, an individual firm improves its export performance by lowering costs, while higher costs tend to worsen competitiveness. However, this dynamic at the firm level does not necessarily translate to the industry level. If an individual firm lowers its unit costs, it gains a relative advantage over its competitors; however, if all firms do the same, overall competitiveness remains unchanged. The result also depends on the behaviour of foreign competitors, which is beyond the scope of this study. Moreover, since the empirical strategy does not fully eliminate endogeneity, these results should be interpreted with caution. Future research using exogenous shocks to ULC, such as those triggered by discrete policy interventions, would provide a more solid basis for causal inference.

Our study also confirms that firm heterogeneity strongly shapes the relationship between cost competitiveness and export activity. Export sensitivity varies according to firm size, technology intensity, productivity, export intensity and the share of labour costs in total expenditure. The more productive the companies are, the lower their export sensitivity to ULC. Companies in the highest decile of the TFP distribution (the most productive) have almost half the elasticity of companies in the lowest decile (the least productive).

This result suggests that increasing the total factor productivity of firms, especially large firms that account for the majority of production and exports, can strengthen the economy's resilience to cost shocks. Since most firms have lower productivity, a reallocation of labour and other resources towards more productive firms could improve the dynamic efficiency of the economy and increase overall productivity while simultaneously increasing resilience to cost shocks.

The analysis also shows that ULC is a significant predictor of exports for firms of all sizes, but only for the period prior to Croatia's accession to the EU. For the average firm, export elasticity has increased in the post-accession period, suggesting that cost competitiveness as measured by ULC has become a relatively more important factor in export dynamics. This increasing export sensitivity can be observed across the entire sample and is primarily due to the higher sensitivity of small firms, while the export sensitivity of large companies has decreased significantly. Croatia's accession to the EU facilitated access to the markets of other member states and lowered trade costs, which potentially increased the response of foreign trade to prices and costs. Non-tariff barriers were removed and the signalling effect of prices increased, which may have strengthened the impact of cost competitiveness on export performance. Orsini and Perić (2021) also confirm that Croatian merchandise exports react more strongly to relative price changes after EU accession.

Our results show that export sensitivity increases with export intensity, i.e. the greater the proportion of revenue generated by exports, the stronger the correlation between exports and ULC, not only in absolute terms but also in relative terms. This is significant insofar as in our sample around 15% of the companies with the highest export intensity, i.e. with an export intensity between 90-100%, generate almost a third of the total exports of all manufacturing firms. An idiosyncratic shock to these firms could have a disproportionate impact on domestic exports and the economy.

In addition, joining the Eurozone has made prices directly comparable, reinforcing the link between

costs and export performance. Also, the member states of a monetary union lack the flexibility to adjust their exchange rates. Consequently, cost changes, such as shifts in the ULC, have a direct impact on competitiveness as there is no mechanism to devalue the domestic currency (Alhola and Keränen 2022), although this channel was already limited by Croatia's existing exchange rate regime prior to joining the monetary union.

Joining the Schengen area facilitates trade by reducing frictions and simplifying cross-border transactions. Greater trade integration may lead to increased cost sensitivity of exports due to market consolidation, increased competition and stronger price signalling. Simultaneous accession to the eurozone and the Schengen area might lead to higher cost and price sensitivity of exports, which remains a topic for future research. These developments place even more emphasis on price and cost stability, which is particularly important for Croatian policymakers given the constraints on the implementation of an independent monetary policy.

Furthermore, Croatia's competitiveness is highly dependent on labour costs, which will inevitably rise in the near future due to convergence policies, inflationary pressures and labour shortages. While there may be scope to reduce tax and social contribution rates that affect labour costs, these are currently around the EU average (Eurostat 2024), suggesting that other ways of increasing competitiveness need to be considered. While rising labour costs are a natural part of economic convergence, they pose a growing challenge to maintaining export competitiveness, particularly in cost-sensitive sectors.

To alleviate this pressure, Croatia should pursue a multi-faceted policy strategy. Firstly, productivity growth should be boosted through targeted support for technological modernisation, digitalisation and R&D activities, especially among small and medium-sized enterprises. Second, labour market policies should focus on improving human capital by investing in vocational training, STEM education and lifelong learning initiatives that match the skills of the workforce with higher value-added production. Third, transitional support for firms facing acute cost pressures, such as tax incentives linked to productivity-enhancing investments can facilitate adjustment without causing long-term distortions. Overall, such measures can cushion the impact of rising labour costs and at the same time strengthen structural change towards sustainable, innovation-driven competitiveness.

In addition to rising labour costs, the government should also monitor the development of other cost-related factors. When costs surge, e.g. due to higher energy costs, industrial policy should include targeted measures to ensure that the firms under the most pressure receive subsidies to withstand these conditions. However, these measures should be limited in time so as not to prop up unproductive and cost-inefficient firms indefinitely. Such incentives are only economically justifiable if they ultimately promote productivity growth and/or structural shifts in production through technological improvements. Otherwise, there is a risk that these measures will become inefficient and counterproductive in the long term.

Further empirical evidence from this study shows that high-tech sectors have a lower export sensitivity to ULC compared to their counterparts in low- and medium-tech sectors. Furthermore, neither higher ULC levels nor a high share of personnel costs in total expenditure are significantly associated with increased export sensitivity in high-tech companies. This suggests that higher labour costs do not make these companies more susceptible to cost shocks. In the low- and medium-tech sectors, on the other hand, a higher wage level correlates more strongly with cost pressure, which leads to greater export sensitivity.

Although the estimated sectoral differences in the coefficients are modest, they do not support the conclusion that high-tech sectors rely much more heavily on non-price elements of competitiveness. This could reflect a potentially sub-optimal competitive positioning. Conversely, the relatively higher ULC sensitivity observed in medium-high tech sectors compared to low and medium-low tech sectors could indicate technological obsolescence and insufficient innovation, forcing firms to compete predominantly on price.

Given the comparatively lower ULC sensitivity of high-tech firms, industrial policy should consider strategically allocating additional resources to these sectors to increase resilience to cost shocks. Such targeted support could promote innovation, productivity growth and the long-term sustainability of competitiveness. At the same time, increasing productivity and promoting technological modernisation in the low- and medium-tech sectors remains essential to ensure a balanced development of the overall industrial base.

Other studies have produced mixed results. For example, Carlin, Glyn, and Van Reenen (2001) confirm a higher sensitivity of exports to changes in ULC in high-tech sectors, while Decramer, Fuss, and Konings (2016) find no difference in elasticity between sectors with different technology intensities. According to domestic studies, the real effective exchange rate is also a significant predictor of output in low-tech sectors or exports in medium- low tech sectors, but not in medium- or medium-high and high tech sectors (Tkalec

and Vizek 2009; Bogdan, Cota, and Rogić 2015).

Our results emphasise the need to invest more in human capital and increase capital intensity. Government should promote lifelong learning and at the same time encourage firms to invest in capital and technology through targeted incentives. In the longer term, improving the quality of manufacturing production towards technologically advanced products with higher added value is crucial, as high-tech exports are less cost sensitive, as already emphasized. Ultimately, competition based on innovation and product quality offers a more sustainable growth path than cost-based competition, which only offers short-term advantages before being eroded by lower-cost producers.

Accordingly, industrial policy should be complemented by efforts to attract strategic foreign direct investment, deepen integration into global value chains and facilitate the transfer of foreign technology and know-how. It is equally important to strengthen the resilience of supply chains and reduce dependence on external energy sources by diversifying and switching to domestic alternatives. Together, these measures can increase the resilience of the Croatian economy to external shocks and support long-term competitiveness.

5. Conclusion

Unit labor cost (ULC) is an indicator of a firm's competitiveness, with any increase implying higher labor costs per unit of output and thus indirectly a potential increase in the export price. This study examined the relationship between ULC and exports at the firm level in the Croatian manufacturing industry, the main driver of merchandise exports. The results provide the most thorough perspective to date on the link between exports and cost competitiveness as measured by ULC. The motivation to investigate this relationship and to explore the degree of export sensitivity stems from Croatia's persistently low export competitiveness compared to other new EU Member States and the dominance of low value-added products among Croatian exporters.

The results confirm that ULC is a significant predictor of exports for firms of all sizes and across different levels of technology intensity. However, there is considerable heterogeneity. In particular, the export performance of high-tech sectors is less sensitive to shifts in ULC, and in these sectors neither a higher ULC nor a larger share of labor costs in total costs increases the sensitivity of exports to ULC. Costs are less strongly linked to export performance in these sectors, meaning that higher costs do not necessarily lead to a loss of competitiveness. Non-price factors such as product quality and human capital play a greater role in driving competitiveness in high-tech. Nevertheless, these products are still underrepresented in the Croatian export structure. At the same time, the link between exports and costs proves to be stronger in the low and medium tech sectors, making cost control crucial for export performance.

After Croatia's accession to the EU, export sensitivity has decreased among large firms, while it has increased among smaller ones. As small firms make up the majority of companies, the export sensitivity of the average company has also increased. Part of this lower sensitivity among large firms can be attributed to their level of multi-factor productivity and their reliance on imported inputs, with EU membership providing access to cheaper inputs and thus contributing to lower cost sensitivity. The increased export sensitivity of small firms is worrying, as they make an important contribution to economic activity and are likely to play a greater role in the country's export activities in the future. Therefore, the causes of these trends should be further investigated.

In the absence of a significant increase in high-tech exports or greater complexity of exports compared to competitors and given Croatia's accession to the Schengen area and the European Monetary Union, there is likely to be an even stronger link between costs and exports in the future. This exerts pressure to keep cost growth below that of competitor countries. Given Croatia's relatively low level of economic development, it will be a challenge to achieve this goal, as faster convergence is required. Overall, price and cost stability are crucial, and the role of fiscal policy is becoming increasingly important due to the limitations of an independent monetary policy. Policy makers should closely monitor cost developments in large and export-intensive ones, as idiosyncratic shocks in these firms could significantly weaken overall exports and affect the domestic economy. In the event of a sudden increase in costs, e.g. due to rising energy prices, selective policy measures should be taken to provide short-term subsidies to the firms and sectors most affected by the costs.

In the long run, it is advisable to increase the quality of manufacturing output and focus on products with higher added value and advanced technology, as the sale of such goods is less sensitive to cost pressures than that of goods with lower complexity. Competition based on innovation and product quality promotes sustainable economic growth, while cost-based competition only offers short-term opportunities. In this context, effective industrial policy, attracting foreign direct investment into productive

segments of the economy, deeper integration into global value chains and the import of foreign technology and expertise are crucial. Building global value chains that are more resilient to shocks such as those triggered by the COVID-19 pandemic is recommended, as is greater use of domestic energy sources. These efforts include an energy transition, diversification of energy supply and reduced dependence on other countries.

References

Alhola, S. and Keränen, H. 2022. Dynamic effects of changes in cost competitiveness. Bank of Finland Research Discussion Paper 6/2022. https://talouspolitiikanarviointineuvosto.fi/wp-content/uploads/2022/01/Alhola-Keranen-2022.pdf (accessed July 7, 2025).

Berman, N., Martin, P., and Mayer, T. 2012. How do different exporters react to exchange-rate changes? The Quarterly Journal of Economics 127 (1): 437–492.

Bernard, A. B., Jensen, J. B., and Lawrence, R. Z. 1995. Exporters, jobs, and wages in US manufacturing: 1976–1987. Brookings Papers on Economic Activity. Microeconomics 1995: 67–119. https://www.brookings.edu/wp-content/uploads/1995/01/1995_bpeamicro_bernard.pdf (accessed July 7, 2025).

Berthou, A. and Dhyne, E. 2018. Exchange-rate movements, firm-level exports and heterogeneity. NBB Working Paper 334. https://www.econstor.eu/bitstream/10419/182211/1/wp334en.pdf (accessed July 7, 2025).

Blundell, R. and Bond, S. 1998. Initial conditions and moment restrictions in dynamic panel-data models. Journal of Econometrics 87 (1): 115–143.

Bogdan, Ž., Cota, B., and Rogić, L. 2015. Modeling the merchandise export function of the Republic of Croatia in recession conditions. Economic Review 66 (4): 321–357.

Buckley, P. J., Pass, C. L., and Prescott, K. 1988. Measures of international competitiveness: A critical survey. Journal of Marketing Management 4 (2): 175–200.

Carlin, W., Glyn, A., and Van Reenen, J. 2001. Export-market performance of OECD countries: An empirical examination of the role of cost competitiveness. The Economic Journal 111 (468): 128–162.

Decramer, S., Fuss, C., and Konings, J. 2016. How do exporters react to changes in cost competitiveness?. The World Economy 39(10): 1558–1583. https://doi.org/10.1111/twec.12412

Dekle, R., Jeong, H., and Ryoo, H. 2007. A microeconomic analysis of the aggregate disconnect between exchange rates and exports. University of Southern California, mimeo. https://www.researchgate.net/profile/Hyeok-Jeong-2/publication/265362227_A_Microeconomic_Analysis_of_the_Aggregate_Disconnect_between_Exchange_Rates_and_Exports/links/54eb3f050cf2082851bd60ab/A-Microeconomic-Analysis-of-the-Aggregate-Disconnect-between-Exchange-Rates-and-Exports.pdf (accessed July 7, 2025).

Demian, V. and di Mauro, F. 2015. The exchange rate, asymmetric shocks and asymmetric distributions. Working Paper No 1801. https://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp1801.en.pdf (accessed July 7, 2025).

Dvouletý, O. and Blažková, I. 2022. Relationship between firm total-factor productivity and performance: The case of the Czech high-tech industry. International Journal of Entrepreneurial Venturing 14(4–5): 391–412. DOI: 10.1504/IJEV.2022.10047629

Ernst, U. 2004. Hidden sources of growth? Looking at microenterprises through the competitiveness lens: A review of evidence. USAID AMAP Microreport 7.

Eurostat. 2024. External trade statistics. Accessed June 2024. https://ec.europa.eu/eurostat

Garelli, S. 2006. Top class competitors: How nations, firms, and individuals succeed in the new world of competitiveness. Hoboken, NJ: John Wiley & Sons.

Giordano, C. and Zollino, F. 2016. Shedding light on price- and non-price-competitiveness determinants of foreign trade in the four largest euro-area countries. Review of International Economics 24(3): 604–634. https://doi.org/10.1111/roie.12225

Griliches, Z. and Mairesse, J. 1995. Production functions: The search for identification. NBER Working Paper Series. Working Paper 5067. https://www.nber.org/system/files/working_papers/w5067/w5067.pdf (accessed July 7, 2025).

Kaldor, N. 1978. The effect of devaluations on trade in manufacturers. In Further essays on applied economics, 99–118. London: Duckworth.

Keil, S. 2024. Competing for manufacturing value added: How strong is competitive-cost pressure on sectoral level? Structural Change and Economic Dynamics 69: 197–212.

Kunovac, M. and Pufnik, A. 2015. Characteristics of the labor market and wage determination in Croatia: Results of the enterprise survey. Zagreb: Croatian National Bank. https://www.hnb.hr/documents/20182/265578/s-019/698287a8-c55f-406d-a110-a7d1ce0cf947 (accessed July 7, 2025).

Melitz, M. J. 2003. The impact of trade on intra-industry reallocations and aggregate industry productivity. Econometrica 71 (6): 1695–1725.

Melitz, M. J. and Ottaviano, G. I. 2008. Market size, trade, and productivity. The Review of Economic Studies 75 (1): 295–316.

Orsini, K. and Perić, A. 2021. Understanding the Croatian export boom. European Commission Directorate-General for Economic and Financial Affairs Discussion Paper 065.

Peltzman, S. 2000. Prices rise faster than they fall. Journal of Political Economy 108 (3): 466–502.

Porter, M. E. 1985. Technology and competitive advantage. Journal of Business Strategy 5 (3): 60–78.

Škuflić, L. 2000. The impact of globalization on the competitiveness of small transition economies. In Globalization processes and the competitiveness of small countries, 115–146. Pula: Faculty of Economics and Tourism Dr. Mijo Mirković, Juraj Dobrila University of Pula.

Škuflić, L., Šokčević, S., and Bašić, M. 2024. Sustainable development and competitiveness: Is there a need for GCI reconstruction? Economics – Innovative and Economics Research Journal 12 (1): 154–174.

Tkalec, M. and Vizek, M. 2009. The impact of macroeconomic policies on manufacturing production in Croatia. Economic Trends and Economic Policy 19 (121): 61–93.

Valdec, M. and Zrnc, J. 2015. The direction of causality between exports and firm performance: Microeconomic evidence from Croatia using the matching approach. Financial Theory and Practice 39(1): 1–30.

World Bank. 2024. World Bank Data. Accessed June 2024. https://data.worldbank.org/

Appendix

Appendix 1. Nonlinearities in the relationship between ULC and exports

	(1) baseline	(2) no UMC and NK	(3) L < 20	(4) before 2013.	(5) after 2013.	(6) y = ΔXMS	(7) baseline	(8) no UMC and K	(9) L < 20	(10) before 2013.	(11) after 2013.	(12) y = ΔXMS
ΔULC	-0.965***	-0.985***	-0.965***	-0.870***	-1.048***	-0.940***	-0.869***	-0.884***	-0.869***	-0.811***	-0.914***	-0.910***
	[0.046]	[0.040]	[0.046]	[0.077]	[0.046]	[0.050]	[0.033]	[0.030]	[0.033]	[0.052]	[0.037]	[0.037]
ΔULC²	**-0.066*** **	**-0.071*** **	**-0.066*** **	**-0.051*** **	**-0.078*** **	**-0.048*** **						
	[0.011]	**[0.009]**	**[0.011]**	**[0.017]**	**[0.011]**	**[0.016]**						
ΔULC*ULC							**-0.082*** **	**-0.089*** **	**-0.082*** **	**-0.072*** **	**-0.087*** **	**-0.087*** **
							[0.014]	**[0.012]**	**[0.014]**	**[0.021]**	**[0.015]**	**[0.015]**
ΔL	0.758***	0.780***	0.758***	0.820***	0.678***	0.772***	0.763***	0.787***	0.763***	0.825***	0.682***	0.680***
	[0.021]	[0.020]	[0.021]	[0.032]	[0.029]	[0.028]	[0.021]	[0.020]	[0.021]	[0.031]	[0.029]	[0.029]
ΔK	0.049***		0.049***	0.035***	0.059***	0.038***	0.049***		0.049***	0.035***	0.059***	0.058***
	[0.007]		[0.007]	[0.012]	[0.010]	[0.014]	[0.007]		[0.007]	[0.012]	[0.010]	[0.010]
ΔUMC	-0.088***		-0.088***	-0.077*	-0.099***	-0.133**	-0.098***		-0.098***	-0.083*	-0.114***	-0.116***
	[0.025]		[0.025]	[0.045]	[0.028]	[0.054]	[0.025]		[0.025]	[0.045]	[0.028]	[0.028]
ΔNK	0.006	0.007*	0.006	0.007	0.006	0.001	0.006	0.007*	0.006	0.008	0.006	0.006
	[0.004]	[0.004]	[0.004]	[0.006]	[0.005]	[0.007]	[0.004]	[0.004]	[0.004]	[0.006]	[0.005]	[0.005]
N	47867	50217	47867	19191	26549	48443	47867	50217	47867	19191	26549	26549
R^2	0.128	0.135	0.128	0.137	0.124	0.047	0.127	0.134	0.128	0.137	0.122	0.114

Source: authors' calculations

Note: Clustered standard errors in brackets. ***, ** and * denotes statistical significance at the 1%, 5% and 10%. All specifications include time and sector fixed effects. Δ = first difference, ULC = unit labour cost, L = number of employees, K = material capital, UMC = unit material cost, NK = non-material capital, N = observations, R^2 coefficient of determination, y = dependent variable, XMS = export market share

Appendix 2. Asymmetry in the relationship between ULC and exports

	(1) baseline	(2) no UMC and NK	(3) L < 20	(4) before 2013.	(5) after 2013.	(6) y = ΔXMS	(7) baseline	(8) no UMC and K	(9) L < 20	(10) before 2013.	(11) after 2013.	(12) y = ΔXMS
ΔULC	-0.751***	-0.766***	-0.673***	-0.745***	-0.745***	-0.771***	-0.721***	-0.730***	-0.721***	-0.690***	-0.746***	-0.741***
	[0.029]	[0.029]	[0.033]	[0.043]	[0.040]	[0.043]	[0.023]	[0.021]	[0.023]	[0.038]	[0.028]	[0.028]
ΔULC_fall*ULC	**0.062**	**0.063**	**0.004**	**0.129****	**-0.015**	**0.016**						
	[0.043]	**[0.043]**	**[0.052]**	**[0.063]**	**[0.060]**	**[0.052]**						
ΔULC_highest_fall*ULC							**-0.002**	**-0.005**	**-0.002**	**0.013**	**-0.016**	**-0.019**
							[0.015]	**[0.014]**	**[0.015]**	**[0.023]**	**[0.020]**	**[0.020]**
ΔL	0.782***	0.795***	0.692***	0.843***	0.703***	0.790***	0.784***	0.812***	0.784***	0.844***	0.703***	0.702***
	[0.021]	[0.021]	[0.027]	[0.031]	[0.029]	[0.026]	[0.021]	[0.020]	[0.021]	[0.031]	[0.029]	[0.029]
ΔK	0.049***	0.049***	0.043***	0.035***	0.059***	0.038***	0.049***		0.049***	0.035***	0.059***	0.057***
	[0.007]	[0.007]	[0.009]	[0.012]	[0.010]	[0.014]	[0.007]		[0.007]	[0.012]	[0.010]	[0.010]
ΔUMC	-0.128***		-0.131***	-0.116**	-0.140***	-0.161***	-0.129***		-0.129***	-0.117**	-0.140***	-0.142***
	[0.025]		[0.031]	[0.046]	[0.028]	[0.049]	[0.025]		[0.025]	[0.046]	[0.028]	[0.028]
ΔNK	0.007*		0.001	0.008	0.006	0.001	0.006*	0.008**	0.006*	0.007	0.006	0.007
	[0.004]		[0.008]	[0.006]	[0.005]	[0.007]	[0.004]	[0.004]	[0.004]	[0.006]	[0.005]	[0.005]
N	47867	47900	47867	19191	26549	48443	47867	47900	47867	19191	26549	48443
R^2	0.125	0.124	0.104	0.135	0.120	0.047	0.125	0.130	0.125	0.134	0.120	0.112

Source: authors' calculations

Note: Clustered standard errors in brackets. ***, ** and * denotes statistical significance at the 1%, 5% and 10%. All specifications include time and sector fixed effects. Δ = first difference, ULC = unit labour cost, L = number of employees, K = material capital, UMC = unit material cost, NK = non-material capital, N = observations, R^2 coefficient of determination, y = dependent variable, XMS = export market share

Appendix 3. Export elasticity and firm size

	(1) baseline	(2) no UMC and NK	(3) before 2013.	(4) after 2013.	(5) y = ΔXMS	(6) L as firm size	(7) L as firm size (before 2013)	(8) L as firm size (after 2013)	(9) TR as firm size	(10) TR as firm size (before 2013)	(11) TR as firm size (after 2013)
ΔULC	-0.694***	-0.708***	-0.625***	-0.751***	-0.754***	-0.643***	-0.559***	-0.722***	-0.539***	-0.305**	-0.788***
	[0.023]	[0.024]	[0.040]	[0.027]	[0.050]	[0.033]	[0.054]	[0.040]	[0.093]	[0.135]	[0.117]
ΔULC*Medium_ firm	**-0.164*** **	**-0.164*** **	**-0.230*** **	**-0.086**	**-0.043**						
	[0.061]	**[0.062]**	**[0.079]**	**[0.098]**	**[0.089]**						
ΔULC*Large_ firm	**-0.242***	**-0.256** **	**-0.534*** **	**-0.176**	**-0.106**						
	[0.126]	**[0.129]**	**[0.128]**	**[0.166]**	**[0.141]**						
ΔULC*L						**-0.039*** **	**-0.059*** **	**-0.017**			
						[0.013]	**[0.019]**	**[0.017]**			
ΔULC*TR									**-0.022** **	**-0.045*** **	**0.004**
									[0.011]	**[0.015]**	**[0.014]**
ΔL	0.784***	0.796***	0.845***	0.703***	0.790***	0.782***	0.842***	0.702***	0.785***	0.851***	0.703***
	[0.021]	[0.021]	[0.032]	[0.029]	[0.026]	[0.021]	[0.032]	[0.029]	[0.021]	[0.032]	[0.029]
ΔK	0.050***	0.050***	0.036***	0.059***	0.038***	0.050***	0.036***	0.059***	0.050***	0.035***	0.059***
	[0.007]	[0.007]	[0.012]	[0.010]	[0.014]	[0.007]	[0.012]	[0.010]	[0.007]	[0.012]	[0.010]
ΔUMC	-0.127***		-0.105**	-0.140***	-0.160***	-0.129***	-0.113**	-0.141***	-0.134***	-0.126***	-0.138***
	[0.025]		[0.045]	[0.028]	[0.049]	[0.026]	[0.046]	[0.028]	[0.025]	[0.044]	[0.028]
ΔNK	0.006*		0.007	0.006	0.001	0.006	0.007	0.006	0.007*	0.008	0.006
	[0.004]		[0.006]	[0.005]	[0.007]	[0.004]	[0.006]	[0.005]	[0.004]	[0.006]	[0.005]
N	47867	47900	19191	26549	48443	47867	19191	26549	47867	19191	26549
R^2	0.126	0.125	0.137	0.120	0.047	0.126	0.136	0.120	0.125	0.136	0.120

Source: authors' calculations

Note: Clustered standard errors in brackets. ***, ** and * denotes statistical significance at the 1%, 5% and 10%. All specifications include time and sector fixed effects. Δ = first difference, ULC = unit labour cost, L = number of employees, K = material capital, UMC = unit material cost, NK = non-material capital, N = observations, R^2 coefficient of determination, y = dependent variable, XMS = export market share

Appendix 4. Changes in export elasticity following EU accession

	(1) Sample: all firms, baseline	(2) Sample: all firms, no UMC and NK	(3) Sample: L < 20	(4) Sample: all firms, y = ΔXMS	(5) Sample: small firms (L < 50)	(6) Sample: medium firms (50 < L < 250)	(7) Sample: big firms (L > 250)
ΔULC	-0.678***	-0.693***	-0.590***	-0.771***	-0.605***	-0.906***	-1.240***
	[0.035]	[0.035]	[0.043]	[0.086]	[0.038]	[0.069]	[0.145]
ΔULC *EU	**-0.085***	**-0.086****	**-0.150*****	**0.015**	**-0.154*****	**0.053**	**0.613*****
	[0.044]	**[0.043]**	**[0.052]**	**[0.092]**	**[0.047]**	**[0.114]**	**[0.197]**
ΔL	0.782***	0.794***	0.690***	0.790***	0.740***	0.923***	0.855***
	[0.021]	[0.021]	[0.027]	[0.027]	[0.024]	[0.057]	[0.096]
ΔK	0.049***	0.049***	0.043***	0.038***	0.043***	0.093***	0.112**
	[0.007]	[0.007]	[0.009]	[0.014]	[0.008]	[0.022]	[0.044]
ΔUMC	-0.128***		-0.129***	-0.162***	-0.130***	-0.121*	0.112
	[0.025]		[0.031]	[0.050]	[0.027]	[0.064]	[0.167]
ΔNK	0.006		0.001	0.001	0.003	0.010*	0.006
	[0.004]		[0.008]	[0.007]	[0.006]	[0.005]	[0.010]
N	47867	47900	26126	48443	35722	9414	2731
R^2	0.125	0.124	0.105	0.046	0.109	0.211	0.334

Source: authors' calculations

Note: Clustered standard errors in brackets. ***, ** and * denotes statistical significance at the 1%, 5% and 10%. All specifications include time and sector fixed effects. Δ = first difference, ULC = unit labour cost, L = number of employees, K = material capital, UMC = unit material cost, NK = non-material capital, N = observations, R^2 coefficient of determination, y = dependent variable, XMS = export market share

Appendix 5. Export elasticity and the level of technological intensity

	(1) Sample: low tech firms	(2) Sample: medium-low tech firms	(3) Sample: medium-high tech firms	(4) Sample: high tech firms	(5) Sample: all firms, baseline	(6) Sample: all firms, no UMC and NK	(7) Sample: all firms, L < 20	(8) Sample: all firms, before 2013	(9) Sample: all firms, after 2013	(10) Sample: all firms, y = ΔXMS
ΔULC	**-0.703*** **	**-0.683*** **	**-0.841*** **	**-0.571*** **	**-0.730*** **	**-0.746*** **	**-0.730*** **	**-0.689*** **	**-0.765*** **	**-0.772*** **
	[0.035]	**[0.040]**	**[0.043]**	**[0.084]**	**[0.023]**	**[0.023]**	**[0.023]**	**[0.039]**	**[0.026]**	**[0.045]**
ΔULC*high_tech					**0.152***	**0.162***	**0.152***	**0.059**	**0.229***	**0.167***
					[0.089]	**[0.089]**	**[0.089]**	**[0.121]**	**[0.126]**	**[0.098]**
ΔL	0.790***	0.744***	0.813***	0.818***	0.784***	0.796***	0.784***	0.844***	0.726***	0.791***
	[0.034]	[0.032]	[0.054]	[0.099]	[0.021]	[0.021]	[0.021]	[0.031]	[0.028]	[0.026]
ΔK	0.053***	0.061***	0.039**	-0.005	0.050***	0.049***	0.050***	0.035***	0.059***	0.038***
	[0.012]	[0.012]	[0.018]	[0.027]	[0.007]	[0.007]	[0.007]	[0.012]	[0.009]	[0.014]
ΔUMC	-0.105***	-0.103**	-0.174***	-0.213**	-0.128***		-0.128***	-0.117**	-0.134***	-0.160***
	[0.037]	[0.048]	[0.044]	[0.088]	[0.025]		[0.025]	[0.046]	[0.027]	[0.049]
ΔNK	0.009	0.011*	-0.002	-0.011	0.006		0.006	0.007	0.005	0.001
	[0.006]	[0.007]	[0.009]	[0.017]	[0.004]		[0.004]	[0.006]	[0.005]	[0.007]
N	19777	16660	9161	2269	47867	47900	47867	19191	28676	48443
R^2	0.123	0.110	0.176	0.100	0.125	0.124	0.125	0.134	0.120	0.047

Source: authors' calculations

Note: Clustered standard errors in brackets. ***, ** and * denotes statistical significance at the 1%, 5% and 10%. All specifications include time and sector fixed effects. Δ = first difference, ULC = unit labour cost, L = number of employees, K = material capital, UMC = unit material cost, NK = non-material capital, N = observations, R^2 coefficient of determination, y = dependent variable, XMS = export market share

Appendix 6. Export elasticity and total factor productivity

	(1) baseline	(2) no UMC and NK	(3) L < 20	(4) before 2013.	(5) after 2013.	(6) y = ΔXMS	(7) low and high TFP
ΔULC	-0.807***	-0.828***	-0.807***	-0.752***	-0.895***	-0.789***	-0.709***
	[0.042]	[0.043]	[0.042]	[0.059]	[0.041]	[0.044]	[0.024]
ΔULC*TFP	**0.101*** **	**0.111*** **	**0.101*** **	**0.082**	**0.153*** **	**0.030**	
	[0.037]	**[0.037]**	**[0.037]**	**[0.051]**	**[0.033]**	**[0.070]**	
ΔL	0.771***	0.780***	0.771***	0.846***	0.683***	0.786***	0.759***
	[0.021]	[0.021]	[0.021]	[0.030]	[0.029]	[0.029]	[0.021]
ΔK	0.050***	0.050***	0.050***	0.037***	0.060***	0.038***	0.049***
	[0.007]	[0.007]	[0.007]	[0.011]	[0.010]	[0.014]	[0.007]
ΔUMC	-0.105***		-0.105***	-0.084**	-0.118***	-0.154**	-0.114***
	[0.024]		[0.024]	[0.039]	[0.028]	[0.061]	[0.026]
ΔNK	0.006		0.006	0.006	0.006	0.001	0.006
	[0.004]		[0.004]	[0.006]	[0.005]	[0.007]	[0.004]
ΔULC*low_TFP							**-0.270*** **
							[0.046]
ΔULC*high_TFP							**0.137*** **
							[0.050]
N	47867	47880	47867	21318	26549	48443	47867
R^2	0.126	0.126	0.126	0.134	0.122	0.047	0.128

Source: authors' calculations

Note: Clustered standard errors in brackets. ***, ** and * denotes statistical significance at the 1%, 5% and 10%. All specifications include time and sector fixed effects. Δ = first difference, ULC = unit labour cost, L = number of employees, K = material capital, UMC = unit material cost, NK = non-material capital, N = observations, R^2 coefficient of determination, y = dependent variable, XMS = export market share

Appendix 7. Export elasticity and export intensity

	(1)	(2)	(3)	(4)	(5)	(6)
	baseline	no UMC and NK	L < 20	before 2013.	after 2013.	y = ΔXMS
ΔULC	-0.840***	-0.857***	-0.840***	-0.856***	-0.824***	-0.929***
	[0.026]	[0.026]	[0.026]	[0.042]	[0.033]	[0.072]
ΔULC*export_ intensity	**-0.077*** **	**-0.078*** **	**-0.077*** **	**-0.109*** **	**-0.048** **	**-0.107*** **
	[0.017]	**[0.017]**	**[0.017]**	**[0.027]**	**[0.021]**	**[0.027]**
ΔL	0.779***	0.791***	0.779***	0.832***	0.703***	0.784***
	[0.021]	[0.021]	[0.021]	[0.031]	[0.029]	[0.026]
ΔK	0.049***	0.048***	0.049***	0.034***	0.058***	0.037***
	[0.007]	[0.007]	[0.007]	[0.012]	[0.010]	[0.014]
ΔUMC	-0.125***		-0.125***	-0.120***	-0.135***	-0.156***
	[0.025]		[0.025]	[0.045]	[0.028]	[0.047]
ΔNK	0.007*		0.007*	0.008	0.006	0.001
	[0.004]		[0.004]	[0.006]	[0.005]	[0.007]
N	47867	47900	47867	19191	26549	48443
R^2	0.127	0.127	0.127	0.139	0.121	0.047

Source: authors' calculations

Note: Clustered standard errors in brackets. ***, ** and * denotes statistical significance at the 1%, 5% and 10%. All specifications include time and sector fixed effects. Δ = first difference, ULC = unit labour cost, L = number of employees, K = material capital, UMC = unit material cost, NK = non-material capital, N = observations, R^2 coefficient of determination, y = dependent variable, XMS = export market share

South East European Journal of Economics and Business
Volume 20 (2) 2025, 34-52
DOI: 10.2478/jeb-2025-0017

THE DYNAMIC INTERPLAY BETWEEN CREDIT RISK AND MONETARY POLICY IN ALBANIA'S BANKING SECTOR: A COMPREHENSIVE ANALYSIS

Rovena Vangjel (Troplini), Skënder Uku, Xhevrije Mamaqi-Kapllani

Abstract

The study examines the relation between credit risk and monetary policy in Albania's banking sector from 2015 to 2023, utilizing the Autoregressive Distributed Lag (ARDL) model. It analyzes post-crisis developments, particularly the Central Bank's (CB) stabilization efforts and the write-off of NPLs. The findings show that higher CB rates increase NPLs in the short and long term.

Following the 2008 financial crisis and the COVID pandemic, measures such as NPL write-offs and loan repayment postponements helped mitigate credit risk. Inflation contributed to credit stability by easing debt repayment burdens.

Inflation and higher rates ease debt repayment and enhance credit stability. The Loan/Deposit Ratio influences NPLs, as managed decreases in LDR lower credit risk. Additionally, increased CB rates reduce new loan issuance, deterring high-risk borrowers and curbing NPL growth. The study highlights the effectiveness of Albania's monetary policy in maintaining banking sector stability and supporting economic recovery.

JEL classification: *E52, E50, E31, O4, C23*

Keywords: *Monetary Policy, central bank ratio, inflation, GDP, ARDL*

Rovena Vangjel (Troplini), PhD
Associate Professor
(Corresponing author)
Finance Accounting Department
Faculty of Business
University Aleksandër Moisiu of Durrës
Rruga Miqësia, Kampusi Universitar, Godina 2, 2001
Albania
Email: rovenatroplini@uamd.edu.al
ORCID: 0000-0002-9150-2019

Skënder Uku, PhD
Associate Professor
Finance Accounting Department
Faculty of Economy and Agrobusiness
Agriculture University of Tirana,
Rruga Pajsi Vodica, Tirana 1029
Albania
Email: suku@ubt.edu.al
ORCID: 0009-0003-5175-0936

Xhevrije Mamaqi-Kapllani, PhD
Associate Professor
Department of Economic Analysis
Faculty of Economics and Business
University of Zaragoza
Gran Vía, 50005
Spain
Email: mamaqi@unizar.es
ORCID: 0000-0002-4711-9792

1. Introduction

The global financial crisis of 2008 and the COVID-19 pandemic have significantly altered the structure and application of monetary policy, highlighting the vital importance of aligning these policies to maintain financial stability.

As Bernanke and Gertler (1995) explain, monetary policy affects credit quality through its impact on credit channels: a tightening policy can increase default risks, particularly among weaker borrowers, while easing conditions can reduce borrowing costs and enhance repayment capacity. Against this global backdrop, Albania presents a compelling case study. Emerging from its post-communist transformation, which began in 1990, Albania undertook significant financial system reforms during the early 1990s, with notable developments occurring after 2000. Foundational legislative changes, such as those established in the laws "On the Bank of Albania" and "On the Albanian Banking System," adopted between 1992 and 1998, created the framework for a market-oriented financial system that also aimed to ensure macroeconomic stability and safeguard social interests. Today, Albania's banking sector operates largely on free market principles and remains predominantly banking-centric, with banks accounting for approximately 85–90% of the financial sector (Bethlendi, Mérő, and Orlovits 2024; BOA, 2023).

Regarding the nonbanking sector, there has been a gradual improvement over the years, with a notable increase in the contribution of Albania's non-bank financial sector from 5 mld ALL in 2014 to over 18 mld ALL in 2024 (BoA/ H2 2024).

Before the 2008 crisis, Albania underwent a period of rapid credit expansion that spurred economic growth while raising concerns about the sustainability of lending practices. As Moinescu and Codirlașu (2013) noted, excessive credit growth, especially when followed by a prolonged period of subdued credit flow, can lead to higher ratios of non-performing loans (NPLs). Skrabic and Konjusak (2017) similarly conclude that various forms of credit growth require approximately two years to lead to a heightened risk of credit.

The financial crisis revealed vulnerabilities within the credit market, prompting the Bank of Albania to write off significant bad loans. In response to the rising NPLs, commercial banks tightened their lending criteria, which, although designed to reduce credit risk, also pushed some borrowers toward informal lending channels and impeded broader economic development. Simultaneously, to boost lending and economic growth, the Bank of Albania implemented a relatively relaxed monetary policy, although this approach carried the potential risk of an increase in non-performing loans. These policy measures, including the strategic write-off process, ultimately decreased NPLs from 22.9% in March 2015 to 18.2% in December 2015 (Leka, Bajrami, and Duci 2019; Bauze 2019).

The onset of the COVID-19 pandemic further complicated Albania's economic landscape. Quarantine measures and forced business closures resulted in an immediate downturn in employment, production, consumption, and investment, reflecting a synchronized global recession. Following these profound disruptions, the Bank of Albania adjusted its monetary policy by again lowering interest rates and offering loan restructuring options to help stabilize the banking sector. The focus of this study is based on this dual experience of post-crisis recovery and pandemic-induced challenges, which examines the period following the 2008 write-off process. Focusing on data from 2015 to 2024—a period marked by enhanced legislative transparency and stable quarterly disclosures—this analysis offers a more precise and comprehensive view of Albania's current credit risk landscape, while also reflecting the effects of the COVID-19 crisis.

This study investigates the distinctive relationship between credit risk measured through NPLs, and monetary policy in Albania, as reflected by the central bank's interest rate and inflation levels. The key results offer empirical insights into the extent to which the monetary policy rate and other relevant control variables affect the dynamics of non-performing loans in the Albanian context.

The structure of the paper is as follows: Section 2 provides a literature review focusing on the relationship between non-performing loans and monetary indicators, with particular attention to studies concerning Albania from 2015 to 2024. Section 3 details the empirical methodology employed, while Section 4 discusses the main findings. Finally, Section 5 concludes the paper by outlining key policy implications.

2. Related literature issue

Credit risk, as measured by NPLs, is a vital indicator of a nation's financial health and economic progress. However, the factors influencing NPLs are essential for making significant macroeconomic policy decisions. There is a wealth of literature on financial and macroeconomic indicators in this regard.

Economic crises significantly impact the rise of NPLs. Most Western Balkan countries and various other regions experienced a sharp increase in loan levels after 2008, coinciding with the observable effects of the 2007-2008 financial crisis (IMF 2017). This

phenomenon accounts for the substantial rise in scientific research focused on identifying factors influencing NPLs and providing guidance primarily to commercial banks and public bank authorities.

Tight monetary policy increased long-term credit risk, while macro-prudential measures reduced it, and monetary easing lowered risk in the short term (Anwar et al. 2023). The study finds that higher monetary policy rates reduce bank risk-taking, while credit expansion increases it, offering valuable insights for central banks in the Western Balkans (Gashi and Fetai 2023).

Various microeconomic and domestic factors influencing bad loans have been identified, primarily associated with financial performance indicators: banks' profitability, loan loss reserves relative to total loans (Messai and Jouini 2013), capital adequacy ratio, the previous year's non-performing loan rate, and return on equity (Gashi and Fetai 2023; Salifu et al. 2025). However, these factors are less significant than macroeconomic factors (Klein 2013). Our study focuses on the macroeconomic factors that affect NPL, providing recommendations for banking institutions, particularly the central bank.

Various studies highlight the relationship between NPLs and GDP growth. Petkovski, Kjosevski and Jovanovski (2018) observed that GDP growth has an inverse relationship with NPLs in Czech banks, whereas unemployment displays a positive correlation. Similarly, Bogdan (2017) found that both the inflation rate (CPI) and GDP growth decrease the NPLs in Central and Eastern European banks, with unemployment again having a positive effect. In a study by Mazreku et al. (2018) involving 10 transition countries in the CEE, it was found that GDP growth exhibited the strongest inverse relationship with NPLs, with Albania included in this analysis.

A study by Staehr and Uusküla (2017) examined Western European and CEE countries and identified four key factors influencing non-performing loans (NPLs) in both regions: GDP growth, inflation, debt, and unemployment. It was found that GDP growth, inflation, and debt all had inverse relationships with NPLs.

Other indicators considered in similar studies included GDP growth, the monetary aggregate M2, and loan interest rates (Leka, Bajrami, and Duci 2019). Baholli, Dika, and Xhabija (2015) also discussed the role of the financial crisis in increasing NPLs, emphasizing the impact on the banking system and associated credit risk.

According to Mahrous, Samak, and Abdelsalam (2020), the negative and significant relationship between the credit-to-deposit ratio and NPLs in MENA countries suggests that, in these regions, increased lending relative to deposits did not result in a rise in NPLs, as one might expect, but instead emphasized a negative relationship.

Most empirical studies have investigated the macroeconomic variables of non-performing loans (NPLs) in various economies, such as Benazic and Radin (2015) in Croatia, Adeola and Ikpesu (2017) in Nigeria, and others in Arab countries like Morocco, Tunisia, Saudi Arabia, and Oman (Touny and Shehab 2015). Estimations have also been conducted in developed countries such as Greece, Italy, and France (Messai and Jouini 2013). These studies employed regression analysis using macroeconomic variables such as inflation, exchange rates, lending rates, and GDP as key explanatory factors. Haniifah (2015) examined the economic factors influencing bad loans in Ugandan banks, analyzing data from 25 banks between 2000 and 2013. Inflation and interest rates showed an inverse relationship with bad loans.

To the best of our knowledge, no prior research has utilized quarterly data to examine the impact of the Monetary Policy Rate (MPR) on Albania's credit risk in both the short and long term. Appendix 1 summarizes the authors, geographical coverage, sample size, time horizon, methods, variables, and key findings of studies related to NPLs and the macroeconomic factors influencing them.

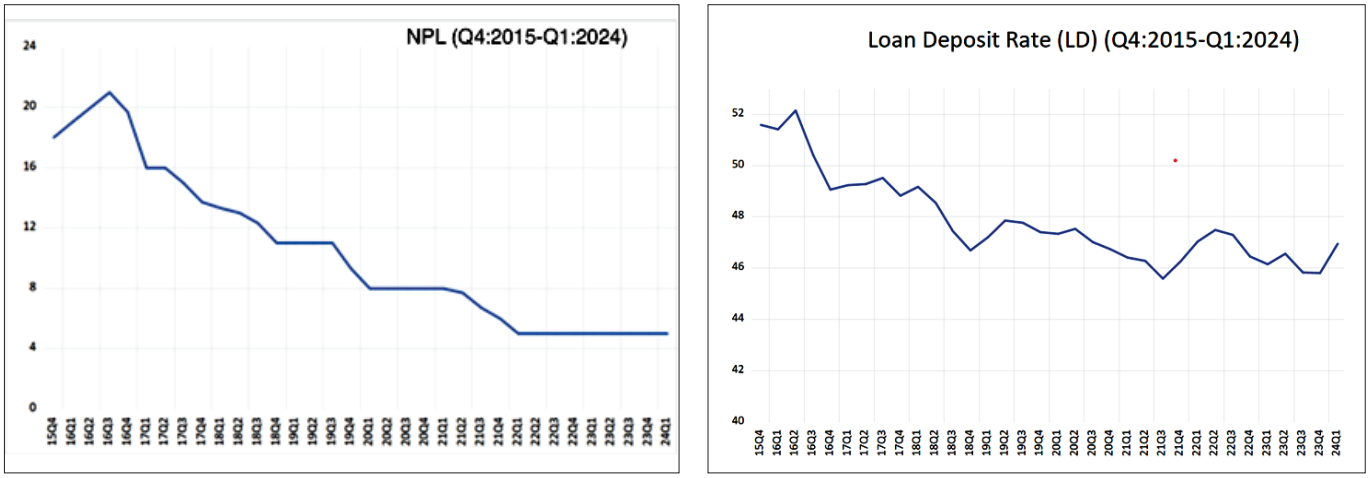
2.1. Banking Sector Developments and Policy Responses in Albania (2014–2024)

The graph demonstrates that increased prudence in the lending practices of Albania's banking sector has contributed to a decline in NPLs. Simultaneously, the loan-to-deposit ratio indicates a trend of reduced lending activity compared to bank deposits. According to Figure 1, the NPL level in Albania fell from 2014 to 2023 as banks tightened their approval procedures.

According to Figure 1, there are two time points when a downward trend in NPLs is observed: in 2016, influenced by controlling non-payment defaults (lowering the numerator), bank portfolio cleaning activities, and a stagnating loan portfolio (lowering the denominator); and in 2020, when moratoria and proactive bank interventions, such as restructuring and writing off bad loans, helped decrease NPLs after the pandemic. Additionally, the LDR steadily declined, reflecting a cautious approach to new lending, which helped banks manage credit risk amid economic challenges.

Many policies have been implemented to support financial activity and aggregate demand. The Bank of Albania increased weekly auctions to inject additional liquidity into the financial system, adopting a strategy

Figure 1. NPL and Loan to Deposit performance during the years.



Source: Bank of Albania (2024).

of unlimited liquidity injection through auctions with no limits on amounts and fixed prices. Interest rates were lowered to a historic low of 0.5% (IMF 2020), and the amount of liquidity injected into the system was increased (BoA 2020). These actions aimed to reduce economic debt service costs and support ongoing financial intermediation. In close consultation with the banking sector, targeted temporary regulatory measures were established to encourage loan deferment or consensual restructuring for distressed yet promising borrowers.

Additionally, at the end of March 2020, it intervened in the forex market to mitigate volatility resulting from the economy's closure and the country's overall activity. Lastly, micro and macroprudential measures were enacted to strengthen banks' balance sheets and preserve their lending capacity (BoA 2021). A moratorium was introduced on loan installment payments for individuals and companies affected by the pandemic. It provided temporary regulatory relief and allowed banks to adjust to the moratorium without negatively impacting their banking health and mediation activity indicators (Sejko 2021). Given the liquidity challenges companies and individuals face, the Bank of Albania extended the temporary suspension of credit risk management obligation requirements until August 31, 2020, before the classification and granting of loans to all client categories. In 2020, the next measure involved adopting a regulation that allows banks to restructure loans without incurring further provisioning costs and without improving the borrowers' situations. The enforcement of stricter requirements for the classification and granting of restructured loans has been postponed until 2022, along with the regulation "On the out-of-court treatment of borrowers in financial difficulty" (Sejko 2021).

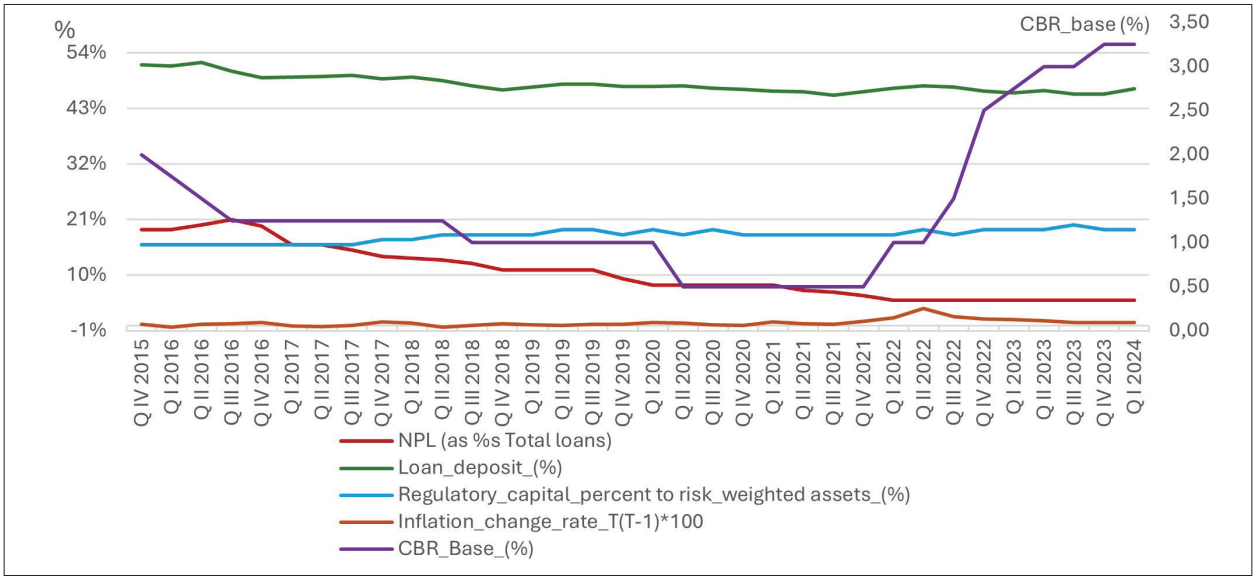
From a fiscal perspective, the Government of Albania provided fiscal relief by i) allocating additional funds to support the health sector, ii) expanding social packages to compensate for income loss, and iii) offering temporary tax relief for businesses along with the introduction of sovereign loan guarantee schemes to enhance their access to financing. This set of measures, coordinated and comprehensive, was implemented at the right time to mitigate the significant economic impact and maintain monetary and financial stability, which is essential for future economic recovery. In terms of post-pandemic monetary policies: i) ensuring price stability, ii) maintaining an inflation rate of 3%, and iii) establishing a legal framework to manage and prevent bad lending.

In the post-pandemic period, Albania entered a phase of economic recovery. The Bank of Albania began normalizing its monetary policies by raising interest rates to control inflation and prevent excessive debt accumulation. Additionally, between 2022 and 2024, it established a legal framework for debtors, credit, and capital risk (BoA 2022).

According to Figure 2, regarding CBIR, the Bank of Albania has upheld a more accommodating monetary policy due to lower inflationary pressures in the country. In early 2022, the Bank of Albania sought a monetary adjustment in response to rising inflation. In March, it raised its primary interest rate by 25 basis points to 3%, then to 3.5% in May. As the cost of lek-denominated loans increased for households and businesses, demand for loans began to ease in the fourth quarter of 2022.

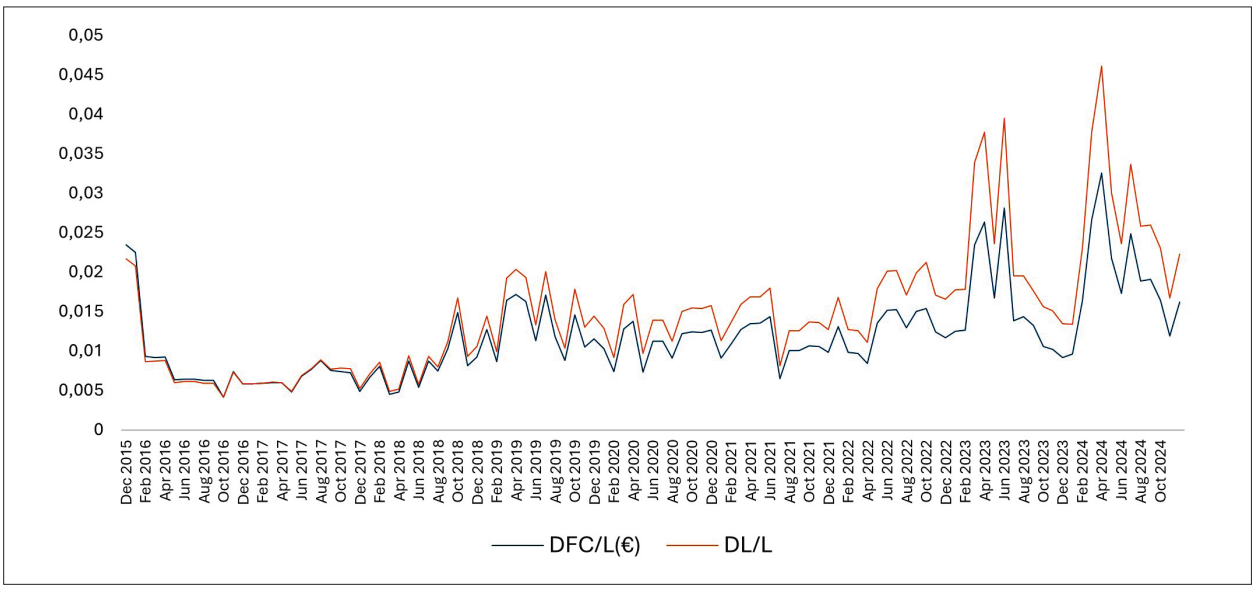
Figure 3 presents the evolution of the deposit of foreign currency denominated in euro (DFC/L in Euro) and the Deposit of Albanian lek (DL/L) from 2015 to 2024. Both ratios remained relatively stable in the

Figure 2. Trends in Key Financial Indicators Over Time



Source: Author calculated with data published by the Bank of Albania, 2015-2024.

Figure 3. Variation loan to foreign deposit in euro and lek.



Source: Author calculated with data published by the Bank of Albania, 2015-2024.

early years, but the diminishing effect of the lek's exchange rate appreciation significantly impacted deposit performance from 2019 to 2023.

Deposits in lek increased by 0.6%, while those in foreign currency decreased by approximately 2%. Deposits by currency rose by about 3%. Nevertheless, the performance of deposits in foreign currency, when measured in the original currency, shows a notable increase of about 5%. Following the changes in 2019, we have experienced nearly equivalent exchange rates between the euro and lek for several years, with the lek becoming somewhat stronger during the summer months when euro inflows surge significantly. These are the Bank of Albania's decisions on exchange rates that support strengthening the country's currency and stabilizing macroeconomic indicators. To achieve this stability, they combine monetary policy and macroprudential measures to maintain Albania's external debt at around 62% of GDP and ensure price stability.

2.2. Bank-level determinant factor

Credit risk factors include the Capital Adequacy Ratio (CAR) and the Loan Deposit Ratio (LDR), which indicate capital levels and bank liquidity. According to Mdaghri (2022), in a study conducted in MENA countries, bank liquidity is inversely related to non-performing loans, meaning that higher bank liquidity reduces NPLs by providing banks with the resources to manage financial stress, offer better support to borrowers, and lower overall credit risk.

This aligns with our idea of including LDR as a bank-specific variable (Ahmed et al. 2021), noting that higher bank liquidity reduces non-performing loans. An increase in NPLs raises the likelihood of defaults in the private sector and diminishes the value of private investments, resulting in decreased credit availability. Factors such as credit to the private sector increase the NPLs, indicating that a rise in these variables corresponds with higher NPL levels (Akinlo and Emmanuel 2014). Boussaada, Hakimi, and Karmani (2022) also found that increased bank liquidity is associated with an increase in bad loans. Additionally, Velliscig, Floreani, and Polato (2022) included CAR and discovered that bank credit risk decreases with a higher capital ratio.

2.3. Macroeconomic factor

The study analyzes essential macroeconomic factors, including the central bank interest rate (CBIR), inflation rates (IR), gross domestic product (GDP), construction cost index, consumer price index (CPI), and producer price index (PPI).

Erdas and Ezanoglu (2022) and Koju, Koju, and Wang (2018) note that inflation influences credit risk, where Erdas and Ezanoglu (2022) argue that inflation increases NPLs. This study posits that when inflation increases without a corresponding rise in debtors' profits, their ability to repay loans weakens, resulting in heightened credit risk. Higher inflation can diminish the purchasing power and the real value of income, making it more challenging for fixed-income earners with fixed-interest rate loans to fulfill their debt obligations. This causes inflation to exert a positive influence on NPLs. The literature presents mixed findings, and this study aims to provide additional evidence.

Following the findings of Zunic, Kozaric, and Dzelihodžic (2021) and Demid (2021), economic growth was included as a variable. Typically, a decline in GDP, which is commonly observed during a recession, indicates an economic downturn. A decrease in consumption and income among the population intensifies the struggle to repay loans, increasing the likelihood of defaults and leading to a rise in NPLs. This forces banks to increase provisions for bad loans, thereby reducing their profits.

The following hypotheses are proposed to be tested based on empirical results.

According to most empirical studies, central bank interest rates and inflation are associated with increased market volatility and risk, resulting in a higher level of non-performing loans (Maivald and Teplý 2020).

H_1: A significant positive relationship exists between CBIR and NPLs.

H_2: There is a significant positive relationship between the inflation rate and NPLs.

H_3: A statistically significant positive relationship exists between NPLs and LD.

H_4: A statistically significant inverse relationship exists between NPLs and the CAP.

3. Research methodology

3.1. Data and Variable Description

We used the Autoregressive Distributed Lag (ARDL) model because NPLs are influenced by different independent variables. The quarterly dataset from 2015 (QIV) to 2024 (QI) is available in the time series statistics session of the Institute of Statistics (INSTAT) and Albanian Central Bank. The time gap between the available data has been a determining factor, leading to the transformation of some variables from their original monthly format into quarterly periods.

3.2. Variable under study

NPL as a percentage of total loans (endogenous variable) serves as the dependent variable, indicating the credit quality of a bank, in terms of risk. The study utilized bank-level financial indicators that could influence the quantity of NPLs. The variables are detailed as shown in Table 1.

The dummy variable (D2020) is assigned a value of 1 for all quarters from 2020 through Q1 2024, capturing the period impacted by the COVID-19 pandemic, and 0 for all other periods. It is incorporated into the model to control for extraordinary events during this timeframe, particularly the pandemic-induced economic disruptions, including the sharp decline in GDP. The reference point is the collapse of GDP, which fell by 11 percentage points, and the anti-COVID economic measures will be approved in the next quarter.

Table 1. Variable in the study

Variable	Measure	Source
Financial performance indicators		
Non-Performance Loan (NPL)	As percent of total Loan (%)	Bank of Albania
Loan-deposit (LD)	Loan to deposit (in %)	Bank of Albania
Reg_capital (CAP)	Regulatory Capital (as a % of risk-weighted assets	Bank of Albania
Macroeconomic performance indicators		
Central Base Rate CBIR Inflation-change rate (IR) Gross Product Domestic growth (GDP)	Central Base Interest Rate (%) Inter-quarterly change rate (%) GDP Growth %	Bank of Albania Bank of Albania World Bank
Consumer Price Index (CPI)	Percentage point (quarterly)	INSTAT
Price Producer Index (PPI)	Percentage point (quarterly)	INSTAT
Construction Cost Index (CCI)	Percentage point (quarterly)	INSTAT
Dummy variable (D2020)	1 (Covid) and 0 (No covid)	

Table 2. Descriptive statistics

Variable	Mean	Std.Dev.	Min	Max
NPL	10.46	5.13	5	21
LD	47.84	1.70	45.60	52.16
CBIR	1.382	0.83	0.50	3.25
CAP	17.84	1.21	16.00	20.00
IR	0.56	0.70	-0.28	3.41
GPD	0.91	2.85	-8.70	11.70
CPI	1.065	0.046	1.00	1.16
PPI	1.08	0.11	0.98	1.31
CCI	1.03	0.72	1.01	1. 04

Source: Authors Calculators

Table 2 presents the descriptive statistics of the variables. According to Table 2, NPLs have an average rate of 10.46%, with a standard deviation of 5.13%. The minimum level is estimated at 5% for the given Albanian sample. The GDP experienced an average growth of 0.91%, with notable fluctuations during the biannual period of the COVID-19 pandemic. In 2021, GDP was more responsive compared to other macroeconomic indicators.

We use Principal Component Analysis (PCA) to analyze three macroeconomic price variables: the Product Price Index (PPI), the Consumer Price Index (CPI), and the Construction Cost Index (CCI). The PCA approach offers several econometric advantages by creating a composite macro price index (PI) to capture overall economic stability. First, it overcomes multicollinearity and overparameterization that would have occurred if the three adopted prices were included in the same equation. The PI accounts for 76% of the variability across the three price indicators, with the CPI being the most influential, explaining 72.30% of the variance, followed by the PPI at 21.95% (INSTAT, 2023a) and the CCI at 0.0574% (INSTAT, 2023b).

The inclusion of an aggregate index of the three macro prices—namely, the CPI, the CCI, and the PPI captures the influence of real economic conditions. These indicators collectively reflect the average variation in prices paid by consumers for a standard basket of goods and services. In contrast, interest rates signify the cost of borrowing, representing the rate at which lenders charge for loans. The interest rate (IR) is measured as the percentage change in the price index over a one period to the next, relative to the previous period.

3.3. Econometric framework

In this part, we examine the model's potential indicators of variable quality (indicators). We assess the positive relationship between CBIR, LD, and CAP with NPL, and whether the inflation rate could decrease the credit quality (NPL), particularly in Albania, an open but small economy characterized by significant foreign currency lending to unhedged borrowers.

Suhendra and Anwar (2022) identified that economic growth impacts the stability of the banking system. The consumption model connects economic growth to non-performing loans (NPLs), suggesting that borrowers experience profits as the economy expands. This relationship is supported by macroeconomic research, which indicates that economic growth enhances borrowers' financial stability and repayment capacity. Benefiting the stability of the banking industry, bad loans tend to decrease when the economy thrives. As the country's economy fluctuates, this study aims to investigate the relationship between NPL, GDP, and the PI. However, the direction could be positive or negative, given the unusual growth in 2020 due to the pandemic. Additionally, the macro price index PI is a potential determinant influencing NPLs. The study by Tham, Said, and Adnan (2021) examines the long-term effects of the CPI on NPLs.

The relationship between NPL and other variables can be written as:

$$Y_{LNP_t} = f(X_{F_t}B + X_{M_t}P) \quad (1)$$

Y_{LNP_t} endogenous variable

$X_{F_t}B$ epresent exogenous variables inthe model and describe the bank factor (LD, IR, and CAP),

$X_{M_t}P$ represent exogenous macroeconomic factors and serve as control variables in the model (CBR, GDP, PI).

This study relies on time series econometric techniques to estimate the relation between macroeconomic variables and NPLs. Traditional regression approaches often face inconsistency issues when using lagged dependent variables. In time series contexts, non-stationarity and the same order of integration are prerequisites for valid estimation. To address both short-term and long-term dynamics, the Vector Error Correction Model (VECM), proposed by Engle and Granger (1987) and Johansen (1995), is commonly used.

However, the Autoregressive Distributed Lag (ARDL) model has gained prominence due to its flexibility in handling variables of mixed integration orders (I(0) and I(1), as noted by Pesaran and Shin (1997). This method is especially reliable for small sample sizes and overcomes the constraint of requiring all variables to be integrated at the same order. Before estimating the ARDL model, unit root tests, specifically the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests, are conducted to confirm that none of the variables are integrated at order I(2) or higher.

The ADF test accounts for higher-order autoregressive processes, whereas the PP test corrects for serial correlation and heteroskedasticity without requiring a predefined lag length. Using both tests together enhances the reliability of stationarity assessment..

The causality between NPL and the six exogenous variables is tested in this sense. The purpose of the procedure developed by Toda and Yamamoto (1995) for testing non-causality, as proposed by Granger, is that it has the advantage of being applicable even when variables are not ordered in the same way or there is no cointegration relationship. This procedure is also known as testing of augmented Granger non-causality, whose idea is to increase the order of the VAR, k, in the maximum order of integration d_{max} of the variables in such a way that it is estimated a VAR model with $d_{max} + k$ differentiated series of the variables, as shown in equations (2) and (3).

$$Y_t = \alpha_0 + \sum_{i=1}^{k} \alpha_{1i} Y_{t-i} + \sum_{j=k+1}^{dmax} \alpha_{2i} Y_{t-1} + \sum_{i=1}^{k} \beta_{1i} X_{t-i} + \sum_{j=k+1}^{dmax} \beta_{2i} X_{t-1} + v_{1t} \quad (2)$$

$$X_t = \delta_0 + \sum_{i=1}^{k} \delta_{1i} X_{t-i} + \sum_{j=k+1}^{dmax} \delta_{2i} X_{t-1} + \sum_{i=1}^{k} \lambda_{1i} Y_{t-i} + \sum_{j=k+1}^{dmax} \lambda_{2i} Y_{t-1} + v_{2t} \quad (3)$$

To validate the existence of causality from X to Y, as specified by equation (2), we also need to consider causality from Y to X in equation (3), which can also be assessed using a Wald test. This approach will facilitate the analysis of the relationship between NPL and financial and macroeconomic growth. The ARDL model, which indicates the direction of causality flowing from financial and economic growth to NPL, as shown in equations (5) and (6), is the most frequently observed causality result in the literature review. However, when estimating the ARDL model, the order for considering causality will rely on the results from applying the procedure by Toda and Yamamoto-Ganger (1995) for no causality.

The standard specification of the ARDL model is:

$$Y_t = \alpha_0 + \sum \alpha_{ipi} Y_{t-1} + \sum \beta_{iqi} X_{t-1} + \sum \lambda_i X_{t-1} + \varepsilon_i \quad (4)$$

The values p and q represent the optimal lags for endogenous and exogenous variables. Based on the relationship specified in equations (1), (2), (3), and (4) for this study, it is proposed that no co-integration ARDL should be specified as follows:

$$l_{LNP_t} = \alpha_0 + \sum_{k=1}^{p} \alpha_1 \Delta l_{LNP\,t-k} + \sum_{k=0}^{q} \beta_1 \Delta l\_LD_{t-k} \cdot \sum_{k=0}^{q} \beta_2 \Delta l\_CBR_{t-k} + \sum_{k=0}^{q} \beta_3 \Delta l\_IR_{t-k} + \sum_{k=0}^{q} \beta_4 \Delta l\_CAPR_{t-k} + \sum_{k}^{q} \beta_5 \Delta l\_GPD_{t-k} + \sum_{k=0}^{q} \beta_{6\Delta l_{PI}+} \beta_7 d_{2020} + \lambda_1 l\_NPL_{t-1} + \lambda_2 l\_LD_{t-1} + \lambda_3 l\_CBR_{t-1} + \lambda_4 l\_IR_{t-1} + \lambda_5 l\_GPD_{t-1} + \lambda_6 l\_PI_{t-1} + \varepsilon_t \quad (5)$$

The term Δ in (3) is the difference operator of the series, and the parameter α_i corresponding lag endogenous variable β_i and λ_i is the parameter for the exogenous variable in both the short and long term. Additionally, dummy variables d_{2020}, they were included to account for the impact of the COVID-19 pandemic, which may have uniquely affected the GDP and PI at the national level.

Rewritten the equation (5) adding the term $\theta EC_{t\text{-}1}$ (error correction and (θ) (the speed adjust parameter, the cointegration VEC model is:

$$l_{LNP_t} = \alpha_0 + \sum_{k=1}^{p} \alpha_1 \Delta l_{LNP\,t-k} + \sum_{k=0}^{q} \beta_1 \Delta l\_LD_{t-k} + \sum_{k=0}^{q} \beta_2 \Delta l\_CBR_{t-k} + \sum_{k=0}^{q} \beta_3 \Delta l\_IR_{t-k} + \sum_{k=0}^{q} \beta_4 \Delta l\_CAPR_{t-k} + \sum_{k}^{q} \beta_5 \Delta l\_GPD_{t-k} + \sum_{k=0}^{q} \beta_{6\Delta l_{PI}+} \beta_7 d_{2020} + \lambda_1 l\_NPL_{t-1} + \lambda_2 l\_LD_{t-1} + \lambda_2 l\_LD_{t-1} + \lambda_3 l\_CBR_{t-1} + \lambda_4 l\_IR_{t-1} + \lambda_5 l\_GPD_{t-1} + \lambda_6 l\_PI_{t-1} + \theta ECT_{t-1} + \varepsilon_t \quad (6)$$

4. Results

The ARDL approach is employed in this study due to its flexibility in handling variables that are either stationary at level I(0) or integrated of the first order I(1). However, the presence of variables integrated of the second order I(2) or higher renders the F-test for cointegration invalid. Thus, it is crucial to verify that none of the variables are I(2). The results of the ADF and PP unit root tests, summarized in Table 3, show that the null hypothesis of a unit root cannot be rejected at level for most variables, but is rejected after first differencing, confirming they are I(1).

Five out of seven variables, including the endogenous NPL variable, are not stationary and integrated I(1). The price index and GDP growth are stationary at I(0).

The results of the no-causality test for Toda-Yamamoto are presented in Table 4. When the variables in the model are integrated in different orders, the Toda-Yamamoto test proves more robust in predicting causality than the Granger Pairwise test. The Wald test confirms the causal relationships of LD and CBIR on NPL at significance levels of 1% and 5%. The causality of GDP, PI, and CAP towards NPLs is only confirmed in one direction at a 10% significance level, as stated in the initial ARDL equation. A bi-directional causal relationship is not established for the IR. In the case of LD, a weak causality exists at a 10% significance level on NPLs. However, obtaining a strong relationship in the opposite direction, according to what our model states, is not necessary for this study to establish an equation with the dependent variable LD.

Table 3. Unit root time series test.

	ADF unit root test				PP stationary test		Observation
	Nivel (c)		First difference (c1)		Nivel (c)	First difference (c1)	Stationery and Integration (I)
Variable	b_0	$b_0 + b_{1t}$	b_0	$b_0 + b_{1t}$	b_0	$b_0 + b_{1t}$	
NPL	-4.07***	-1.33	-4.51***	-5.71***	-1.93	-3.89***	No stationary; I (1)
LD	-3.48***	-2.57	-4.90***	-4.12***	-2.08	-3.91***	No Stationary; I (1)
CBR	-1.84	-1.51	-3.62***	-4.29***	-1.7	-3.01**	No Stationary I (1)
CARP	-1.1	-5.28**	-3.42***	-4.07***	-1.87	-3.84***	No stationary I (1)
IR	-2.43	-2.92	-6.00***	-3.78***	-1.91	2.89**	No stationary I (1)
GPD	-6.21***	-6.11***	-5.53***	-5.82***	5.78***	-5.90***	Stationary; I (0)
PI	-2.63	-4.96***	-4.68***	-4.33***	2.13	3.62***	Stationary I (0)

Source: Author calculators

Statistical significance *** 1%, ** 5% and * 10%

Note: Null hypothesis: the series has a unit root

Table 4. Toda-Yamamoto causality test results.

Null hypothesis	Wald $\chi 2$	Sense of causality
LD does not cause NPL	10.90***	LD → NPL
NPL does not cause LD	4.45*	NPL → LD
CBIR does not cause NPL	6.95***	CBIR → NPL
NPL does not cause CBIR	1.89	NPL → CBIR (no causality)
IR does not cause NPL	1.45	IR → NPL (no causality)
NPL does not cause IR	0.89	NPL→ IR (no causality)
CAR does not cause NPL	4,20*	CAP→NPL
NPL does not CAR	1.17	NPL→CAP (no causality)
Gross Product Growth does not cause NPL	4.75**	GPD → NPL
NPL does not cause Gross Product Growth	1.81	NPL → GPD (no causality)
Price Index does not cause NPL	3.95*	PI → NPL
NPL does not cause Price Index	1.15	NPL→PI (no causality)

Source: Author calculators

Significance: *** 1%, ** 5% and * 10%.

Table 5. The optimal number of lags.

	Endogenous variable	Exogenous variables					
	NPL	LD	CBIR	IR	CAP	GPD	PI
Optimal lags	2	2	4	2	3	0	0

Source: Author calculators

Table 6. Limit for cointegration F bound test

F value			Statistical significance level					
	1%		2,5%		5%		10%	
	U-bound	**L-bound**	**U-bound**	**L-bound**	**U-bound**	**L-bound**	**U-bound**	**L-bound**
5,83	3.65	4.66	3.15	4.08	2.79	3.67	2.37	3.2

Source: Author calculators

Null hypothesis: variables are not cointegrated

Determining the optimal lag lengths for all variables in the model is another crucial requirement for parameter estimates in an ARDL dynamic model. The optimal lag lengths were selected using the Akaike (AIC) and Schwarz information criteria (Table 5).

To test the long-term model, it is necessary to confirm the cointegration between variables. In the Bounds test, the null hypothesis is that the series has no relationship in the long run or is not cointegrated. The validity test has been conducted by comparing the test value with the limits at four levels of statistical significance. If the calculated test value of the sample does not fall within these limits, the null hypothesis of non-cointegration is rejected. For an F Bound value of 5.83, the theory of no cointegration is rejected at all levels of statistical significance considered (see Table 6). The critical values for each statistical level are presented by Pesaran, Shin, and Smith (2001).

Table 7. Variance Inflation Factor for the collinearity problem.

Exogenous variables	VIF
LD	4.662
CBIR	3.049
CAP	5.444
IR	2.359
PI	6.478
GDP	1.191

Source: Author calculators

VIF: Minimum possible value = 1.0. Values > 10.0 may indicate a collinearity problem.

The boundary test provides an initial insight into the relationship of cointegration in the model. However, regarding the direction of causality and the long-term relationship, to achieve more robust results, it is essential estimating the ARDL dynamic model. Before testing the ARDL model, a standard regression model assessed multicollinearity among exogenous variables. In the model, none of the variables exhibits a Variance Inflation Factor (VIF) exceeding the allowed limits (Table 7).

4.1. Results of the ARDL dynamic model

In Table 8, the results of the estimated coefficients are presented. First, it is determined that the error correction coefficients (ECT – 1; θ = –0.82) must be both negative and statistically significant to confirm a relationship in long run between the studied variables, which would also validate the causality implied in the long run. In this regard, as indicated in Table 8, the error correction coefficient meets the previously mentioned conditions; that is, it supports the findings of limit testing in the specified models. The estimated coefficients are presented in the long term after confirming the cointegration relationship in the selected models. Additionally, the error correction indicates that most of the instability (82.00%) of the NPL ratio is due to shocks from exogenous variables (bank variables) at the initial moment, echoing the observations of Makri, Tsagkanos, and Bellas (2014), and Ahmed et al. (2021).

Furthermore, Table 8 shows the estimated coefficient for the short run, where a dummy variable (D2020) is included to ensure the stability of the parameter estimates and capture the effect of the sudden drop in the GDP variable during the COVID-19 pandemic.

D2020 is a dummy variable, and the coefficient of 0.38 in the short run is associated with the increase

Table 8. The ARDL dynamic model

	Short run		Variables	Long run	
Variables	$\widehat{\alpha_i}$; $\hat{\beta}_i$	ST. Error		$\hat{\lambda}_i$	ST. Error
(D)L__NPL (-1)	0.36**	0.12	L_LD	0.46***	0.15
(D)L__LD (-1)	0.14**	0.06	L_CBIR	0.32**	0.12
(D)L_CBIR (-1)	0.18**	0.08	L_IR	0.54*	0.29
(D)L_CBIR (-2)	0.09**	0.09	L_CAP	0.10*	0.05
(D)L_CBIR (-3)	0.06*	0.04	L_GDP	-0.23**	0.09
(D)L_CBIR (-4)	0.11*	0.03	L_PI	0.18*	0.08
(D)L_IR (-1)	-0.09*	0.05	Dummy D (2020)	-0.27	0.30
(D)L_CAP (-1)	-0.44**	0.06			
(D)L_CAP (-2)	-0.15*	0.039			
L_GPD	-0.24***	0.56			
L_PI	0.17**	0.08			
Dummy (D2020)	0.38**	0,09			
Coint (ECT-1)	-0.82***	0.20			
C (constant)	-6.9***	0.17			
@ (trend)	-7,4**	1.5			
Model estimated ARDL (2,2,4,2,3,0,0) Model selection method AIC= -7.68					

Source: Author calculators

in NPLs following COVID compared to the pre-COVID period. This increase may arise from the significant uncertainty caused by the pandemic, as it shows no significance in the long run.

The ARDL long-run results in Table 8 indicate that LD, CBIR, and CAP have a statistically significant effect on NPLs over the long term. A coefficient of 0.46 for LD suggests that a one percentage point increase in this rate results in a 0.46 percentage point increase in NPLs, holding other factors constant. These findings support the notion that the bank liquidity level, or the LD volume, directly increases NPL levels. Typically, the ideal loan-to-deposit ratio ranges from 80% to 90%. In this analysis, the ratio stands between 20 and 25 percentage points below the recommended limits (averaging 47.8%), which may explain low loan returns and establish a positive relationship with NPLs.

Regarding bank rates, a one-percentage-point increase resulted in a 0.32 percentage - point rise in NPLs. The interest rate has a weak long-term effect on the behavior of NPLs, as it is statistically significant only at the 10 percent significance level. For each percentage increase in the interest rate, NPLs increase by 0.54 in terms of the estimated coefficients, which is the factor that worsens NPLs. Regulatory capital and PI variables maintain a discreet relationship with long-term NPLs that is statistically significant at 10% and increases NPLs. The growth of NPLs is attributed to regulatory capital at 0.10% and the PI at 0.18%, while keeping the other variables in the model constant in each case. The growth rate has a coefficient with negative signs in both the short and long term. This result is corroborated by several empirical studies, such as Mazreku et al. (2018) and Petkovski, Kjosevski, and Jovanovski (2018). The interpretation is that the increase in GDP reduces the NPL rate, holding the other variables constant. In this specific case, it is logical that, except for the third quarter of 2020, which saw a decline due to the pandemic, Albania's GDP growth has steadily increased over the last decade. This trend is part of the relative stability of the economy and market stability measures.

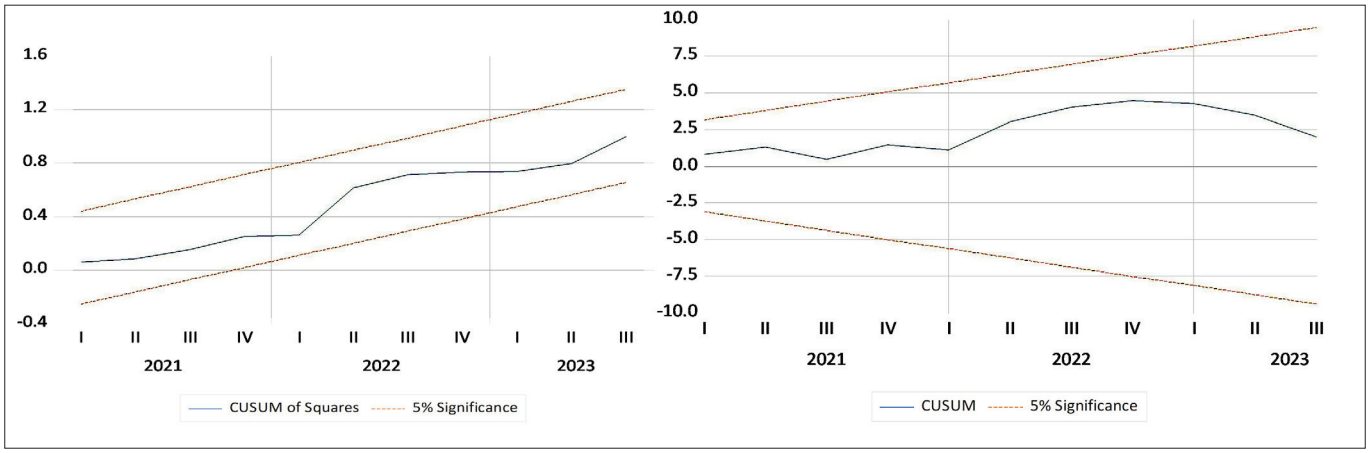
4.2. Model validation

Multiple tests have been conducted to validate the estimated model. Under the null hypothesis of variance homoscedasticity, the Breusch-Pagan-Godfrey test (level and squares) has been applied. With a χ^2 value of 23.78 (p-value 0.29), we maintain the null hypothesis of homoscedasticity, ensuring that the estimated coefficients are not inflated and that there is no heteroscedasticity in the equation. The Breusch-Pagan Serial Correlation test confirms that the null hypothesis regarding the relationship between error and error variance is consistent. With a critical value of 12.37 (p-value = 0.41), we can reject the null hypothesis.

The normality of the residuals has been verified using the Jarque-Bera test, resulting in a statistic of 0.39 (p-value = 0.67), which indicates a failure to reject the null hypothesis of normal distribution at a 5 percent significance level.

A stability test was also conducted to assess the model's stability. The results are presented in Figure 4. The graphs plot the CUSUM and the squared CUSUM. The CUSUM graph stays within the critical limits of 5%, confirming the long-term relationship between the variables and the stability of the coefficients. Similarly, the squared CUSUM statistic remains within the critical limits of 5%, further supporting the stability of the estimates in the ARDL dynamic model.

Figure 4. Stability test.



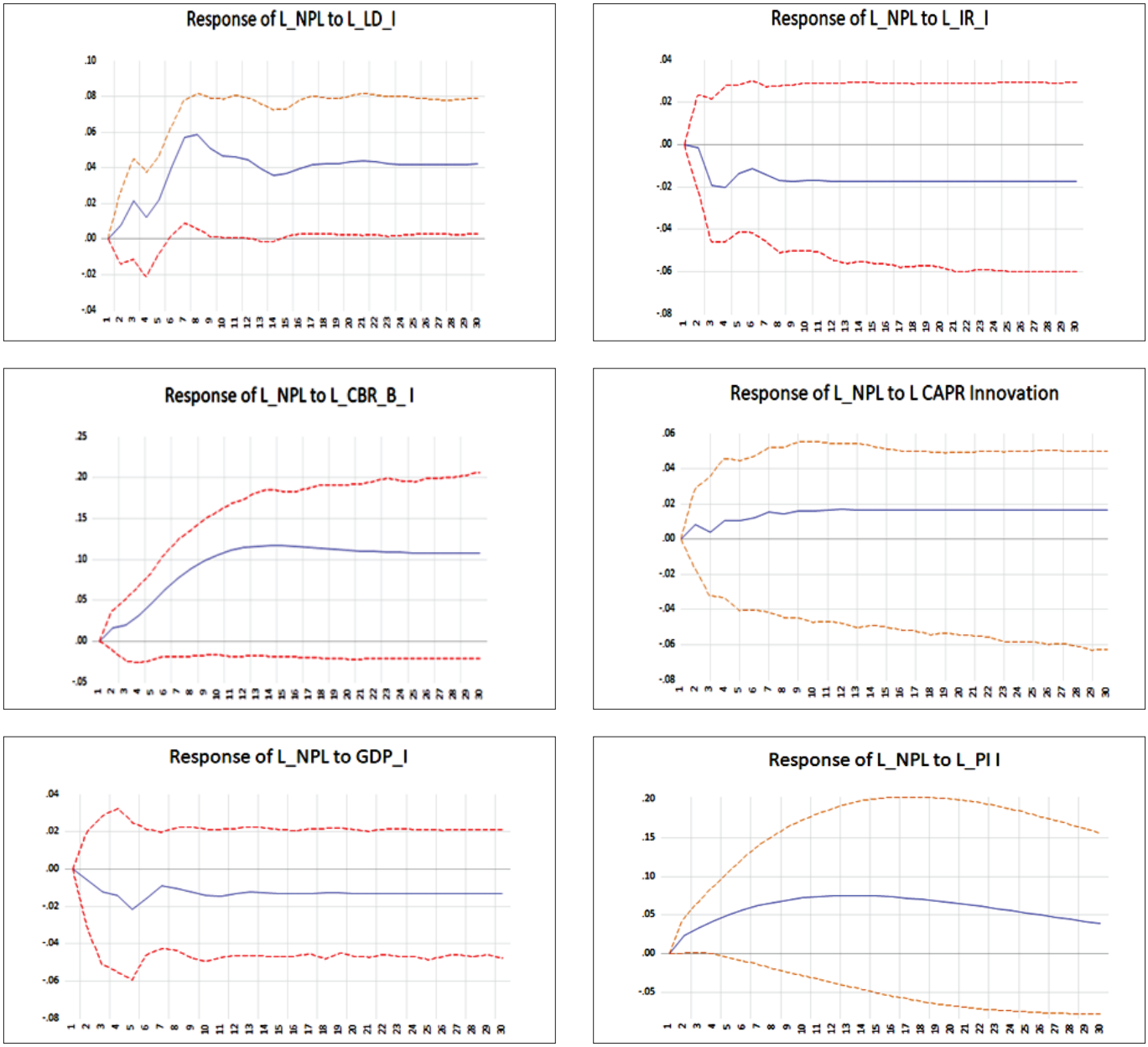
Source: Author calculators

4.3. Impulse response discussion

Impulse response analysis has been employed to examine the impact of a single shock on the exogenous variables affecting the current and future values of the endogenous variable (NPL). The NPL's response to a shock in an exogenous variable is determined using a 95% bootstrap confidence interval (CI). The results, presented graphically in Figure 5, indicate that NPLs respond differently based on the explanatory variables and the shock duration.

L_NPL's response to a loan deposit rate impulse (L_LD) shows a positive impact on the loan deposit ratio in both the short and long term. In the long run, it experiences a slight decline between the end of the first quarter and the second quarter of 2016, before recovering and increasing over the next two quarters, ultimately stabilizing in the first quarter of 2017. This indicates a long-term equilibrium that has been achieved after more than one year. When the L_LD ratio falls below 100% (approximately 50% in this study), the bank maintains its liquidity effectively, with low returns to account for the fluctuations and decrease in NPLs, which corresponds to a reduction in the percentage of loans. These results are consistent with findings from other empirical studies, such as Tham, Said, and Adnan (2021).

Figure 5. 95% CI using Standard percentile bootstraps with 999 bootstrap repetitions.



Source: Author calculators

Response to Cholesky One S.D. (d.f. adjusted)

L_NPL's response to L_Capital Regulatory (L_CARP) is positive regarding an increase in the capital adequacy ratio for both the short and long term. Over the long term, the impact decreased slightly from periods 3 to 4, then stabilized and remained consistently optimistic from the ninth quarter onward. This long-term trend aligns with initial expectations and economic theory.

Based on the impulse response of L_NPL to the graphs below, we can identify the relationship between the monetary policy of L_CBR and credit risk. The impact of NPLs is significant and critical for decisions to adjust the central bank rate. The term experiences several changes in the short run, with fluctuations continuing into the fourth quarter. It begins with a slight increase over the following five periods before stabilizing at a constant level or equilibrium from the tenth quarter onward. From that point, it remains stable while enduring a gradual long-term decline.

The response of L_NPL to a change in the inflation rate (L_IR) is asymmetric and negative in the short term. Between periods 3 and 4, a decline stabilizes as a negative constant in period 8 in the long term. However, the response of L_NPL to an impulse from the Price Index (IP) variable increases symmetrically during the initial periods and begins a slight long-term decrease after period 12.

The response of L_NPL to a shock in L_GDP growth is negative in both the short and long run. In the short term, it is asymmetrical, decreasing during periods 2, 3, and 4, and increasing during periods 5, 6, and 7. It remains negative in the long term at equilibrium. Numerous empirical studies have confirmed this negative relationship between the two variables when stability is higher. The country's GDP has shown consistent growth over the last decade, apart from the third quarter of 2020, which marked the abrupt decline in COVID-19 recovery after two periods, leading to a level that surpasses the previous drop. Therefore, the discrete variable D2020 holds significance only in the short term and indicates the current rupture.

In response to an impulse from exogenous variables, the instability of the initial periods of NPLs lasts between 8 and 12 periods. In the long run, variables such as GDP and the PI stabilize to exhibit consistent long-term behavior. The impact of macro-variables is strongest with time lags of 2, 3, and 4 quarters.

The variables of banking activity and government decision-making regarding the central bank ratio and the regulatory capital inflation rate tend to experience longer fluctuations in the long-term equilibrium of the first 12 to 14 periods.

5. Conclusion

Utilizing the ARDL approach, this study, which spans from 2015 to 2024 in Albania, examines the influence of monetary policies and various control variables on bank credit risk in Albania, confirming a long-term relationship among the variables. Increased CBIR and LD ratios contribute to higher NPLs, while economic growth and stable inflation help to mitigate them. The Bank of Albania's policies have successfully maintained price stability and reduced NPLs.

CAP also demonstrates a positive yet weaker impact. IR decreases the NPLs in the short term but has a positive long-term effect. The COVID-19 dummy variable increases the NPLs in the short term but is insignificant in the long run. LD tended to remain below the average (80%) due to the potential for an increase in NPLs in both the short and long term (Ahmed et al. 2021). A decrease in banking liquidity (an inverse increase in LD) leads to a rise in NPLs. The impulse response analysis suggests that the variables tend to respond to short-term shocks while maintaining long-term stability of the price index and promoting economic growth. Furthermore, the Bank of Albania's policies have successfully ensured price stability in consumer prices, one of the objectives of its actions (Gojčaj 2024).

The Toda-Yamamoto causality test indicates bi-directional causality between LD and NPL, as well as unidirectional causality from CBR to NPL. Model validation tests verify the absence of heteroscedasticity, serial correlation, and a normal distribution of residuals, ensuring the robustness of the ARDL model. This outcome is consistent with previous findings that highlight the impact of monetary policy, as represented by the CB rate, on credit risk. Furthermore, it supports the notion that higher interest rates imposed on borrowers can increase the likelihood of credit failures in the banking sector (Asiama and Amoah 2019).

The findings revealed that inflation has a weak negative significance on non-performing loans in the short run. The actual value of loans tends to decline with higher inflation rates, which facilitates timely repayments and reduces the risk of default. This aligns with the study by Asiama and Amoah (2019), which indicates a negative connection between inflation and NPLs in brief. The impact is positive.

The results indicate that monetary policy, as measured by CBIR, decreases credit risk, suggesting that a tightening of monetary policy, characterized by an increase in CBIR, raises NPLs due to a rise in bank credit risk. Additionally, improving macroeconomic

indicators, such as stable inflation reduction and higher economic growth, is essential for reducing NPLs in Albania's banking sector over the long term. Decreasing bank liquidity (through LD) and capital (through CAP) can lower credit risk in the long run. These findings can help bank representatives refine their lending policies regarding NPLs. A lower CAP in the short term contributes to an increase in NPLs, but in the long run, it can lead to a decrease in NPLs and vice versa, as Velliscig, Floreani, and Polato (2022) found.

The response to shocks indicates that the recovery period for various banking activities tends to be prolonged. In the short term, bank-level variables such as the IR and the CBIR play a more significant role. Meanwhile, macroeconomic variables such as GDP and the PPI exhibit greater volatility in the short term, gradually stabilizing in the long term.

Macroprudential measures were implemented to strengthen bank balance sheets and maintain lending capacity. These initiatives aimed to support financial stability and enable a sustained recovery after economic shocks. The resilience of the banking sector was further reinforced by coordinated fiscal interventions from the government, expanded social programs to mitigate income losses, temporary tax relief for businesses, and sovereign loan guarantees to improve access to financing. These combined efforts were crucial for alleviating the economic impacts of the pandemic and maintaining monetary stability.

During the COVID-19 pandemic, the Bank of Albania was compelled to follow traditional monetary policy methods. Interest rates were raised to control inflation and prevent excessive debt accumulation. Between 2022 and 2024, a legal framework was established to address debtors, credit, and capital risks. These measures ensured the continued stability of the financial system and laid a foundation for sustained economic growth.

Additionally, the government should implement more effective macro-prudential and monetary policies to mitigate credit risk within Albania's banking sector. While the study provided valuable insights, it encountered challenges, including reliance on secondary data and a limited sample size of 12 commercial banks in Albania over a short period. Future research could investigate additional bank-specific indicators, such as net loan loss provisions, as dependent or independent variables, and macroeconomic factors like remittances, unemployment, credit growth, and exchange rates.

ACKNOWLEDGEMENTS

The funding for this manuscript is provided by the Read Fellowship Program (Research Expertise from the Academic Diaspora), which is supported by the Albanian American Development Foundation (AADF).

References

Adeola, O. and Ikpesu, F. 2017. Macroeconomic determinants of non-performing loans in Nigeria: An empirical analysis. The Journal of Developing Areas 51 (2): 31–43.

Ahmed, Sh., Majeed, E. M., Thalassinos, E., and Thalassinos, Y. 2021. The Impact of Bank-Specific and Macro-Economic Factors on Non-Performing Loans in the Banking Sector: Evidence from an Emerging Economy. Journal of Risk and Financial Management 14 (5): 217.

Akinlo, O., and Emmanuel, M. 2014. Determinants of non-performing loans in Nigeria. Accounting & taxation 6 (2): 21-28.

Alaoui Mdaghri, A. 2022. How does bank liquidity creation affect non-performing loans in the MENA region? International Journal of Emerging Markets 17 (7): 1635–1658.

Anbar, A., and Alper, D. 2011. Bank-specific and macroeconomic determinants of commercial bank profitability: Empirical evidence from Turkey. Business and economics research journal 2 (2): 139-152.

Anwar, C. J., Suhendra, I., Purwanda, E., Salim, A., Rakhmawati, N. A., and Jie, F. 2023. Investigating the relationship between monetary policy, macro-prudential policy and credit risk in Indonesia banking industry. Heliyon 9 (7).

Asiama, R. K., and Amoah, A. 2019. Non-Performing Loans and Monetary Policy Dynamics in Ghana. African Journal of Economic and Management Studies 10 (2): 169–184.

Asiama, R. K., and Amoah, A. 2019. Non-performing loans and monetary policy dynamics in Ghana. African Journal of Economic and Management Studies 10 (2): 169–184.

Baholli, F., Dika, I., and Xhabija, G. 2015. Analysis of factors that influence non-performing loans with econometric model: Albanian case. Mediterranean Journal of Social Sciences 6 (1): 391-398.

Bank of Albania. 2020. Annual report on the banking sector.

Bank of Albania. 2020. The Bank of Albania's Response To COVID-19. Https://Www.Bankofalbania.Org/Shtypi/Pergjigjja_E_Bankes_Se_Shqiperise_Ndaj_COVID-19/.

Bank of Albania. 2022. Medium-term development strategy of the Bank of Albania 2022-2024. Bank of Albania. https://www.bankofalbania.org/Botime/Botime_te_vecanta/Strategjia_afatmesme_e_zhvillimit_te_Bankes_se_Shqiperise_2022-2024.html.

Bank of Albania. 2024. Time Series. Accessed March–April. https://www.bankofalbania.org/Statistics/Time_series/.

Bank of Albania. 2025. Financial Stability Report – H2 2024. Retrieved from https://www.bankofalbania.org/rc/doc/RSF_6MII_2024_23042025.pdf.

Bank of Albania. N.d. Legislation: Laws. Retrieved from https://www.bankofalbania.org/Rreth_Bankes/Legjislacioni/Ligjet/.

Bauze, K. 2019. Non-performing loan write-offs: Practices in the CESEE region. The World Bank, September.

Benazic, M., and Radin, D. 2015. Macroeconomic determinants of the non-performing placements and off-balance sheet liabilities of Croatian banks. Organizacija 48 (2): 75-87.

Bernanke, B. S., and Gertler, M. 1995. Inside the Black Box: The Credit Channel of Monetary Policy Transmission. The Journal of Economic Perspectives 9 (4): 27–48.

Bethlendi, A., Mérő, K., and Orlovits, Z. 2024. Shadow banking in central and eastern europe: specificities and drivers. The Southeast European Journal of Economics and Business 19 (2): 13-29.

Bogdan, F. 2017. Lessons from the impact of internal and macroeconomic determinants of bad loans in CEE banks. Online at http://cse.uaic.ro/eurint/proceedings/ index_htm_files/EURINT2017_FIL.pdf. EURINT 4: 198-212.

Boussaada, R., Hakimi, A., and Karmani, M. 2022. Is there a threshold effect in the liquidity risk–non–performing Loans Relationship? A PSTR Approach for MENA Banks. International Journal of Finance and Economics 27 (2): 1886–1898.

Demid, E. 2021. Heterogeneity in the relationship between NPIs and real economy: evidence from the Mongolian banking system. Journal of Central Banking Theory and Practice 10 (2): 133–155.

Dickey, D. A. and Fuller, W. A. 1979. Distribution of the Estimators for Autoregressive Time Series with a Unit Root. Journal of the American Statistical Association 74: 427–431.

Engle, R. F., and Granger, C. W. J. 1987. Co-integration and error correction: Representation, estimation, and testing. Econometrica 55 (2): 251–276.

Erdas, M. L., and Ezanoglu, Z. 2022. How do bank-specific factors impact non-performing loans: evidence from G20 countries. Journal of Central Banking Theory and Practice 11 (2): 97–122.

The World Bank. 2017. Republic of Albania Financial Sector Development Policy Loan: Program Document. The World Bank.

Foglia, M. 2022. Non-Performing loans and macroeconomics factors: The Italian Case. Risks 10 (1): 1–13.

Gashi, F., and Fetai, B. 2023. The Impact of Monetary Policy on Bank Risk in the Western Balkan Countries. Southeast European University Review, 18 (1).

Gojčaj, V. 2024. Analysis of the Transparency Index of the Central Banks of the Western Balkan Countries. Journal of Central Banking Theory and Practice 10 (2): 109–128.

Haniifah, N. 2015. Economic Determinants of Non-Performing Loans (NPLs) In Ugandan Commercial Banks. Taylor's Business Review 5 (2): 137–153.

International Monetary Fund. 2017. Banking challenges in the Western Balkans: Prospects and challenges. In Regional Economic Outlook: Europe.

International Monetary Fund. 2020. Albania: Economic monitoring report. International Monetary Fund. https://www.imf.org/en/Publications/CR/Issues/2020/11/30/Albania-First-Post-Program-Monitoring-Press-Release-Staff-Report-and-Statement-by-the-49923?

Institute of Statistics (INSTATa). 2023 November. Producer Price Index, Q3 – 2023. https://www.instat.gov.al/en/themes/prices/producer-price-index/publications/2023/producer-price-index-q3-2023/

Institute of Statistics (INSTATb). 2023 July. Business and Consumer Confidence Survey, Q2 – 2023. https://www.instat.gov.al/en/themes/industry-trade-and-services/business-and-consumer-confidence-survey/

Johansen, S. 1995. Likelihood-Based Inference in Cointegrated Vector Autoregressive Models. Oxford University Press.

Klein, N. 2013. Non-Performing Loans in CESEE: Determinants and Impact on Macroeconomic Performance. IMF Working Papers WP/13/72.

Koju, L., Koju, R., and Wang, S. 2018. Macroeconomic and Bank-Specific Determinants of Non-Performing Loans: Evidence from the Nepalese Banking System. Journal of Central Banking Theory and Practice 7 (3): 111–138.

Leka, B., Bajrami, E., and Duci, E. 2019. Key Macroeconomic Drivers on Reducing Non-Performing Loans in Albania. Academic Journal of Interdisciplinary Studies 8 (2).

Mahrous, S. N., Samak, N., and Abdelsalam, M. A. 2020. The Effect of Monetary Policy on Bank Credit Risk: Evidence from the MENA Region. Review of Economics and Political Science 5 (4): 289–304.

Maivald, M., and Teplý, P. 2020. The impact of low interest rates on banks' non-performing loans. FFA Working Papers.

Makri, V., Tsagkanos, A., and Bellas, A. 2014. Determinants of non-performing loans: The case of Eurozone. Panoeconomicus 61 (2): 193–206.

Mazreku, I., Morina, F., Misiri, V., Spiteri, J., and Grima, S. 2018. Determinants of the Level of Non-Performing Loans in Commercial Banks of Transition Countries. European Research Studies Journal 21 (3): 3-13.

Messai, A. S., and Jouini, F. 2013. Micro and Macro Determinants of Non-Performing Loans. International Journal of Economics and Financial Issues 3 (4): 852–860.

Moinescu, B., and Codirlașu, A. 2013. Assessing the Sectoral Dynamics of Non-Performing Loans: Signs from the Financial and Real Economies. Theoretical and Applied Economics 2 (567): 69–80.

Mwikali, M. 2018. The Effect of Interest Rate Volatility and Inflation Rate on the Level of Non-performing Mortgage Loans in Commercial Banks in Kenya (Doctoral dissertation, University of Nairobi).

Panapoulou, E., and Pittis, N. 2004. A Comparison of Autoregressive Distributed Lag and Dynamic OLS Cointegration Estimators in the Case of a Serially Correlated Cointegration Error. The Econometrics Journal 7: 585–617.

Pesaran, M. H., and Pesaran, B. 1997. Working with Microfit 4.0: Interactive Econometric Analysis. Oxford: Oxford University Press.

Pesaran, M. H., and Shin, Y. 1997. Generalized impulse response analysis in linear multivariate models. Economics Letters 58 (1): 17–29.

Pesaran, M. H., Shin, Y., and Smith, R. J. 2001. Bounds Testing Approaches to the Analysis of Level Relationship. Journal of Applied Economics 16: 289–326.

Pesaran, M. H., Shin, Y., and Smith, R. J. 2001. Bounds testing approaches to the analysis of level relationships. Journal of Applied Econometrics 16 (3): 289–326.

Petkovski, M., Kjosevski, J., and Jovanovski, K. 2018. Empirical Panel Analysis of Non-Performing Loans in the Czech Republic. What are their Determinants and How Strong is Their Impact on the Real Economy? Finance a úvěr-Czech Journal of Economics and Finance 68 (5): 460-490.

Phillips, P. C. B., and Perron, P. 1988. Testing for a Unit Root in Time Series Regression. Biometrika 75 (2): 335-346.

Salifu, M., Abdulai, M. G., Angko, W., Domanban, P. B., Yakubu, I. N., and Ridwan, S. M. 2025. The Effect of Monetary Policy and Global Economic Policy Uncertainty on Bank Credit Risk. In Strategic Approaches to Banking Business and Sustainable Development Goals: 285–300.

Sejko, G. 2021. The Central Bank and Its Policies in The Covid-19 Era: Future Challenges. https://www.bankofalbania.org/rc/doc/CENTRAL_BANKS_AND_ITS_POLICIES_DURING_COVID_19_21455.pdf.

Skrabic Peric, B., and Konjusak, N. 2017. How Did Rapid Credit Growth Cause Non-Performing Loans in Cee Countries? The Southeast European Journal of Economics and Business 12 (2): 73–84.

Staehr, K., and Uusküla, L. 2017. Forecasting Models for Non-Performing Loans in the EU Countries." Working Paper, Westi Pank. http://www.eestipank.ee/en/publications/series/working-papers.

Suhendra, I., and Anwar, C. J. 2022. The Response of Asset Prices to Monetary Policy Shock in Indonesia: A Structural VAR Approach. Banks Bank Systems 17 (1): 104–114.

Tham, K. W., Said, R., and Adnan, Y. 2021. The Dynamic Relationship Between Inflation and Non-Performing Property Loans in Malaysia. Journal of Surveying, Construction, and Property 12 (1).

Toda, H. Y., and Yamamoto, T. 1995. Statistical inference in vector autoregressions with possibly integrated processes. Journal of Econometrics 66 (1-2): 225–250.

Touny, M. A., and Shehab, M. A. 2015. Macroeconomic determinants of non-performing loans: An empirical study of some Arab countries. American Journal of Economics and Business Administration 7 (1): 11–22.

Velliscig, G., Floreani, J., and Polato, M. 2022. Capital and Asset Quality Implications for Bank Resilience and Performance in the Light of NPLs' Regulation: A Focus on the Texas Ratio. Journal of Banking Regulation 10: 1–23.

World Bank Group. 2023. The World Bank in Albania. https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?locations=AL.

World Bank. 2012. From Recession to Reform: The Western Balkans and the Impacts of a Double Dip Recession. https://www.worldbank.org/en/news/feature/2012/12/18/from-recession-to-reform-western-balkans-and-impacts-of-double-dip-recession

Zunic, K., Kozaric, E., and Dzelihodžic, E. 2021. Non-Performing Loan Determinants and Impact of COVID-19: The Case of Bosnia and Herzegovina. Journal of Central Banking Theory and Practice 10 (3): 5–22.

Appendix 1

Summary of reviewed literature: the impact of macroeconomic and bank-specific factors on NPLs

Authors	Geographical Coverage	Sample Size	Time Horizon	Methods	Variables	Main Results
Makri, Tsagkanos, and Bellas 2014	Greece, CEE	17 countries of the Eurozone	2000-2008	Panel data analysis	Profitability, oans to deposits ratio, NPLs	Identified the impact of financial performance indicators on NPLs in banks across Greece and CEE countries.
Petkovski, Kjosevski and Jovanovski 2018	Czech Republic	22 banks from the Czech Republic,	2005-2016	Generalised Method of Moments	GDP growth, unemploymen, inflation, NPLs	Non-performing loans are influenced by the real economy, with significant feedback effects from macroeconomic factors such as private sector credit, GDP growth, unemployment, and inflation.
Bogdan 2017	Central and Eastern Europe	12 countries	2005-2015	Panel Least Squares Fixed Effects Method	Inflation, GDP growth, crisis, unemploymen, bank size, cost to income ratio, NPLs	Inflation and GDP growth decrease the NPLs, while unemployment, crisis and cost to income ratio had a positive impact.
Mazreku et al. 2018	CEE countries	10 countries	2006-2016	Panel data, including Pooled OLS, Fixed and Random Effects estimation, Generalised Method of Moments (GMM) estimation	GDP growth, inflation, unemploymen, export growth, NPLs	Found that GDP growth, inflation had the strongest inverse relationship with NPLs in transition countries, including Albania.
Staehr and Uusküla 2017	Western Europe and CEE	26 EUcountries and 11 CEE countries	1997Q4 to 2017Q1.	Forecasting model with a forecasting horizon	GDP growth, inflation, Mortgage loans, Real house prices, Current account, unemploymen, NPLs	Identified GDP growth, inflation, debt, and unemployment as key factors affecting NPLs, with GDP growth and inflation having inverse relationships with NPLs.
Skrabic and Konjusak 2017	CEE	11 countries	1999-2013	Dynamic Panel Data Generalised Method of Moments (GMM) estimation.	ROA, GDP, Inflation, Interest Rate, Loan Growth NPLs	Found that ROA and GDP decrease NPLs, while Credit Growth had a positive impact.
Leka, Bajrami, and Duci 2019	Albania	11 years	-	Multiple regression	GDP growth, M2, loan interest, exchange rate, NPLs	Investigated the role of monetary aggregates and loan interest rates in determining NPLs.
Baholli, Dika, and Xhabija 2015	Albania and Italy	Not specified	Q1 2008 – Q1 2014	Regression analysis	Financial crisis,exchange rate, NPLs	Emphasized the role of the financial crisis in raising NPLs and the importance of banking system oversight.
Mdaghri 2022	MENA countries	Not specified	Not specified	Regression analysis	Bank liquidity (LDR), Loan Loss provisions, Net interest margin, Interest rate, Exchange rate, GDP growth rate, NPLs	Found that bank liquidity has an inverse relationship with NPLs in MENA countries.

Ahmed et al. 2021	Pakistani banking sector	20 banks	2008–2018	Dynamic-GMM estimations	Bank liquidity (LDR), NPLs	Found that higher bank liquidity reduces NPLs, consistent with the inverse relationship between liquidity and credit risk.
Akinlo and Emmanuel 2014	Nigeria	Banks in Nigeria	1981-2011	ECM, Cointegration	Credit to the private sector, NPLs	Identified that increases in credit to the private sector were associated with higher NPLs, suggesting higher credit risk.
Boussaada, Hakimi, and Karmani 2022	MENA countries	Not specified	2004–2017	Panel Smooth Transition Regression model	Bank liquidity, bank performance, bank capital, bank size, inflation, NPLs	Found that bank performance, bank capital, bank size, international financial crisis, and the inflation rate significantly impacts NPLs in MENA countries.
Velliscig, Floreani, and Polato 2022	22 European countries	63 listed European banks	2005Q1-2018Q4	Fixed effects panel data regression analysis,	Capital Adequacy Ratio (CAR), Asset Quality and Provisioning, Texas Ratio NPLs	Found that higher CAR reduces NPLs, indicating lower credit risk with higher capital levels.
Erdas and Ezanoglu 2022	G20 countries	Not specified	1998 and 2017	Regression analysis	Inflation, NPLs	return on equity, credit growth and credit costs have a positive impact on NPLs due to decreased repayment ability from higher inflation.
Koju, Koju, and Wang 2018	30 Nepalese commercial banks	Not specified	2003-2015	Regression analysis	Inflation, NPLs	GDP growth rate, capital adequacy and inflation decrease NPLs, as rising inflation leads to higher interest rates and reduces loan defaults.
Zunic, Kozaric, and Dzelihodžic 2021	Bosnia and Herzegovina banking system	Not specified	-	Regression analysis	GDP growth, NPLs, Loan Loss Provisions, Covid 19	By declining GDP, lead to higher NPLs. While NPLs decreases with the increase of COVID-19.
Demid 2021	Mongolian Banking System	Not specified	2002. Q1 to 2019.Q1	Heterogeneous panel SVARs and standard SVAR models	NPLs output gap; inflation; ominal exchange rate, bank-level interest rate; bank asset size and profitability	The presence of NPLs creates a feedback effect in the economy. As credit quality deteriorates due to rising NPLs, lending slows down, which in turn hampers overall economic growth.
Gashi, F., and Fetai, B. 2023	6 Western Balkan countries banking system	79 number of observation	2003-2017 annual data	Fixed and Random effects panel, pooled OLS techniques and Hausman-Taylor Instrumental IV model	NPIs, Bank Capital/Total assets, Regulatory Capital Risk-Weighted Assets (Solvency Risk GDP growth Rate, ROA, ROE, Money market rate, Loan Port. Growth	Econometric results show that higher monetary policy rates reduce bank risk-taking, while credit expansion increases it in the Western Balkans.
Salifu et al. 2025	Ghana	Not specified	2010q1 to 2022q4	ARDL) bounds testing	GDP growth, inflation rate, capital adequacy ratio, and bank performance (as measured by the return on equity)	Our findings show that monetary policy rates increase NPLs in the long run but reduce them in the short run, while global economic policy uncertainty lowers credit risk in both periods.

South East European Journal of Economics and Business
Volume 20 (2) 2025, 53-67
DOI: 10.2478/jeb-2025-0018

PRODUCT-LINE DIVERSIFICATION AND FINANCIAL PERFORMANCE: THE CASE OF THE MACEDONIAN NON-LIFE INSURANCE MARKET

Bojan Srbinoski, Klime Poposki, Jasmina Selimovic

Abstract

This study investigates the relationship between product-line diversification and financial performance among non-life insurers in North Macedonia over the period 2013–2022. Drawing on firm-level data and applying fixed and random effects two-stage least squares (IV-2SLS) models, we examine whether diversification improves profitability in a market characterized by low insurance culture and heavy reliance on the regulated motor third-party liability (MTPL) segment. We use two diversification measures: the Herfindahl-Hirschman Index (HHI) of insurers' product portfolios and a weighted HHI adjusted for market competition across lines of business. Our findings reveal a nonlinear relationship between diversification and profitability, supporting the coexistence of both diversified and specialized insurers. While initial diversification appears beneficial, excessive diversification may reduce returns, and evidence linking diversification away from competitive lines (e.g., MTPL) to higher profitability is weak. These insights carry important policy implications, suggesting that a measured liberalization of the MTPL market could support healthier diversification dynamics, while highlighting the need for careful monitoring of risk underpricing and solvency risks in evolving product strategies.

Keywords: *non-life insurance, diversification, performance, North Macedonia*

JEL Codes: *G22; L25; O50*

Bojan Srbinoski, PhD (Corresponding author)
Assistant Professor
Faculty of Tourism and Hospitality, University St. Kliment Ohridski Bitola, North Macedonia
E-mail: bojan.srbinoski@uklo.edu.mk
ORCID: 0000-0003-4815-3762

Klime Poposki, PhD
Associate Professor
Faculty of Tourism and Hospitality, University St. Kliment Ohridski Bitola, North Macedonia
E-mail: klime.poposki@uklo.edu.mk
ORCID: 0000-0002-7497-5826

Jasmina Selimovic, PhD
Professor
School of Economics and Business, University of Sarajevo, Bosnia and Herzegovina
E-mail: jasmina.selimovic@efsa.unsa.ba
ORCID: 0000-0001-8485-8642

1. INTRODUCTION

The aftermath of the Covid-19 pandemic brought a resurgence in inflation, significantly impacting the insurance industry. The inflationary pressures had an imminent impact on non-life insurers through rising future claims costs and downward pressures on insurance demand (Schanz and Treccani 2023). The persistently higher levels of inflation imposed significant challenges to insurers, which dominantly underwrite business in Motor and P&C insurance lines, negatively affecting their financial performance (Deloitte 2022). The low insurance culture in North Macedonia imposes constraints on non-life insurers' underwriting portfolios to be less diversified and pressures insurers to

compete within the mandatory lines of business, such as motor insurance. However, the recent dynamics in the underwriting portfolio of non-life insurers show tendencies toward greater diversification. The recent surge in inflation brings forward the question of the relevance of corporate diversification for insurers' performance in North Macedonia: Whether greater specialization brings efficiency gains, improving non-life insurers' financial performance, or greater diversification creates synergies arising from economies of scope, supporting the profitability and stability of insurers?

The extant literature provides mixed evidence regarding the diversification-performance relationship in insurance. One group of studies provide support to the so-called conglomeration hypothesis, i.e. a positive relationship between diversification and performance (e.g., Berry-Stölzle, Hoyt, and Wende 2013; Che and Liebenberg 2017; Che et al. 2017; Lee 2017; Meador, Ryan, and Schellhorn 2000; Rehman et al. 2021; Wu and Deng 2021), while another group of studies provide evidence for the so-called strategic focus hypothesis, i.e. a negative relationship between diversification and performance (e.g., Baggett and Cole 2023; Cummins and Nini 2002; Liebenberg and Sommer 2008; Shim 2011; Born et al. 2023; McShane and Cox 2009). Moreover, most of the studies investigate these hypotheses for the developed countries, however, just a few studies exist which examine the issue for the less developed Eastern European countries (e.g., Krivokapic, Njegomir, and Stojic 2017; Ortyński 2019; Pavić and Pervan 2010). None of the existing studies covers North Macedonia.

This article examines the relationship between product-line diversification and insurer performance in the Macedonian non-life insurance market for the period 2013 – 2022 using firm-level data. We use two measures of product diversification: a simple Herfindahl-Hirschman index of product portfolio and a weighted sum of product-line shares in the insurer's portfolio multiplied by the line-specific Herfindahl-Hirschman Index. The latter takes into account not only the level of product diversification but also the competition within each line of business. We employ a robust methodological approach, fixed effects and random effects two-stage least squares regressions using a unique set of instrumental variables (FE IV-2SLS/RE IV-2SLS).

This research contributes to existing literature in two aspects. Firstly, we add to the three-decade-long discussion of the diversification-performance literature. Secondly, different from the existing literature, which is largely focused on the developed world, we investigate the issue of a less-developed insurance market but with a more competitive structure, especially in the mandatory motor insurance lines. Similar to the Serbian, the Macedonian motor insurance market is still constrained by the tariff regulation, which creates significant challenges for insurers dominantly active in the motor insurance lines. North Macedonia's motor third-party liability (MTPL) insurance market remains under state-mandated tariff regulation, with all insurers charging a uniform premium set by the authorities. Regulators have openly acknowledged the need to liberalize this segment; a government commission was even established to guide the transition toward risk-based pricing, but no substantive deregulation has been implemented yet. Recent government interventions (e.g. capping a 2024 premium increase and reverting prices to prior levels) further underscore that MTPL pricing is still tightly controlled by the state (Todorovski 2024). The study provides policy implications concerning the regulatory constraints within the mandatory motor insurance lines.

The remainder of this article is organized as follows. The second section reviews the literature. The third section presents the data and the empirical methodology. The empirical results are presented in the fourth section, which is followed by the conclusions.

2. LITERATURE REVIEW

The debate about corporate diversification and financial performance in insurance revolves around two competing hypotheses. The conglomeration hypothesis states that operating across multiple lines of business can improve the efficiency of insurers by realizing revenue or cost scope and scale economies, reducing the information costs from external financing by creating internal capital markets, and reducing the (default) risk by risk diversification (Berger et al. 2000). In contrast, the strategic focus hypothesis states that corporate diversification creates agency problems, stimulating cross-subsidization to poor-performing units in the firm (Liebenberg and Sommer 2008). Thus, the insurer focuses on its core business lines to avoid the profit scope diseconomies from greater diversification (Fier, Liebenberg, and Liebenberg 2017). However, the empirical evidence shows that the relationship between corporate diversification and performance in insurance is far from clear, as the relationship may be non-linear and moderated by various internal or external factors.

The pro-conglomeration evidence shows that product-line diversification in non-life insurance contributes to overcoming the barriers to growth,

reducing the volatility of underwriting results, affecting risk-taking behavior and improving profitability. Berry-Stölzle, Hoyt, and Wende (2013) argue that insurers may expand their product lines into unrelated markets to circumvent barriers to growth. This is in line with Li and Greenwood's (2004) mutual forbearance hypothesis, which states that multiline competition enables a reduction in competition intensity. Alternatively, Shim (2017a) claims that product and geographical diversification improve the financial stability of insurers by reducing the volatility of underwriting results. Regele (2022) extends this view further, suggesting that the diversification across non-life and life segments lowers the contribution to systemic risk. Similarly, recent evidence shows that business diversification enables insurers to reduce underwriting risks while improving their investment profitability (e.g., Che and Liebenberg 2017; Che et al. 2017; Lee 2017; Meador, Ryan, and Schellhorn 2000). While the previous studies mainly relate to developed countries, pro-conglomeration evidence also exists for developing countries (e.g., Krivokapic, Njegomir, and Stojic 2017; Ortyński 2019; Rehman et al. 2021; Wu and Deng 2021).[1]

The evidence that product specialization boosts financial performance in insurance is mainly present in the US insurance market. Hoyt and Trieschmann (1991) find that individual life-health and property-liability insurers tend to have higher performance compared to diversified insurers due to efficiency losses related to operating larger entity. Fier, Liebenberg, and Liebenberg (2017) argue that product expansion can be an expensive process for insurers, affecting the decision-making process of expanding insurers. The strategic focus hypothesis holds even within the US property-liability insurance market (e.g., Baggett and Cole 2023; Cummins and Nini 2002; Liebenberg and Sommer 2008; Shim 2011) as well as within the US health insurance market (e.g., Born et al. 2023; McShane and Cox 2009). Additionally, Pavić and Pervan (2010) provide evidence of the positive impact of product specialization on profitability by focusing on a small developing insurance market (Croatia).

However, the coexistence of diversified and specialized insurers may indicate potential non-linearities regarding the diversification-performance link (Du 2017; Shim 2017b). The relationship might be moderated by external (country-specific) and internal (firm) characteristics. For instance, insurers consider financial constraints and economic conditions in determining their diversification strategies (González-Fernández, Rubio-Misas, and Ruiz 2020). For instance, Berry-Stölzle, Hoyt, and Wende (2013) find that product diversification boosts performance in countries with well-developed capital markets, better property rights protection and stronger competition. Moreover, Elango, Ma, and Pope (2008) argue that the effects of corporate diversification on financial performance also depend on the extent of geographical diversification. Besides external factors, firm characteristics play an important role in maximizing the value of product diversification strategies. For example, Lee (2017) finds that larger insurers tend to benefit more from product diversification compared to their smaller counterparts. Additionally, the quality of the Enterprise Risk Management (ERM) reinforces the positive effects of diversification on performance (e.g., Ai, Bajtelsmit, and Wang 2018; Altuntas, Berry-Stölzle, and Cummins 2021). Finally, the interplay between leverage and product diversification significantly impacts the insurers' performance in more constrained insurance markets (Foong and Idris 2012). Thus, the impact of product diversification on the financial performance of insurers is market-specific and conditional on the institutional setting and market environment.

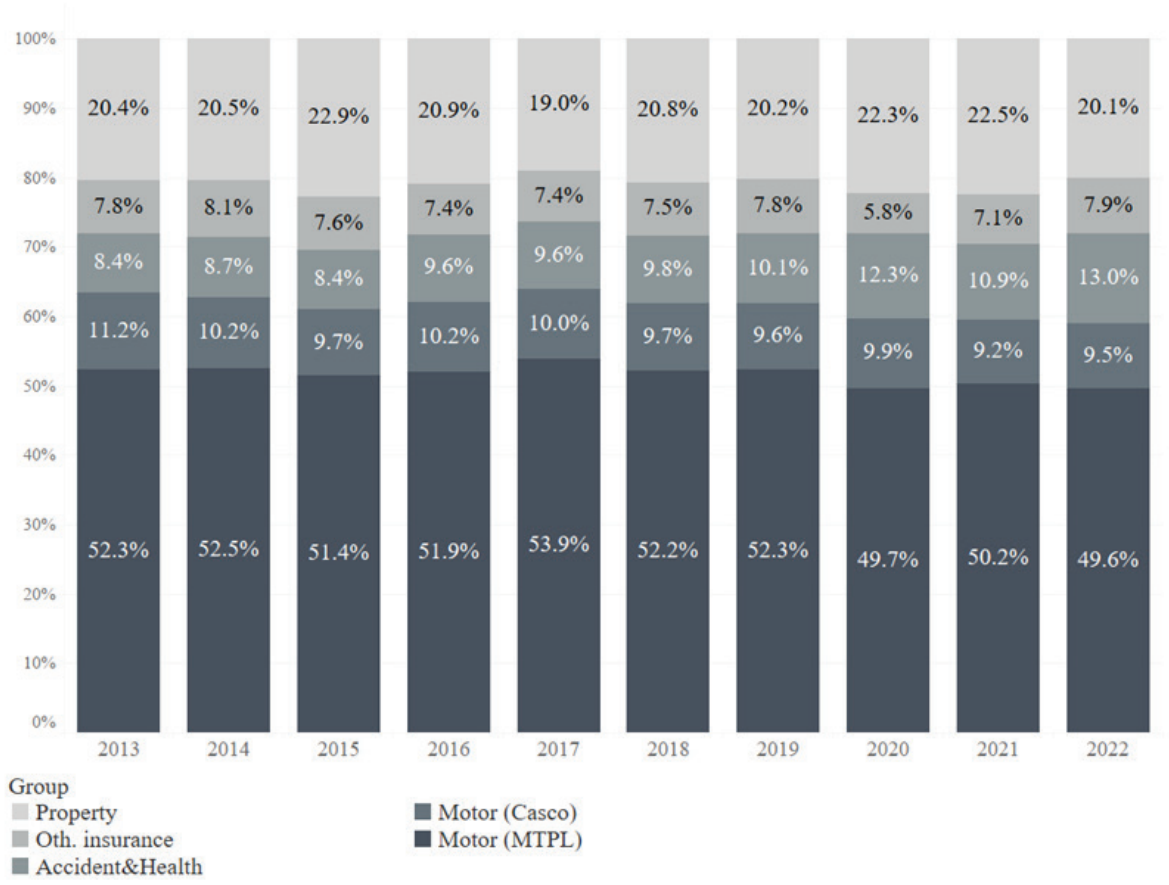
3. DATA AND METHODOLOGY

3.1. Data, sample and main variables

The Macedonian non-life insurance market has a peculiar setting for examining the diversification-performance link. Firstly, insurers must establish separate entities to write business in non-life or life segments, making insurers constrained to diversify only within one segment. Secondly, the Macedonian non-life insurance market is relatively competitive compared to other developing insurance markets and does not have significant market entrance/exit dynamics.[2] Throughout the observed period, the number of non-life insurance companies remained unchanged. Thirdly, the underdeveloped insurance culture constrains insurers to concentrate predominantly on mandatory or semi-mandatory lines of business, most notably motor third-party liability (MTPL) insurance, which consequently accounts for the largest proportion of the market portfolio. The tariffs in the MTPL market are regulated and without significant changes for the period of analysis, making the MTPL business less profitable in times of rising costs and increasing competition. Thus, the pressure on non-life insurers to reconsider their product mix strategy is significant.

The dataset is derived from official industry reports published by the Insurance Supervision Agency (ISA) of North Macedonia. It comprises 110 firm-year observations covering 11 non-life insurance companies over the period 2013–2022, encompassing all business lines within the non-life insurance segment.[3]

Figure 1. The structure of the market portfolio in North Macedonia during 2013-2022



Authors' calculations based on the Macedonian ISA's data

Figure 1 shows the tendencies in the structure of the market portfolio in North Macedonia. In aggregate, motor insurance (Casco and MTPL) slowly loses its importance over time, while accident and health insurance gain a larger share in the market portfolio. This process of a more diversified market portfolio was accelerated by the Covid-19 crisis.

Performance measures. In line with prior research, we employ commonly applied performance indicators, namely return on assets (ROA) and return on equity (ROE) (e.g., Liebenberg and Sommer, 2008). Nonetheless, as elevated profitability may stem from increased risk-taking, numerous studies adjust performance measures to account for risk exposure. A conventional approach involves correcting the performance indicators by their variability across a specified period. Alternatively, risk measures can be incorporated directly into the regression models to control for risk levels. For reasons of interpretability regarding the impact of diversification on performance, we adopt the latter strategy. Accordingly, we compute the standard deviations of ROA and ROE over rolling three-year intervals and introduce these values as control variables in the respective regressions.

Diversification measures. To assess the degree of product diversification among insurers, we employ two distinct measures. Firstly, we compute the Herfindahl–Hirschman Index (HHI) using Gross Premiums Written (GWP) for each insurer (i=1,…,11) across all lines of business (j=1,…,18) in each year (t). A lower value of HHI_{it} indicates a greater degree of diversification in the insurer's product portfolio. Consequently, a negative relationship between HHI_{it} and performance measures would provide support for the conglomeration hypothesis.

$$HHI_{it} = \sum_{j=1}^{18} \left(\frac{GWP_{ijt}}{GWP_{it}}\right)^2 \quad (1)$$

Additionally, we use the weighted sum of product-line shares in the insurer's portfolio multiplied by the line-specific Herfindahl-Hirschman Index (e.g., Krivokapic, Njegomir and Stojic 2017). Firstly, we

calculate each business line's (j = 1,...,18) participation in each firm's (i = 1,...,11) portfolio in each year (t).

$$w_{ijt} = \frac{GWP_{ijt}}{GWP_{it}} w_{ijt} = \frac{GWP_{ijt}}{GWP_{it}} \quad (2)$$

Using w_{it} as weights, we then calculate the weighted sum of a firm's exposure to industry concentration across all business lines in which it operates.

$$WHHI_{it} = \sum_{j=1}^{18} w_{ijt} * HHI_{jt} \quad (3)$$

The lower the value of the $WHHI_{it}$, the insurer has a more concentrated product portfolio in more competitive lines of business. Given the dominance of the MTPL in the Macedonian non-life insurance market, lower $WHHI_{it}$ would indicate a greater concentration of the insurer's portfolio in the MTPL business. Thus, the positive relationship between $WHHI_{it}$ and performance measures would indicate support for the conglomeration hypothesis.

3.2. Control variables

Firm size. To account for revenue scope economies, we employ the natural logarithm of total assets as a proxy for firm size. Larger insurers are generally expected to derive greater benefits from revenue scope economies than smaller ones. Prior studies document a positive association between firm size and financial performance (e.g., Nini, 2002; Elango, Ma, and Pope 2008; Liebenberg and Sommer, 2008).

Capitalization. Financial stability allows insurers to charge higher premiums and thereby achieve greater profitability (Sommer 1996). Previous studies have employed various indicators of capitalization, including the capital-to-asset ratio (e.g., Krivokapic, Njegomir, and Stojic 2017) and the policyholder-surplus-to-asset ratio (e.g., Liebenberg and Sommer 2008). In contrast, we adopt the ratio of capital to the minimum solvency margin, as defined by the Insurance Supervision Agency, as a risk-based indicator of financial stability. A higher value of this ratio reflects a more stable insurer.

Business growth. Excessive business expansion may increase the riskiness of an insurer's underwriting portfolio if sufficient time is not available to adjust risk-based capital or surplus to accommodate the growth in premium inflows (Killins 2020). To account for business growth, we measure the change in inflation-adjusted Gross Written Premiums (GWP).

Reinsurance. An insurer's riskiness depends on reinsurance utilization (Weiss and Choi 2008). On one side, reinsurance can be an expensive mechanism for underwriting portfolio management and may lead to inefficiencies, resulting in lower profitability. On the other side, reinsurance may improve risk diversification and lead to improved underwriting results. We calculate the retention ratio as the difference between GWP and the part of GWP ceded to reinsurance divided by the total GWP.

Cost efficiency. Given the level of market competitiveness, more efficient firms are able to achieve higher profitability without necessarily increasing prices (Weiss and Choi 2008). Accordingly, cost efficiency allows insurers to expand their market share while sustaining profitability. We employ the proportion of administrative expenses relative to total Gross Written Premiums (GWP) as a proxy for cost efficiency, where lower ratios denote higher efficiency.

3.3. Regression methodology

We adopt a rigorous methodological framework to address the structure of our data and potential endogeneity concerns. The panel nature of the dataset enables the application of fixed-effects models to account for time-specific influences and mitigate unobserved variable bias. Instead of relying solely on the Hausman test to determine the appropriate specification, we estimate both fixed-effects and random-effects models.[4] Moreover, endogeneity concerns may emerge as a result of potential simultaneity bias. The product-diversification strategy may also depend on the performance of insurers (Elango, Ma, and Pope 2008). Thus, we employ fixed effects and random effects two-stage least squares regressions using instrumental variables (FE IV-2SLS/RE IV-2SLS). In the first stage, we regress the diversification measure on the other independent and selected instrumental variables. In the second stage, we estimate Equation (4) using the predicted values of the diversification measure estimated in the first stage. To check for potential non-linearities, we also include the squared version of the main independent variable.

$$PERFORMANCE_{i,t} = \beta_0 + \beta_1 DIVERSIFICATION_{i,t} + \beta_2 DIVERSIFICATION_{i,t}^2 + \beta_3 SIZE_{i,t} + \beta_4 CAPITALIZATION_{i,t} + \beta_5 RETENTION_{i,t} + \beta_6 EFFICIENCY_{i,t} + \beta_{7\text{-}15} YEAR_{i,t} + \varepsilon_{i,t} \quad (4)$$

Implementation of the 2SLS methodology necessitates the identification of valid instruments. Instrument validity requires that the chosen instruments exhibit a strong partial correlation with the diversification measures while remaining uncorrelated with the error term. Accordingly, an appropriate identification strategy involves determining the treatment of the key independent variables and constructing a suitable set of instruments. We treat corporate

diversification variables as endogenous; thus, the squared term of the diversification variable results in an endogenous variable. In that case, the estimation of Equation 4 represents a system nonlinear in endogenous variables. As suggested in Wooldridge (2010), such a system requires a different or extended set of instruments for proper identification. Wooldridge suggests a general approach in dealing with systems nonlinear in endogenous variables through the inclusion of squares and cross-products of the exogenous variables.

The dataset enables the construction of potential instruments by examining dynamics within the brokerage market. We use the share of GWP generated through brokers, the ratio of commission costs to GWP and their product as instruments in Equation 4. The chosen instruments plausibly influence an insurer's diversification strategy while remaining orthogonal to direct profitability outcomes. These variables capture the insurer's distribution-channel intensity, which can shape product-line decisions (insurers heavily reliant on brokers may broaden their offerings via broker networks) without inherently improving profitability. Crucially, the Macedonian non-life market's institutional context underpins the exclusion restriction: the dominant motor third-party liability (MTPL) line operated under a fixed-tariff regime during the sample period. With premium rates administratively set (i.e. no risk-based price competition), insurers primarily compete through volume and distribution rather than pricing. Insurers often boost broker commissions to capture market share in mandatory MTPL business, effectively using acquisition costs as a competitive lever, given the fixed pricing. While such commission structures clearly affect insurers' incentive to diversify (firms weighed down by high MTPL acquisition costs have stronger motives to expand into other, less constrained lines), they are unlikely to directly spur profitability. In fact, high commission outlays tend to uniformly erode underwriting margins across the industry, meaning any performance impact of broker dynamics is felt broadly rather than conferring an idiosyncratic advantage to specific firms. Moreover, the tariff-imposed uniformity in MTPL margins implies that differences in broker use and commission ratios reflect strategic allocation (focus on MTPL vs. other lines) rather than intrinsic efficiency differences. In sum, the Macedonian market's features – fixed tariffs in key lines, intense intermediary competition, and unregulated commission arrangements – ensure that the selected instruments drive diversification decisions but do not independently influence profitability, satisfying the exclusion restriction. We assess the validity of the instruments through Hansen's J-test for overidentifying restrictions. Under this test, the null hypothesis posits that the instruments are exogenous, meaning they are uncorrelated with the error term. The definitions and summary statistics of the selected variables are included in Table 1.

Table 1. Variable definitions and basic statistics

Variable	Definition	Obs	Mean	Std. Dev.	Median
ROA	Return on assets	110	.009	.065	.020
ROE	Return on equity	110	-.023	.365	.064
HHI	Herfindahl-Hirschman Index of insurer's portfolio	110	.398	.175	.364
WHHI	Weighted Herfindahl-Hirschman Index of insurer's portfolio	110	.124	.019	.119
Assets (Ln)	Natural logarithm of total assets	110	14.006	.495	14.090
Rgrowth (GWP)	Real GWP growth	110	.037	.129	.031
Solvency ratio	Capital to Solvency margin	110	4.145	3.091	3.062
Retention ratio	Share of non-ceded GWP	110	.819	.144	.874
Admin. costs (% of GWP)	Share of administrative costs in GWP	110	.185	.039	.182
SDROA	Standard deviation of ROA (3-year_	110	.027	.036	.015
SDROE	Standard deviation of ROE (3-year)	110	.139	.265	.047
SBroker	Share of premium generated via brokers	110	.251	.098	.232
Comm. costs (% of GWP)	Share of commission costs in GWP	110	.112	.056	.095

Authors' calculations

Finally, to address the potential reverse causality problem, that insurer profitability in year t-1 might influence diversification strategies in year (t), we extended our empirical analysis by incorporating a lagged dependent variable in the model specifications. This approach allows us to capture the dynamic nature of firm performance and control for unobserved factors that persist over time, thereby enhancing the robustness of our results. The inclusion of $ROA(-1)$ and $ROE(-1)$ in separate model variants serves to mitigate endogeneity concerns by accounting for the possibility that past profitability could drive diversification decisions.

4. Empirical results

We report the estimated effects of product diversification on ROA using the FE IV-2SLS and RE IV-2SLS methods in Table 2. We devise eight models based on the inclusion and exclusion of time dummies, a lagged dependent variable, and a risk measure. Panel A presents the fixed effects estimates of HHI and HHI squared on ROA. The Herfindahl-Hirschman Index is consistently negatively related to ROA, and the squared term is consistently positively related, but they are only statistically significant at the 10% confidence level in Model 1. Expectedly, the FE models are more restrictive, and many of the coefficients are insignificant. The F-statistics show that the models are properly estimated, and the Hansen J-test confirms that the instruments are valid. Panel B shows the RE estimates of HHI and HHI squared on ROA. The RE estimates provide stronger results for the non-linear relationship between corporate diversification and profitability. The negative relationship between HHI and ROA supports the conglomeration hypothesis, that greater product diversification (lower HHI) leads to improved performance, however, there is a threshold level after which the relationship reverses.

We conduct a similar analysis using ROE as a dependent variable. Table 3 reports the FE (Panel A) and RE (Panel B) estimates. The results are qualitatively similar to the results in Table 2, showing a nonlinear relationship between HHI and ROE. Our results corroborate the view that product diversification stimulates financial performance in less developed and more concentrated markets (e.g., Krivokapic, Njegomir, and Stojic 2017; Ortyński 2019; Rehman et al., 2021; Wu and Deng 2021). Given that there are demand constraints in the Macedonian non-life insurance market, leading to higher competition in the mandatory motor insurance lines, Macedonian insurers may circumvent the barriers to growth by expanding in other (non-mandatory) lines of business, resulting in improved performance (e.g., Berry-Stölzle, Hoyt, and Wende 2013). However, at the other extreme of product specialization, the increase in portfolio specialization

Table 2. Impact of diversification (HHI) on ROA (FE IV-2SLS (Panel A) and RE IV-2SLS (Panel B))

Panel A: FE IV-2SLS								
Dependent variable	ROA							
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
HHI	-4.411*	-4.940	-2.791	-3.592	-4.651	-4.426	-3.086	-2.832
	(-1.754)	(-1.552)	(-1.496)	(-1.177)	(-1.633)	(-1.535)	(-1.041)	(-0.751)
HHI squared	4.590*	5.179	3.051	3.975	4.874	4.630	3.622	3.341
	(1.676)	(1.504)	(1.418)	(1.142)	(1.570)	(1.475)	(1.009)	(0.741)
Controls	Included	Included	Included	Included	Included	Included	Included	Included
ROA (-1)					Included	Included	Included	Included
SDROA		Included		Included		Included		Included
Time dummies			Included	Included			Included	Included
Obs.	110	110	110	110	99	99	99	99
R-squared	0.181	0.313	0.311	0.200	0.188	0.123	0.289	0.329
No. of insurers	11	11	11	11	11	11	11	11
F-stats	1.933	1.488	2.691	2.113	1.471	1.461	2.392	2.444
Hansen J (p-value)	0.660	0.629	0.768	0.795	0.669	0.610	0.388	0.357

Table 2. ***Continued***

Panel B: RE IV-2SLS								
Dependent variable	ROA							
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
HHI	-2.946*	-1.031	-2.079*	-0.716	-1.238*	-1.018**	-0.721*	-0.586*
	(-1.799)	(-1.598)	(-1.655)	(-1.493)	(-1.797)	(-1.970)	(-1.760)	(-1.687)
HHI squared	2.961**	0.939*	2.252**	0.672*	1.096*	0.860*	0.675	0.513*
	(2.001)	(1.651)	(1.983)	(1.655)	(1.733)	(1.918)	(1.513)	(1.721)
Controls	Included	Included	Included	Included	Included	Included	Included	Included
ROA (-1)					Included	Included	Included	Included
SDROA		Included		Included		Included		Included
Time dummies			Included	Included			Included	Included
Obs.	110	110	110	110	99	99	99	99
No. of insurers	11	11	11	11	11	11	11	11
R-squared	0.003	0.212	0.010	0.339	0.070	0.197	0.223	0.336
Chi-squared	23.13	53.26	118.7	177.6	63.66	945.6	245.9	265.8
Sargan-Hansen (p)	0.462	0.858	0.915	0.607	0.776	0.929	0.732	0.545

Note: HHI is the Herfindahl-Hirschman Index of each insurer's underwriting portfolio based on the share of each business line in the total GWP. The controls include: Assets (Ln) is the natural logarithm of insurer's assets; Rgrowth (GWP) is the growth of inflation-adjusted GWP; Solvency ratio is the ratio of capital to the minimum solvency margin; Retention ratio is the difference between GWP and the part of GWP ceded to reinsurance divided by the total GWP; Administrative costs (% of GWP) is the share of administrative costs charged in the total GWP; SDROA is the standard deviation of ROA in the previous three years; ROA (-1) is the lagged dependent variable. Z-statistics are given in the parentheses below the coefficient estimates. Statistical significance at the 1%, 5%, and 10% levels is denoted by ***, **, and *, respectively.

Authors' calculations

contributes to higher profitability. This is in line with Li and Greenwood (2004) who argue that the multi-line competition may reduce competition intensity, especially in motor insurance, leading to the coexistence of more specialized and diversified insurers.

While the Hansen's J-tests indicate that the selected instruments are valid and uncorrelated with the structural error term, we acknowledge that the relatively small sample size (110 firm-year observations) may limit the statistical power of the overidentification tests. In finite samples, particularly with a modest number of cross-sectional units and multiple instruments, these tests may lack sufficient power to detect weak violations of the exclusion restriction. Similarly, although our instruments exhibit strong first-stage relevance, the potential for finite-sample bias remains. We mitigate these concerns by using a limited set of instruments and by verifying robustness across model variants (e.g., with and without lagged dependent variables, risk controls, and time dummies).

We re-run Equation 4, replacing the HHI with the weighted Herfindahl-Hirschman Index of the insurer's portfolio (WHHI). We initially estimated the regressions, including the WHHI squared; however, the regressions were not properly estimated, and the coefficients of the main variables were insignificant. We report the estimated effects of WHHI on ROA without including the WHHI squared in Table 4. Similarly, the F-statistic (Panel A) and Chi-squared (Panel B) show that the models are properly estimated, and the Hansen J-test/Sargan-Hansen test show that the assumption of exogenous instruments is not violated, except in models 5 and 6 in Panel A. The coefficient of WHHI is mainly positive but statistically significant at the 10% confidence level only in model 5 in Panel A, and models 5 and 6 in Panel B. These results, while weak, support the consolidation hypothesis, suggesting that insurers, having a product mix in business lines characterized by less competitive market structures, secure higher profitability.

Table 3. Impact of diversification (HHI) on ROE (FE IV-2SLS (Panel A) and RE IV-2SLS (Panel B))

Panel A: FE IV-2SLS								
Dependent variable	ROE							
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
HHI	-23.574*	-20.800	-13.902	-12.043	-17.775	-12.021	-5.365	2.353
	(-1.688)	(-1.097)	(-1.306)	(-0.662)	(-1.286)	(-0.894)	(-0.336)	(0.111)
HHI squared	24.322	21.337	15.094	12.894	18.501	12.389	6.488	-2.225
	(1.600)	(1.023)	(1.226)	(0.606)	(1.197)	(0.823)	(0.330)	(-0.088)
Controls	Included	Included	Included	Included	Included	Included	Included	Included
ROE (-1)					Included	Included	Included	Included
SDROE		Included		Included		Included		Included
Time dummies			Included	Included			Included	Included
Obs.	110	110	110	110	99	99	99	99
R-squared	0.109	0.179	0.429	0.441	0.269	0.370	0.448	0.398
No. of insurers	11	11	11	11	11	11	11	11
F-stats	2.902	2.995	3.899	3.723	4.773	5.709	2.871	1.831
Hansen J (p-value)	0.582	0.540	0.958	0.927	0.715	0.957	0.880	0.836

Panel B: RE IV-2SLS								
Dependent variable	ROE							
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
HHI	-13.373*	-4.035	-8.893*	-3.435	-10.743	-3.885	-4.589	-1.909
	(-1.762)	(-1.342)	(-1.658)	(-1.469)	(-1.571)	(-1.626)	(-1.278)	(-1.472)
HHI squared	13.702*	3.704	10.015**	3.155	10.428*	3.362	5.152	1.670*
	(1.937)	(1.306)	(2.098)	(1.538)	(1.664)	(1.644)	(1.349)	(1.699)
Controls	Included	Included	Included	Included	Included	Included	Included	Included
ROE (-1)					Included	Included	Included	Included
SDROE		Included		Included		Included		Included
Time dummies			Included	Included			Included	Included
Obs.	110	110	110	110	99	99	99	99
No. of insurers	11	11	11	11	11	11	11	11
R-squared	0.003	0.308	0.025	0.396	0.001	0.314	0.045	0.446
Chi-squared	23.01	300.5	109.5	14.65	16.39	338.0	29.52	344.1
Sargan-Hansen (p)	0.45	0.942	0.91	0.964	0.733	0.81	0.847	0.55

Note: HHI is the Herfindahl-Hirschman Index of each insurer's underwriting portfolio based on the share of each business line in the total GWP. The controls include: Assets (Ln) is the natural logarithm of insurer's assets; Rgrowth (GWP) is the growth of inflation-adjusted GWP; Solvency ratio is the ratio of capital to the minimum solvency margin; Retention ratio is the difference between GWP and the part of GWP ceded to reinsurance divided by the total GWP; Administrative costs (% of GWP) is the share of administrative costs charged in the total GWP; SDROE is the standard deviation of ROE in the previous three years; ROE (-1) is the lagged dependent variable. Z-statistics are given in the parentheses below the coefficient estimates. Statistical significance at the 1%, 5%, and 10% levels is denoted by ***, **, and *, respectively.

Authors' calculations

Table 4. Impact of diversification (WHHI) on ROA (FE IV-2SLS (Panel A) and RE IV-2SLS (Panel B))

Panel A: FE IV-2SLS								
Dependent variable	ROA							
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
WHHI	1.343	1.274	0.672	0.605	1.366*	1.193	0.509	-0.055
	(1.462)	(1.423)	(0.602)	(0.545)	(1.703)	(1.613)	(0.501)	(-0.055)
Controls	Included	Included	Included	Included	Included	Included	Included	Included
ROA (-1)					Included	Included	Included	Included
SDROA		Included		Included		Included		Included
Time dummies			Included	Included			Included	Included
Obs.	110	110	110	110	99	99	99	99
R-squared	0.159	0.185	0.317	0.331	0.137	0.201	0.316	0.350
No. of insurers	11	11	11	11	11	11	11	11
F-stats	3.541	3.376	2.175	2.147	2.452	2.303	1.800	1.993
Hansen J (p-value)	0.126	0.165	0.343	0.453	0.0829	0.097	0.298	0.445
Panel B: RE IV-2SLS								
Dependent variable	ROA							
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
WHHI	1.972	1.576	1.077	1.278	2.223*	1.890*	1.922	1.518
	(1.459)	(1.377)	(0.725)	(1.001)	(1.676)	(1.676)	(1.286)	(1.154)
Controls	Included	Included	Included	Included	Included	Included	Included	Included
ROA (-1)					Included	Included	Included	Included
SDROA		Included		Included		Included		Included
Time dummies			Included	Included			Included	Included
Obs.	110	110	110	110	99	99	99	99
No. of insurers	11	11	11	11	11	11	11	11
R-squared	0.129	0.337	0.227	0.406	0.183	0.299	0.254	0.367
Chi-squared	9.922	610.4	63.60	2142	130.6	421.3	1169	193.4
Sargan-Hansen (p)	0.121	0.16	0.127	0.403	0.475	0.6	0.536	0.674

Note: WHHI is the weighted sum of product-line shares in the insurer's portfolio multiplied by the line-specific Herfindahl-Hirschman Index. The controls include: Assets (Ln) is the natural logarithm of insurer's assets; Rgrowth (GWP) is the growth of inflation-adjusted GWP; Solvency ratio is the ratio of capital to the minimum solvency margin; Retention ratio is the difference between GWP and the part of GWP ceded to reinsurance divided by the total GWP; Administrative costs (% of GWP) is the share of administrative costs charged in the total GWP; SDROA is the standard deviation of ROA in the previous three years; ROA (-1) is the lagged dependent variable. Z-statistics are given in the parentheses below the coefficient estimates. Statistical significance at the 1%, 5%, and 10% levels is denoted by ***, **, and *, respectively.

Authors' calculations

Figure 2. HHI by class over the period 2013 - 2022

Class	Year 2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Accident	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.11	0.11
Health	0.48	0.36	0.29	0.40	0.42	0.43	0.36	0.26	0.18	0.16
Motor vehicles (Casco)	0.14	0.13	0.14	0.15	0.13	0.12	0.12	0.12	0.11	0.11
Aircrafts (Casco)	0.85	0.77	0.77	0.77	0.44	0.46	0.54	0.60	0.79	0.70
Vessels (Casco)	0.21	0.20	0.21	0.28	0.21	0.25	0.19	0.21	0.19	0.32
Cargo	0.22	0.19	0.20	0.21	0.22	0.21	0.20	0.20	0.23	0.19
Property (fire and nat. forces)	0.16	0.15	0.17	0.16	0.16	0.14	0.14	0.14	0.15	0.13
Property (other)	0.15	0.18	0.17	0.17	0.15	0.15	0.16	0.15	0.14	0.15
Motor third-party liability (MTPL)	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Aircraft third-party liability	0.69	0.63	0.55	0.54	0.31	0.32	0.45	0.55	0.39	0.46
Vessel third-party liability	0.18	0.19	0.20	0.20	0.20	0.19	0.16	0.17	0.15	0.15
General liability	0.15	0.16	0.17	0.17	0.15	0.17	0.16	0.16	0.15	0.14
Credit					1.00	1.00	0.93	0.33	0.33	0.54
Suretyship	0.43	0.39	0.23	0.32	0.75	0.82	0.48	0.24	0.27	0.40
Financial losses	0.44	0.67	0.65	0.49	0.45	0.58	0.52	0.51	0.54	0.53
Legal expenses	1.00				1.00	1.00	1.00	0.53	0.52	1.00
Travel assistance	0.11	0.11	0.12	0.12	0.12	0.12	0.12	0.13	0.14	0.15

Authors' calculations based on the Macedonian ISA's data

In the case of North Macedonia, insurers who tend to diversify away from the motor insurance lines improve their profitability. Figure 2 shows that the MTPL line has the lowest HHI, indicating a competitive market. Thus, insurers with a higher extent of product specialization in MTPL have lower WHHI. As the insurers diversify away from the competitive lines of business (higher WHHI), the competition intensity relaxes (Li and Greenwood 2004) and the less competitive market structure enables earning higher profits as predicted by the structure-conduct-performance hypothesis (Krivokapic, Njegomir, and Stojic 2017; Liebenberg and Sommer 2008).

We conduct a similar regression analysis of the effects of WHHI on ROE and report the results in Table 5. Regardless of the specification, we fail to find any significant relationship between WHHI and ROE. Hence, the results of the effects of WHHI on profitability are not robust. We cannot confirm that the diversification away from the competitive lines of business brings higher profitability to Macedonian insurers.

In summary, the empirical findings reveal a nonlinear relationship between product-line diversification and insurer profitability in the Macedonian non-life insurance market, supporting the coexistence of both diversified and specialized insurers. The Herfindahl-Hirschman Index (HHI) and its squared term show that while greater diversification initially improves performance, there is a threshold beyond which further diversification may reduce profitability. This indicates that both strategies, diversification and specialization, can be effective, depending on the insurer's positioning and market focus. However, when using the weighted HHI (WHHI), which accounts for the competitiveness of each business line, the evidence becomes

Table 5. Impact of diversification (WHHI) on ROE (FE IV-2SLS (Panel A) and RE IV-2SLS (Panel B))

Panel A: FE IV-2SLS								
Dependent variable	ROE							
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
WHHI	8.425	7.791	4.110	5.028	6.875	4.145	1.113	-3.327
	(1.353)	(1.352)	(0.652)	(0.740)	(1.438)	(1.322)	(0.213)	(-0.629)
Controls	Included	Included	Included	Included	Included	Included	Included	Included
ROE (-1)					Included	Included	Included	Included
SDROE		Included		Included		Included		Included
Time dummies			Included	Included			Included	Included
Obs.	110	110	110	110	99	99	99	99
R-squared	0.235	0.303	0.349	0.398	0.215	0.337	0.337	0.411
No. of insurers	11	11	11	11	11	11	11	11
F-stats	2.924	2.998	1.876	1.976	2.133	2.239	1.722	1.883
Hansen J (p-value)	0.271	0.559	0.522	0.796	0.716	0.770	0.966	0.996

Panel B: RE IV-2SLS								
Dependent variable	ROE							
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
WHHI	8.750	5.534	2.461	7.421	9.457	6.116	4.650	5.301
	(1.414)	(1.284)	(0.338)	(1.258)	(1.612)	(1.489)	(0.776)	(0.986)
Controls	Included	Included	Included	Included	Included	Included	Included	Included
ROE (-1)					Included	Included	Included	Included
SDROE		Included		Included		Included		Included
Time dummies			Included	Included			Included	Included
Obs.	110	110	110	110	99	99	99	99
No. of insurers	11	11	11	11	11	11	11	11
R-squared	0.108	0.394	0.223	0.427	0.103	0.404	0.204	0.459
Chi-squared	21.08	691.8	164.7	4550	46.71	802.5	75.13	236.9
Sargan-Hansen (p)	0.161	0.241	0.07	0.613	0.361	0.659	0.44	0.751

Note: WHHI is the weighted sum of product-line shares in the insurer's portfolio multiplied by the line-specific Herfindahl-Hirschman Index. The controls include: Assets (Ln) is the natural logarithm of insurer's assets; Rgrowth (GWP) is the growth of inflation-adjusted GWP; Solvency ratio is the ratio of capital to the minimum solvency margin; Retention ratio is the difference between GWP and the part of GWP ceded to reinsurance divided by the total GWP; Administrative costs (% of GWP) is the share of administrative costs charged in the total GWP; SDROE is the standard deviation of ROE in the previous three years; ROE (-1) is the lagged dependent variable. Z-statistics are given in the parentheses below the coefficient estimates. Statistical significance at the 1%, 5%, and 10% levels is denoted by ***, **, and *, respectively.

Authors' calculations

weaker. Although some models suggest that insurers operating more in less competitive lines may earn higher profits (supporting the consolidation hypothesis), these effects are only marginally significant and not robust across all specifications. Notably, we do not find consistent evidence that diversification away from the highly competitive motor insurance lines leads to improved profitability. These results imply that in the Macedonian insurance market, diversification is not uniformly advantageous, and both product-focused and diversified strategies may coexist as viable approaches under different market conditions.

5. Conclusions

The recent inflationary pressures have imposed critical challenges on the non-life insurance sector in North Macedonia, particularly in relation to the insurers' product-line strategy and its effects on financial performance. The purpose of this study was to assess whether increased product-line diversification enhances the financial performance of insurers or whether a more focused specialization strategy yields superior results. To achieve this, we conducted an empirical analysis using firm-level data spanning the period from 2013 to 2022, employing a rigorous methodological framework involving fixed effects two-stage least squares (FE IV-2SLS) and random effects two-stage least squares (RE IV-2SLS) regression models with uniquely identified instrumental variables. The results indicate a nonlinear link between diversification and profitability, suggesting that both specialized and diversified insurers can thrive in the Macedonian market. While initial diversification appears beneficial, beyond a certain point it may reduce profitability. Although some evidence supports higher returns for insurers operating in less competitive lines, these effects are weak and not consistently significant. Importantly, we cannot confirm that diversifying away from competitive segments like MTPL consistently leads to better performance, reinforcing the idea that multiple strategic approaches can coexist in this market.

Our study provides important insights into the debate over the liberalization of the MTPL insurance market. The pro-liberalization view suggests that the current rate regulation holds the prices below levels that would have occurred underpricing freedom, hurting the insurers' profitability, however, the extant literature argues that deregulation in highly competitive automobile insurance markets brings down the unit price, intensifying the competitive forces in that line of business (e.g., Grabowski, Viscusi, and Evans 1989). In light of our findings, a cautious and gradual approach to market reform is needed. Specifically, a measured, phased liberalization of the MTPL market, rather than abrupt deregulation, could allow insurers to adapt gradually, supporting healthier diversification dynamics without triggering destructive price competition. Rapid diversification efforts under expanded pricing freedom should be carefully monitored to prevent risk underpricing and associated market conduct or solvency risks. The prospective adoption of Solvency II in North Macedonia further underlines the importance of robust risk management and adequate capitalization amid these changes. However, evidence from our study indicates that certain insurers with low diversification and heavy MTPL concentration still achieve strong profitability, suggesting that specialization remains viable under current conditions. Overall, these insights counsel a balanced regulatory approach where diversification is encouraged alongside prudent oversight, ensuring market stability while enhancing insurer performance.

This study is subject to several limitations that should be acknowledged. First, the analysis is confined to a single country, North Macedonia, which limits the generalizability of the findings to broader regional or international contexts. Second, while our instrumented models address endogeneity concerns, the relatively small sample size may constrain the statistical power of the identification strategy. Third, the availability of firm-level data restricted the analysis to certain performance indicators and diversification measures. Future research could benefit from cross-country comparisons within the Western Balkan or broader Eastern European region to test the robustness of the diversification–performance relationship under varying regulatory regimes. Additionally, expanding the scope to incorporate dynamic panel estimators or alternative identification strategies could further validate the findings.

Endnotes

1 Additionally, Peng et al. (2017) find that the conglomeration hypothesis holds also for insurance intermediaries in Taiwan.

2 We note that two foreign-owned insurers were acquired by other two foreign insurers.

3 The non-life insurance classes are Accident, Health, Motor vehicles (Casco), Railway vehicles (Casco), Aircrafts (Casco), Vessels (Casco), Cargo, Property (fire and nat. forces), Property (other), Motor third-party liability (MTPL), Aircraft third-party liability, Vessel third-party liability, General liability, Credit, Suretyship, Financial losses, Legal expenses, and Travel assistance.

4 The fixed-effects models are estimated using the IV-2SLS fixed-effects panel data approach, implemented through the xtivreg2 command in STATA, which supports estimation of fixed-effects and first-differences models only (Schaffer 2020). These models are estimated without the cluster option to permit adjustment of the covariance matrix and regression statistics for the number of fixed effects. In addition, random-effects models are estimated with clustered standard errors via the xtivreg command in STATA.

References

Ai, J., Bajtelsmit, V., and, Wang, T. 2018. The Combined Effect of Enterprise Risk Management and Diversification on Property and Casualty Insurer Performance. *Journal of Risk and Insurance* 85 (2): 513–43.

Altuntas, M., Berry-Stölzle, T. R., and, Cummins, J. D. 2021. Enterprise Risk Management and Economies of Scale and Scope: Evidence from the German Insurance Industry. *Annals of Operations Research* 299 (1): 811–45.

Baggett, C. B. and Cole, C. R. 2023. Insurance Groups, Product Diversification, and the Role of Surplus Lines Affiliation. *Risk Management and Insurance Review* 26 (1): 35–56.

Berger, A. N., Cummins, J. D., Weiss, M. A., and Zi, H. 2000. Conglomeration versus Strategic Focus: Evidence from the Insurance Industry. *Journal of Financial Intermediation* 9 (4): 323–62.

Berry-Stölzle, T. R., Hoyt, R. E., and Wende, S. 2013. Capital Market Development, Competition, Property Rights, and the Value of Insurer Product-Line Diversification: A Cross-Country Analysis. *Journal of Risk and Insurance* 80 (2): 423–59.

Born, P., Cook, A., Sirmans, T., and Yang, C. 2023. Are Health Insurers in Multiple Lines of Business Less Profitable? An Examination of Scope Economies in Health Insurance. *Journal of Risk and Insurance* 90 (1): 185–212.

Che, X. and Liebenberg, A. P. 2017. Effects of Business Diversification on Asset Risk-Taking: Evidence from the U.S. Property-Liability Insurance Industry. *Journal of Banking and Finance* 77 (April):122–36.

Che, X., Liebenberg, A. P., Liebenberg, I. A., and Powell, L. S. 2017. Decomposing Diversification Effect: Evidence from the U.S. Property-Liability Insurance Industry. *Insurance Markets and Companies* 8.

Cummins, J. D. and Nini, G. P. 2002. Optimal Capital Utilization by Financial Firms: Evidence from the Property-Liability Insurance Industry. *Journal of Financial Services Research* 21 (1): 15–53.

Deloitte. 2022. CEE Insurance M&A Outlook: Calm after the Storm – Steady Outlook with Further Consolidation and Disposal of Non-Core Assets on the Horizon. Deloitte Hungary. https://www2.deloitte.com/content/dam/Deloitte/cz/Documents/financial-services/MA_Insurance_Study_2021.pdf.

Du, Y. 2017. The Effects of Products Diversification on Firm Performance Revisit: A Non-Linear Prospective. https://apria2017.syskonf.pl/conf-data/APRIA2017/files/artykuły/PMS000995.pdf.

Elango, B., Ma, Y-L., and Pope, N. 2008. An Investigation Into the Diversification–Performance Relationship in the U.S. Property–Liability Insurance Industry. *Journal of Risk and Insurance* 75 (3): 567–91.

Fier, S. G., Liebenberg, A. P., and Liebenberg, I. A. 2017. Insurer Growth Strategies. *Risk Management and Insurance Review* 20 (3): 309–37. https://doi.org/10.1111/rmir.12088.

Foong, S-Y. and Idris, R. 2012. Leverage, Product Diversity and Performance of General Insurers in Malaysia. *The Journal of Risk Finance* 13 (4): 347–61.

González-Fernández, A. I., Rubio-Misas, M., and Ruiz, F. 2020. Goal Programming to Evaluate the Profile of the Most Profitable Insurers: An Application to the Spanish Insurance Industry. *International Transactions in Operational Research* 27 (6): 2976–3006.

Grabowski, H., Viscusi, W. K., and Evans, W. N. 1989. Price and Availability Tradeoffs of Automobile Insurance Regulation. *The Journal of Risk and Insurance* 56 (2): 275–99.

Hoyt, R. E. and Trieschmann, J. S. 1991. Risk/Return Relationships for Life-Health, Property-Liability, and Diversified Insurers. *The Journal of Risk and Insurance* 58 (2): 322–30.

Killins, R. N. 2020. Firm-Specific, Industry-Specific and Macroeconomic Factors of Life Insurers' Profitability: Evidence from Canada. *The North American Journal of Economics and Finance* 51 (January).

Krivokapic, R., Njegomir, V., and Stojic, D. 2017. Effects of Corporate Diversification on Firm Performance: Evidence from the Serbian Insurance Industry. *Economic Research-Ekonomska Istraživanja* 30 (1): 1224–36.

Lee, C-Y. 2017. Product Diversification, Business Structure, and Firm Performance in Taiwanese Property and

Liability Insurance Sector. *The Journal of Risk Finance* 18 (5): 486–99.

Li, S. X. and Greenwood, R. 2004. The Effect of Within-Industry Diversification on Firm Performance: Synergy Creation, Multi-Market Contact and Market Structuration. *Strategic Management Journal* 25 (12): 1131–53.

Liebenberg, A. P. and Sommer, D. W. 2008. Effects of Corporate Diversification: Evidence From the Property–Liability Insurance Industry. *Journal of Risk and Insurance* 75 (4): 893–919.

McShane, M. K. and Cox, L. A. 2009. Issuance Decisions and Strategic Focus: The Case of Long-Term Care Insurance. *Journal of Risk and Insurance* 76 (1): 87–108.

Meador, J. W., Ryan Jr, H. E., and Schellhorn, C. D. 2000. Product Focus Versus Diversification: Estimates of X-Efficiency for the US Life Insurance Industry. In *Performance of Financial Institutions: Efficiency, Innovation, Regulation*, edited by P. T. Harker and S. A. Zenios. New York: Cambridge University Press.

Ortyński, K. 2019. Product Diversification and Firm Performance in Polish Non-Life Insurance Sector. *Electronic Journal of Polish Agricultural Universities* 22 (3).

Pavić, I. and Pervan, M. 2010. EFFECTS OF CORPORATE DIVERSIFICATION ON ITS PERFORMANCE: THE CASE OF CROATIAN NON-LIFE INSURANCE INDUSTRY. *Ekonomska Misao i Praksa* 19 (1): 49–66.

Peng, J. L., Chen, L. R., Wang, J. L., and Tzeng, L. Y. 2017. Diversification Versus Strategic Focus: Evidence from Insurance Intermediaries in Taiwan. *The Geneva Papers on Risk and Insurance - Issues and Practice* 42 (3): 530–55.

Regele, F. 2022. Insurance Business Diversification and Systemic Risk. *Journal of Insurance Regulation*.

Rehman, Z., Khan, A., Khuhro, R. A., and Khan, A. G. 2021. Product Line Diversification and Its Impact on Firm Performance. *Journal of Applied Economics and Business Studies* 5 (3): 43–58.

Schaffer, M. E. 2020. XTIVREG2: Stata Module to Perform Extended IV/2SLS, GMM and AC/HAC, LIML and k-Class Regression for Panel Data Models. *Statistical Software Components*, June. https://ideas.repec.org//c/boc/bocode/s456501.html.

Schanz, K-U. and Treccani, P. 2023. The Return of Inflation: What It Means for Insurance. The Geneva Association. https://www.genevaassociation.org/sites/default/files/2023-01/inflation_report.pdf.

Shim, J. 2011. Mergers and Acquisitions, Diversification and Performance in the U.S. Property-Liability Insurance Industry. *Journal of Financial Services Research* 39 (3): 119–44. https://doi.org/10.1007/s10693-010-0094-3.

Shim, J. 2017a. An Investigation of Market Concentration and Financial Stability in Property–Liability Insurance Industry. *Journal of Risk and Insurance* 84 (2): 567–97. https://doi.org/10.1111/jori.12091.

Shim, J. 2017b. Does Diversification Drive Down Risk-Adjusted Returns? A Quantile Regression Approach. *Asia-Pacific Journal of Risk and Insurance* 11 (2). https://doi.org/10.1515/apjri-2016-0015.

Sommer, D. W. 1996. The Impact of Firm Risk on Property-Liability Insurance Prices. *The Journal of Risk and Insurance* 63 (3): 501–14. https://doi.org/10.2307/253623.

Todorovski, N. 2024. MoF: Commission for Motor Vehicle Liability Insurance Convened to Review Insurance Undertakings' Decision on Premium Increase. *Ministry of Finance* (blog). May 21, 2024. https://finance.gov.mk/2024/05/21/mof-commission-for-motor-vehicle-liability-insurance-convened-to-review-insurance-undertakings-decision-on-premium-increase/?lang=en.

Weiss, M. A. and Choi, B. P. 2008. State Regulation and the Structure, Conduct, Efficiency and Performance of US Auto Insurers. *Journal of Banking and Finance*, Dynamics of Insurance Markets: Structure, Conduct, and Performance in the 21st Century, 32 (1): 134–56.

Wooldridge, J. M. 2010. *Econometric Analysis of Cross Section and Panel Data*. 2nd ed. Cambridge, Mass: MIT Press.

Wu, S. and Deng, X. 2021. Corporate Diversification, Ownership, and Solvency in China's Property-Liability Insurance Companies. *Mathematical Problems in Engineering* 2021 (1).

South East European Journal of Economics and Business
Volume 20 (2) 2025, 68-84
DOI: 10.2478/jeb-2025-0019

ARTIFICIAL INTELLIGENCE AND DIGITAL LEADERSHIP: MAPPING RESEARCH TRENDS AND THEMATIC PATTERNS

Enis Mulolli, Xhavit Islami

Abstract

Digital transformation has accelerated the integration of artificial intelligence (AI) into organizational processes, reshaping leadership practices across industries. Therefore, this study utilizes bibliometric analysis to examine the evolving landscape of artificial intelligence in leadership research. This study conducts a bibliometric analysis of 60 articles retrieved from the Dimensions.ai database (2019–2025), utilizing the Bibliometrix package in RStudio. The study provides essential insights by examining publishing trends, prominent authors and sources, thematic developments, and collaboration networks, and trending topics within AI and leadership.*

The findings illustrate that the publishing trends revealed a significant and rapid growth in research output over the years. Moreover, the analysis of prominent authors and sources highlights the most influential works that have had a substantial impact on the field. Thematic mapping identifies six significant research clusters, with "AI, leadership, and digital transformation" serving as a motor theme. Collaboration networks uncover limited but growing international collaboration, with the United States and China exhibiting the most robust partnerships. Furthermore, trending keywords such as "artificial intelligence," "leadership," and "digital transformation" indicate ongoing research interest and signal directions for future research. This study not only maps the existing knowledge structure but also offers valuable insights that can inspire future research directions regarding the evolving role of leadership in the age of artificial intelligence.

Keywords: *Artificial intelligence; Leadership; Digital transformation; Bibliometric analysis; Dimensions.ai*

JEL code: *L20, M12, M15, O33*

Enis Mulolli, PhD
Management Department
Faculty of Economics, AAB College
St. "Elez Berisha", No. 56, 10000 Prishtinë
Republic of Kosovo

Xhavit Islami, PhD (Corresponding author)
Assistant Professor
Management Department
Faculty of Economics
AAB College
St. "Elez Berisha", No. 56, 10000 Prishtinë
Republic of Kosovo
E-mail: xhavit.islami@aab-edu.net
ORCID: 0000-0002-6653-4166

1. INTRODUCTION

Digital transformation, driven by digital technologies, has revolutionized all industries and companies (Bresciani et al. 2021) and is a crucial priority for businesses in this century (İnel 2019). This digital transformation has changed the nature of work in ways that were unimaginable even a decade ago (Barley et al. 2017), enhancing business processes by improving customer experience, optimizing operations, or

creating new business models (Fitzgerald et al. 2014; Kraus et al. 2021), while also putting tremendous pressure on employees to innovate through the use of information technology (Pilav-Velić et al. 2021). Digital transformation should be included into the existing business perspectives, as this topic addresses much more than just technological shifts (Bouncken et al. 2021). As a result of digital transformation, a variety of technological tools and processes, including artificial intelligence, machine learning, blockchain, and data analytics, have become essential for businesses that aspire to thrive in a dynamic and increasingly competitive environment (Chowdhury et al. 2023). Therefore, as firms transition into digital work environments, digital leadership has become significant in enabling successful digital transformation (Ghavifekr and Pei 2023). The majority of companies are currently in the process of assessing and strategizing the implementation of digital leadership (DL) as a leadership strategy that is designed to facilitate the development of digitally enabled business models by altering the behavior of leaders, organizational structures, and employee management (Oberer and Erkollar 2018). Furthermore, artificial intelligence is redefining leadership by enhancing key functions such as planning, decision-making, organizing, leading, and controlling, fostering a symbiotic partnership that transforms managerial practices and drives organizational success (Islami and Mulolli 2024). According to Haenlein and Kaplan (2019), AI can assist leaders in formulating more objective and well-informed decisions, but in order to harness this potential in strategic decisions within the firms, the leaders play a crucial role in its implementation and use (Ruokonen and Ritala 2024). AI technologies are increasingly essential in strategic contexts, gaining attention due to their demonstrated potential, as highlighted in reports from leading consultancies and technology firms (Islami, Mulolli, and Mustafa 2025).

In recent years, there has been a notable surge in interest in the intersection of artificial intelligence and leadership studies. For instance, Peifer et al. (2022) study, highlights that leaders and leadership are crucial for implementing and using AI successfully. Another study, concluded that the integration of artificial intelligence into leadership practices will change how leaders operate. By offering data-driven insights and real-time analysis, AI has the potential to change decision-making by relieving executives of routine responsibilities and allowing them to concentrate on strategic thinking and innovation (Madanchian et al. 2024). Also, Wagner (2020) stated that the advancement of AI technologies brings about a paradigm shift in how leaders conceptualize, strategize, and carry out their duties inside organizations. Furthermore, Bevilacqua et al. (2025) investigated the intersection of artificial intelligence and top managerial leadership using bibliometric and content analysis. Their findings offer a framework for successfully integrating AI into business strategy. Another study by Rademaker et al. (2023) through conceptual analysis reveals that effective leadership is critical in reducing technostress and cultivating a healthy digital work environment. Therefore, this study aims to review the literature on artificial intelligence and leadership in the digital era, investigating the thematic progression, collaboration patterns, identifying emergent topics, and potential avenues for future research in this area. By carefully gathering and analyzing relevant data from the dimensions.ai database, we address several research questions:

RQ1: What are the research trends in the literature addressing the relationship between artificial intelligence and leadership in terms of contributing authors, publication sources, and countries?

RQ2: What are the main thematic areas and conceptual structures explored in the literature on artificial intelligence and leadership?

RQ3: What are the patterns and dynamics of collaboration among authors and countries in the field of artificial intelligence and leadership?

RQ4: What are the emerging research trends and potential future directions in the field of artificial intelligence and leadership?

In response to addressing our research questions, this study employs bibliometric analysis, a quantitative approach that employs statistical methods to analyze large volumes of scientific data.

This methodology enables us to identify influential authors, journals and countries, thereby offering critical insights into the development of the field of AI and leadership. Moreover, it facilitates the identification of thematic patterns, the analysis of keyword networks and collaboration dynamics, and the detection of trending topics within AI and leadership research.

This paper organizes its subsequent sections as follows: Section 2 highlights the definitions for the main concepts. Section 3 discusses the chosen methodology in the form of criteria, terms, and software, as well as the data sources. Section 4 presents the results and analysis. Section 5 addresses the discussion and future research opportunities. Section 6 presents the conclusions and limitations of the study.

2. CONCEPTUAL DEFINITIONS OF AI AND DIGITAL LEADERSHIP

2.1. Artificial intelligence

Artificial intelligence has emerged as one of the most essential technologies in many organizations, growing to be an intrinsic part of our society (Lu et al. 2024). The term "artificial intelligence" originated in the mid-1950s when American computer scientist and AI pioneer John McCarthy employed the word in a grant proposal for a conference (Zerfass et al. 2020). Artificial intelligence is the term used to describe systems that are capable of imitating human intelligence with minimal human intervention (Haenlein and Kaplan 2019). Due to its multifunctionality, AI enables its application across diverse domains performing diverse tasks, ranging from image recognition to autonomous decision-making. As the technology advances, it is becoming increasingly apparent that AI will eventually replace a significant number of the functions presently performed by humans, potentially in a broader scope than we can currently imagine (Mumali 2022). In order to succinctly illustrate the evolution of AI over time, Table 1 provides a list of several key definitions of AI within their historical contexts.

2.2. Digital Leadership

The initial leadership concepts emerged in the 19th century. According to the Great Man theory, leadership qualities are inherent and can only be transmitted genetically from one generation to the next (Lee 2011). Today, leadership has a crucial role in the organization's leading process (Islami and Mulolli 2020). However, leadership remains a complex, ever-changing dynamic concept that continues to defy a universally accepted definition, requiring ongoing research (Nixon et al. 2012). With the rise of digital communication, the concept of *e-leadership* emerged. The term "e-leadership" came to refer to leaders who conduct many of their leadership processes via electronic channels and have a worldwide reach (Zaccaro and Bader 2003). However, rapid digital transformation has broadened this concept beyond electronic mediation to include a broader spectrum of digital tools and strategies. This evolution has paved the way for the emergence of *digital leadership*. According to Larjovuori et al. (2016), digital leadership is defined as "the leader's ability to create a clear and meaningful vision for the digitalization process and the capability to execute strategies to actualize it. Digital leadership is a term that serves as an umbrella term for a variety of leadership styles, including technology leadership,

Table 1. Artificial intelligence definitions

Author/s (year)	Definition
McCarthy (1956)	Define Artificial intelligence as "the science and engineering of making intelligent machines.
Rich (1983)	Artificial intelligence concentrates on creating computer systems that can perform tasks that require human intelligence.
Simmons and Chappell (1988, p.14)	"The term artificial intelligence denotes behavior of a machine which, if a human behaves in the same way, is considered intelligent."
Haenlein and Kaplan (2019, p.5).	Artificial intelligence is defined as "a system's ability to interpret external data correctly, to learn from such data, and to use those learnings to achieve specific goals and tasks through flexible adaptation."
Abbass (2021, p.95)	"Artificial Intelligence is social and cognitive phenomena that enable a machine to socially integrate with a society to perform competitive tasks requiring cognitive processes and communicate with other entities in society by exchanging messages with high information content and shorter representations."
Sheikh et al. (2023)	AI is defined as a technology that enables machines to imitate various complex human skills
Gil de Zúñiga et al. (2024)	AI refers to the ability of non-human machines or artificial entities to do tasks, solve problems, communicate, interact, and behave logically in the same way that biological humans do.

Source: First author

Table 2. Definitions of Digital Leadership

Author/s (year)	Definition
Avolio et al. (2000, p.617)	"E-leadership is defined as a social influence process mediated by AIT to produce a change in attitudes, feelings, thinking, behavior, and/or performance with individuals, groups, and/or organizations".
El Sawy et al. (2016, p. 141)	Define digital leadership as "doing the right things for the strategic success of digitalisation of the enterprise and its business ecosystem".
Zhong (2017)	Digital leadership entails leading and inspiring digital transformation, fostering and sustaining a digital learning culture, enhancing professional development through technology, as well as providing and maintaining a digital organization.
Eberl and Drews (2021, p. 4)	"Digital leadership is a complex construct aiming for a customer-centered, digitally enabled, leading-edge business model by (1) transforming the role, skills, and style of the digital leader, (2) realizing a digital organization, including governance, vision, values, structure, culture, and decision processes, and (3) adjusting people management, virtual teams, knowledge, and communication and collaboration on the individual level".

Source: First author

virtual leadership, e-leadership, and leadership 4.0, all of which are used interchangeably in the literature (Karakose et al. 2022). Table 2 provides a list of several key definitions of digital leadership.

3. METHODOLOGY

This study employs a bibliometric analysis to investigate the research questions advanced in the introduction. Bibliometric analysis is a highly effective instrument that can be employed for complex scientific mapping, analyzing the relationship between different factors, exploring the emerging and niche themes providing future directions, collaboration among countries and authors, and identifying intellectual structures (Khan et al. 2021). Figure1 illustrates the rigorous article selection process using the PRISMA method (Page et al. 2021), to enhance the reproducibility and transparency of the research. The data for this analysis were extracted on 9 March 2025, from the Dimensions.ai database. The search query was formulated as follows: ("Artificial intelligence" and "Leadership"); we limited our search to the last 10 years (2015–2025*). The Dimensions.ai database was selected because it includes a wide range of information, such as details about awarded grants, clinical trials, patents, policy documents, altimetric data, and regular publication and citation data (Herzog et al. 2020). Moreover, Singh et al. (2021) highlighted that Dimensions.ai has the most exhaustive journal coverage compared to its competitors, indexing 82.22% more unique journals than Web of Science and 48.17% more than Scopus, while still covering almost all journals indexed on the two platforms.

In this study, bibliometric analysis is employed to (1) identify descriptives and trends in reporting among authors, sources and countries; (2) identify thematic patterns and keyword networks; (3) analyze the collaborations among authors and countries; and (4) identify the trend topics, on the research topic of AI and leadership. The Bibliometrix R package within RStudio (Aria and Cuccurullo 2017) was used to conduct the bibliometric analysis of 60 articles obtained through gathering data, cleansing, and screening. Bibliometrix R package was selected for its open-source environment and comprehensive suite of bibliometric techniques (Aria and Cuccurullo 2017).

3.1. Search criteria and screening of documents

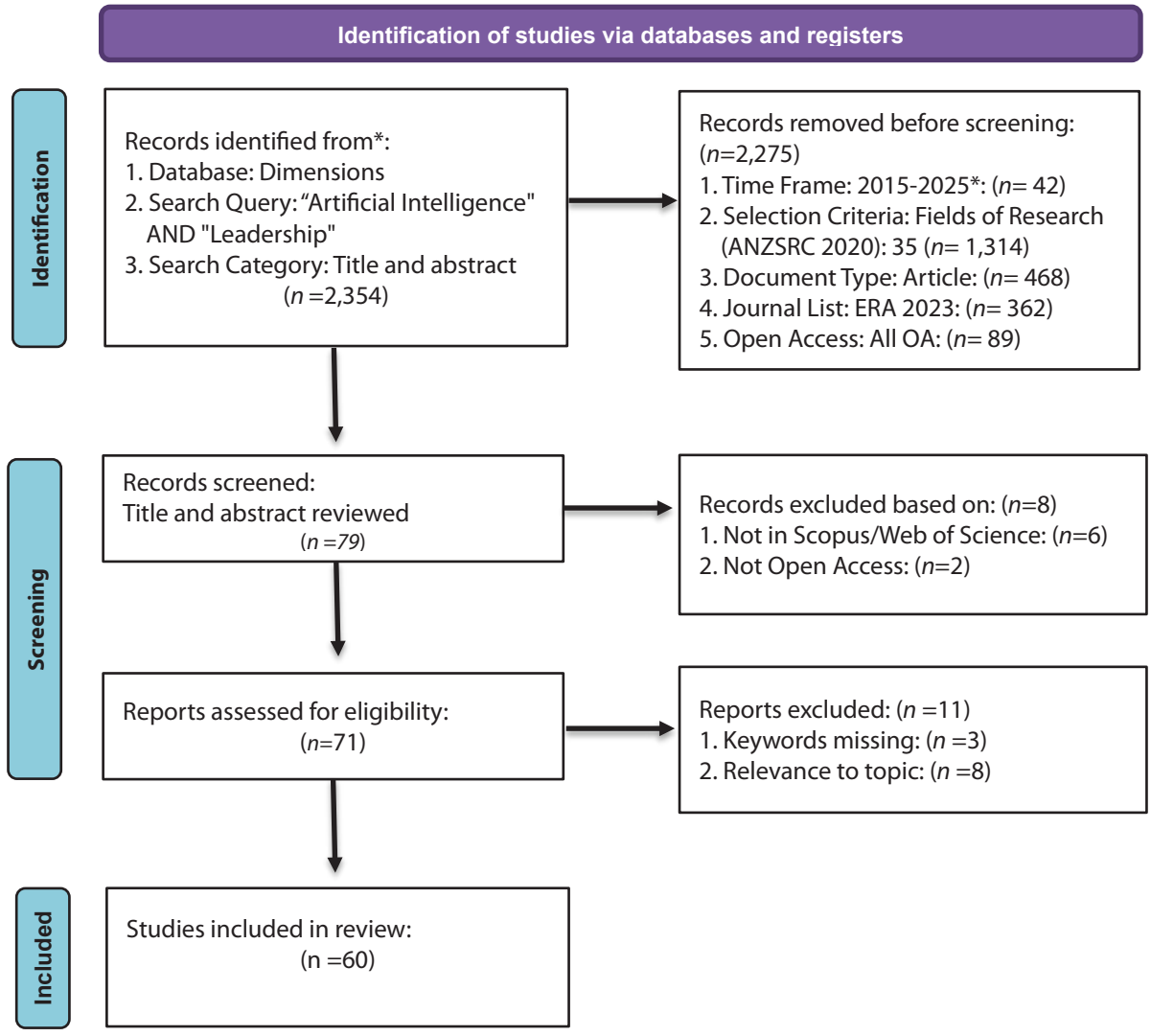
The selection criteria and screening process is illustrated in Figure 1. First an initial search was conducted in the Dimensions database using the query *"Artificial Intelligence"* and *"Leadership"* in the title and abstract fields. This search resulted in 2,354 titles using the query terms.

Second in the pre-Screening phase 2,275 records were excluded based on predefined criteria: time frame was 2015-2025* (n = 42 excluded); publications had to be classified within a relevant field of study according to the Australian and New Zealand Standard

Research Classification (ANZSRC) 2020 codes, in our case the code was 35 which included publication from Commerce, Management, Tourism and Services (*n* = 1,314 excluded); the classification of document types was restricted solely to articles (*n* = 468 excluded), as other source types, including books, book chapters, and conference papers, were excluded from consideration due to their lack of adherence to the rigorous review process typically applied to conceptual, empirical, and review articles published in journals (Bretas and Alon 2021); we have limited the scope of the journal quality types to ERA 2023 (Excellence in Research for Australia), which includes only articles published in journals that are recognized as reputable and high-quality by the ERA framework (*n* = 362 excluded); and the study included only all open access (OA) articles (n = 89 excluded) based on the "UNESCO Recommendation on Open Science" (UNESCO 2022).

Third after filtering, 79 articles remained for detailed screening based on their titles and abstracts. In this step, articles were screened if they were written in English, and if they were not indexed in *Scopus/Web of Science* (*n* = 6 excluded) or did not meet OA requirements (*n* = 2 excluded), leaving 71 articles for full eligibility assessment. Fourth, 71 eligible articles were reviewed in full to determine their final suitability for inclusion in the study. During this phase 11 article were removed due to missing keywords (*n* = 3) and insufficient focus on AI and Leadership (*n* = 8). Finally, a total of 60 articles met all criteria and were included in the final review. Following the final screening, we did not receive any publications prior to 2019; thus, the data given pertains to the years 2019-2025*.

Figure 1. PRISMA flow chart.



Source: PRISMA 2020 statement (Page et al., 2021)

4. RESULTS AND ANALYSIS

4.1. Descriptives and publication trends

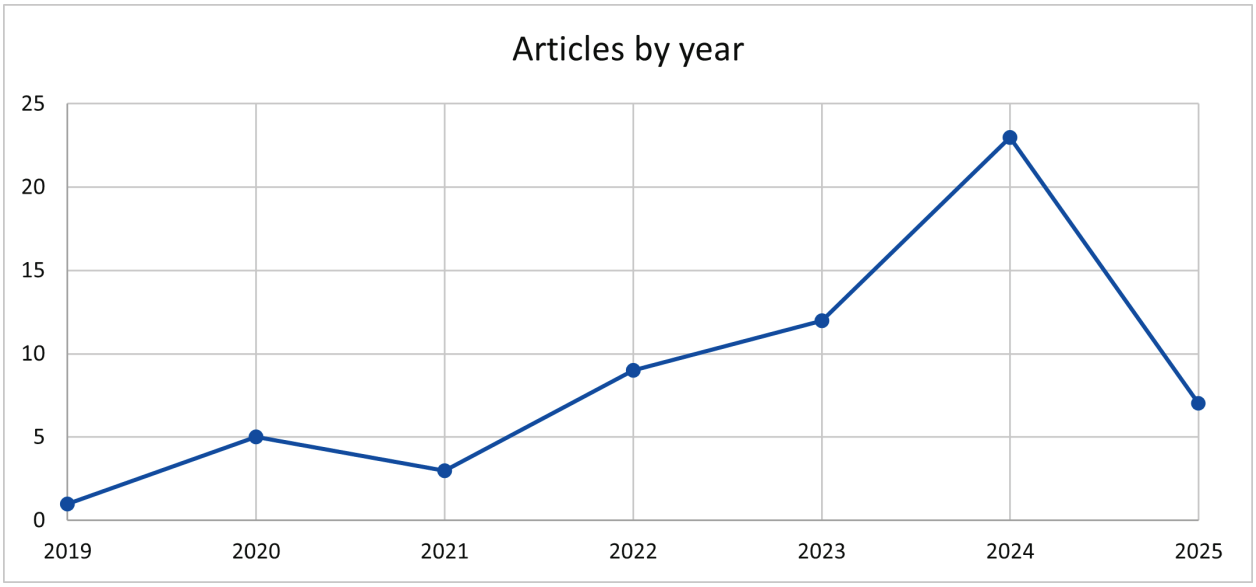
Table 3 presents an overview of the bibliometric data examined in this study. The dataset consists of 60 publications authored by 210 individuals and published during a six-year span, from 2019 to 2025*, across 38 different sources. Figure 2 presents the general trend of publications between 2019 and 2025*. We can observe that the annual publication of articles showed a consistent upward trend over the period under study, without the months of 2025. Figure 2 shows an annual growth rate of publications stands at 38.31%, demonstrating a rapid increase in field of research over the years.

Table 3. Main information of Bibliograpic data.

Description	Results
Timespan	2019:2025
Sources	38
Documents	60
Annual Growth Rate %	38.31
Document Average Age	1.95
Average citations per doc	37.97
Document contents	
Keywords Plus (ID)	272
Author's Keywords (DE)	272
Authors	
Authors	210
Authors of single-authored docs	4
Authors collaboration	
Single-authored docs	4
Co-Authors per Doc	3.58
International co-authorships %	28.33
Document types	
Article	60

Source: Authors' elaboration using Biblioshiny package in R

Figure 2. Annual scientific production (2019-2025*).



Source: Authors' elaboration using Biblioshiny package in R

4.2. Analysis of authors, sources and country collaborations

This section analyzes the authors, publication sources, and countries contributing to AI and leadership research. Table 4 highlights the ten most relevant articles in the field, ranked by their total global citations (TGCs). The article by Huang and Rust (2021) is the most cited publication, with a total of 597 citations, published in the *Journal of Service Research*, indicating its significant impact in the field.

In the topic sources, Table 5 illustrates the most influential journals, based on the number of publications, citations, and h-index. The highest publisher was owned by MDPI with 4 in total. The journal *Sustainability* leads the ranking with 11 publications, a total of 196 citations, and the highest h-index (6), indicating its strong contribution to the discourse in this domain. In contrast, the *Journal of Service Research*, despite contributing only 1 article, has garnered 597 citations, indicating a highly impactful study on the field.

Table 6 and Figure 3 show the corresponding author's countries in the context of the research theme. Australia leads the field of study with six articles, five of which are related to the source country and one to multiple country publications, followed by China with five articles, which has more multi-country publications (MCP=4), indicating a greater emphasis on international collaboration.

Table 4. Top 10 authors of most relevant articles (sorted by citations)

Rank	Author and Year	Journal	TGC
1	Huang and Rust (2021)	Journal of Service Research	597
2	Chatterjee et al. (2021)	Technological Forecasting and Social Change	359
3	Larson and DeChurch (2020)	The Leadership Quarterly	206
4	Dubey et al. (2021)	International Journal of Production Research	156
5	Lundvall and Rikap (2022)	Research Policy	107
6	Zerfass et al. (2020)	Journal of Communication Management	93
7	Dey et al. (2024)	International Journal of Production Research	71
8	Lee et al. (2020)	European Journal of Marketing	65
9	Quaquebeke and Gerpott (2023)	Journal of Leadership & Organizational Studies	61
10	Henderikx and Stoffers (2022)	Sustainability	55

Source: Authors' elaboration using Biblioshiny package in R

Table 5. Most influential sources/journals

Rank	Journals	Publications	H-Index	Total citations	Publisher
1	Sustainability	11	6	196	MDPI
2	Administrative Sciences	4	2	50	MDPI
3	Heliyon	3	2	81	Elsevier
4	Journal of Global Information Management	3	2	40	IGI Global
5	International Journal of Production Research	2	1	227	Taylor & Francis
6	Applied Sciences	2	1	1	MDPI
7	Asia Pacific Management Review	2	1	9	Elsevier
8	Journal of Organizational and End User Computing	2	1	3	IGI Global
9	Systems	2	1	5	MDPI
10	Journal of Service Research	1	1	597	SAGE

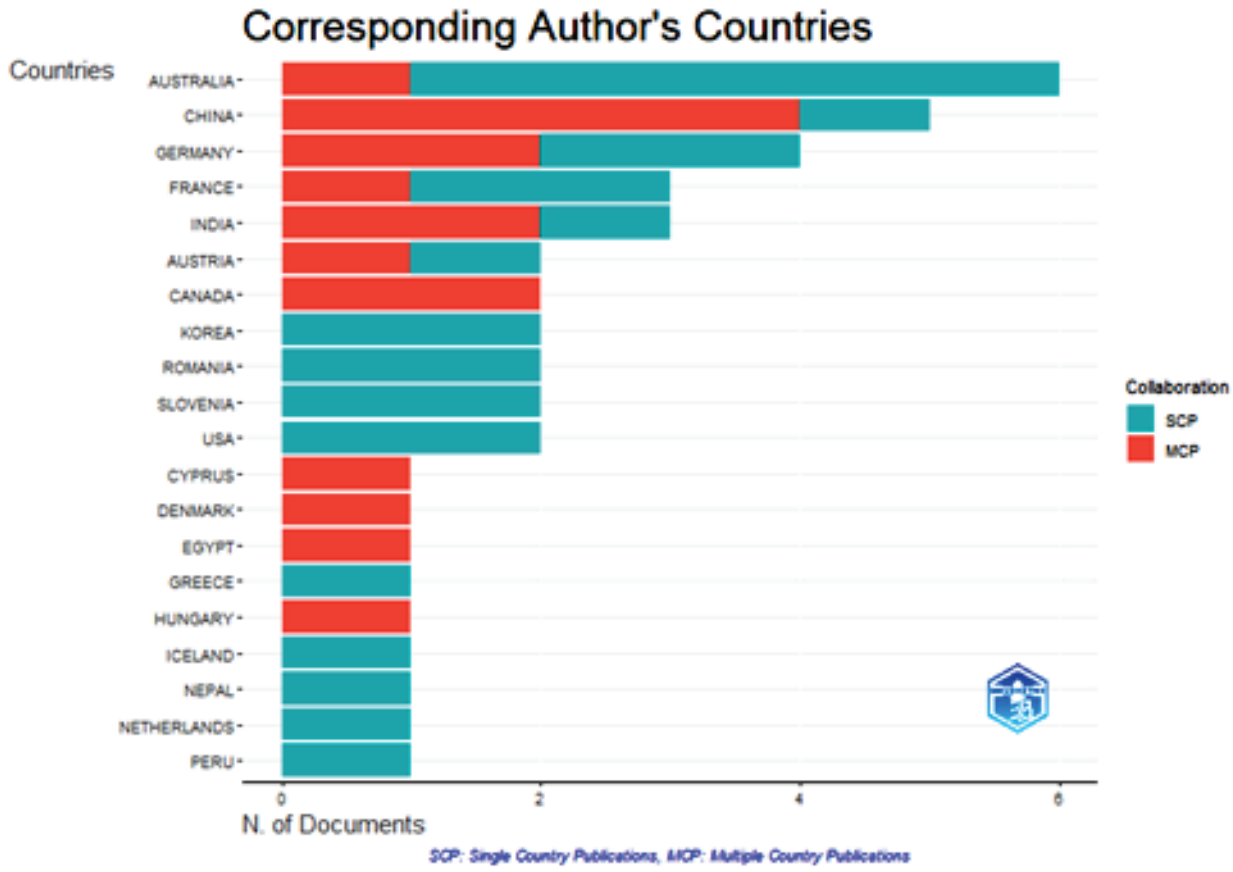
Source: Authors' elaboration using Biblioshiny package in R

Table 6. Most productive corresponding author countries

Rank	Contry	Articles	Articles %	SCP	MCP
1	Australia	6	10	5	1
2	China	5	8.3	1	4
3	Germany	4	6.7	2	2
4	France	3	5	2	1
5	India	3	5	1	2
6	Austria	2	3.3	1	1
7	Canada	2	3.3	0	2
8	Korea	2	3.3	2	0
9	Romania	2	3.3	2	0
10	Slovenia	2	3.3	2	0

Source: Authors' elaboration using Biblioshiny package in R

Figure 3. Country of the corresponding author

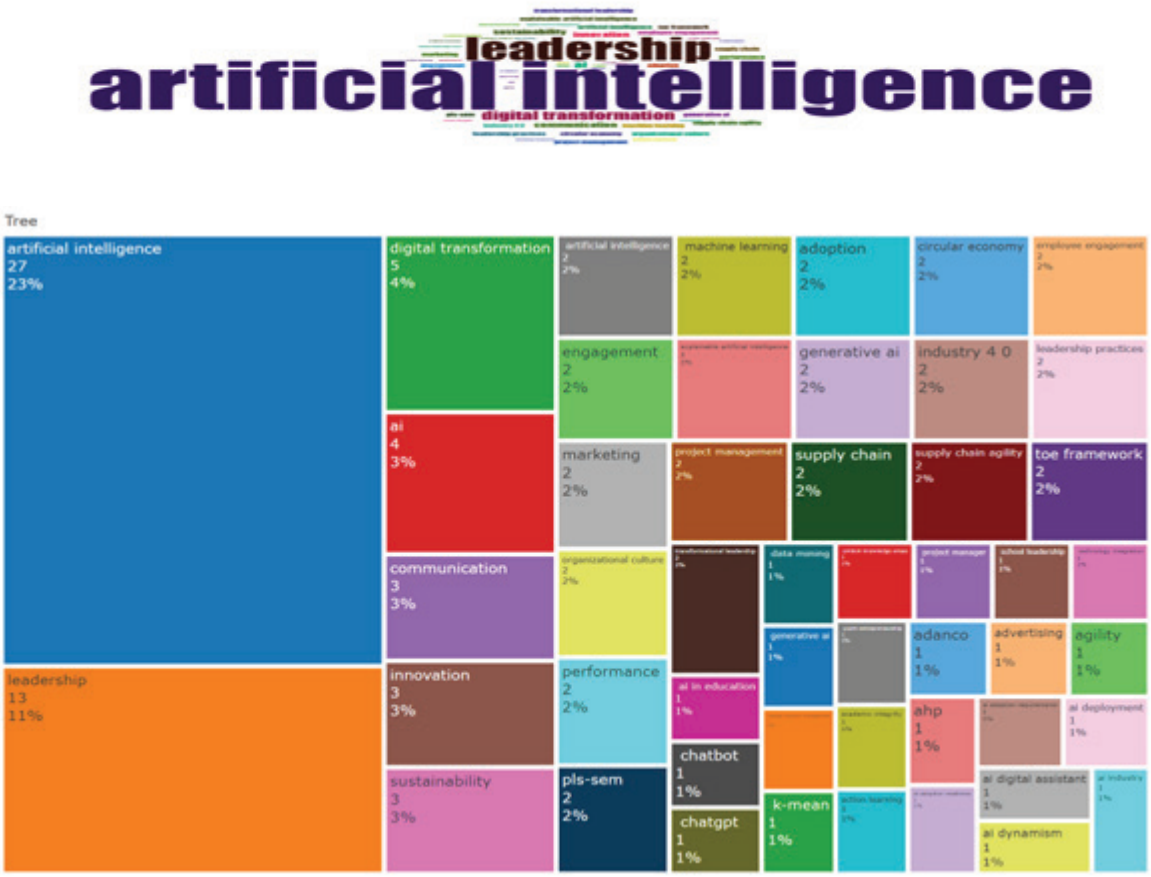


Source: Authors' elaboration using Biblioshiny package in R

4.3. Analysis of Thematic Patterns and Keyword Networks

Keyword Analysis - of authors is an essential method for comprehending and identifying the research focus and priorities within a specific research field (Song et al. 2019). Figure 4 illustrates the most frequently used keywords across the analyzed documents. *Artificial intelligence* emerges as the dominant keyword, appearing 27 times, highlighting its central role in the research. It is followed by *leadership*, mentioned 13 times, and *digital transformation*, which appears 5 times.

Figure 4. Word cloud and Word tree of keywords



Source: Authors' elaboration using Biblioshiny package in R

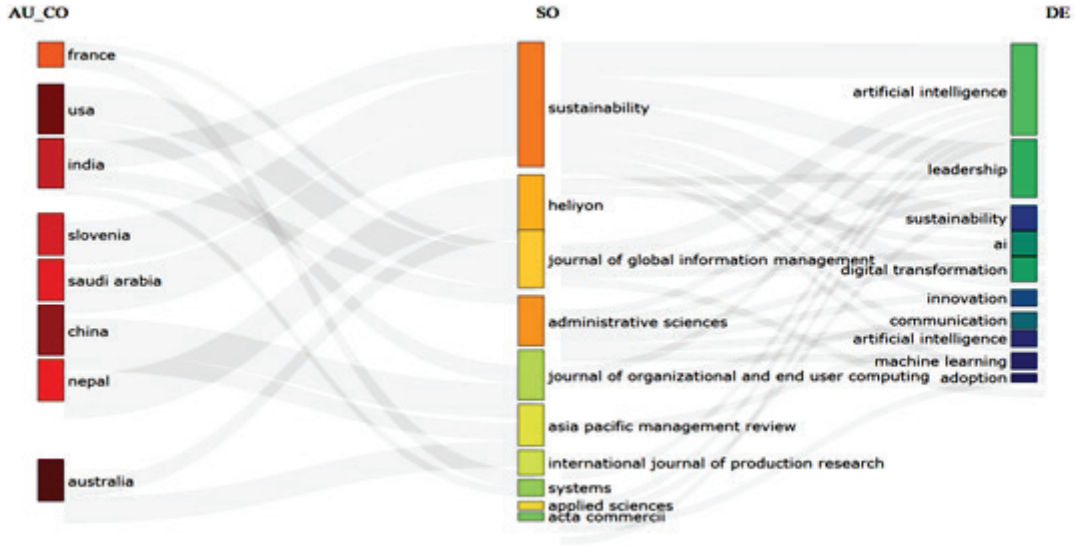
Sankey diagram - also known as a three-field plot, effectively visualizes the flow of values between interconnected sets. In Figure 5, a three-field plot illustrates the interconnections between countries, journals, and keywords in bibliometric analysis. The analysis shows that authors from India have published in three different journals, reflecting a broader distribution of publication sources compared to other countries, which predominantly used only two. *Sustainability* was the most preferred journal among authors from India, Slovenia, and Saudi Arabia. The most frequently used keywords include "artificial intelligence," "leadership," "sustainability" "AI," and "digital transformation." Overall, these bibliometric findings underscore the expanding research focus on AI and leadership studies, while also highlighting key contributors in terms of countries, journals, and authors. Such insights are valuable for identifying dominant trends and shaping future research directions (Kraus, Bouncken, and Yela Aránega 2024).

Thematic map - the thematic analysis develops themes using author's keywords and represent the most relevant issues in the field. The purpose of creating a thematic map is to comprehend the present status and analyses the future direction of research advancement in the topic (García-Lillo et al. 2023). The cluster size in the themed map indicates the frequency of occurrence. Figure 6 illustrates the thematic map, encompassing six research themes covering the entire dataset of artificial intelligence and leadership studies between 2019 and 2025*. Themes are classified into four categories: Niche themes, Motor themes, Emerging or Declining themes, and Basic themes, according to their density and centrality. The thematic map is delineated as follows:

Two clusters classified as niche themes: "communication, leadership practices, performance" and "machine learning, transformational leadership". One cluster for the motor theme: "artificial intelligence, leadership, and digital transformation". These clusters

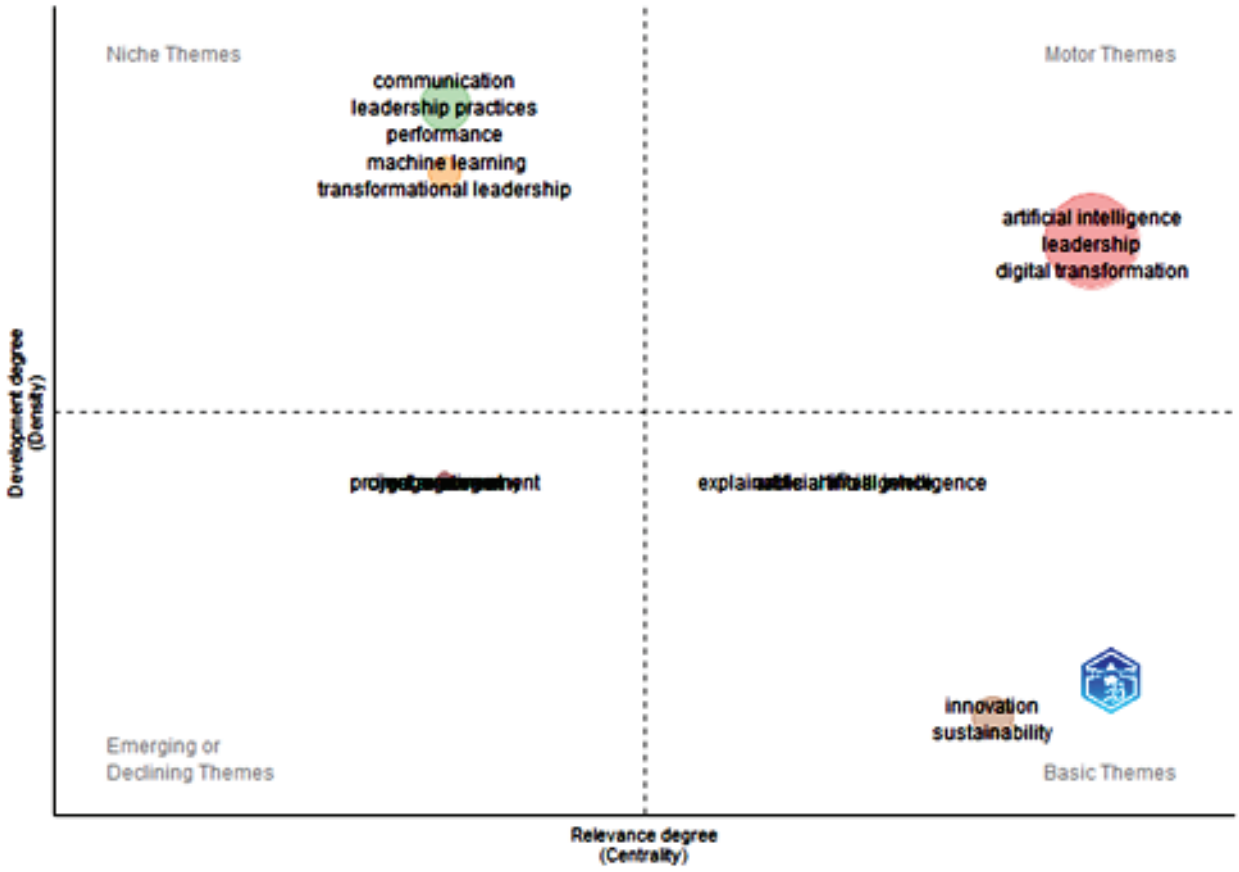
represented the foundation of contemporary study in this field. There are two clusters of basic themes: "explainable artificial intelligence" and "innovation, sustainability". One cluster is classified as emerging or declining themes: "project management".

Figure 5. A three-field plot illustrating the network among countries (left), journals (middle), and keywords (right).



Source: Authors' elaboration using Biblioshiny package in R

Figure 6. Thematic map by author keywords



Source: Authors' elaboration using Biblioshiny package in R

4.4. Analysis of Collaborations among Authors and Countries

The collaborative networks of co-authors were grouped in the 13 distinct research clusters, as identified in Figure 7. Cluster 1 (red) includes four co-authors from India and Saudi Arabia (Chatterjee S, Baabdullah AM, Chaudhuri R, and Chaudhuri S). Cluster 2 (pale blue) with three co-authors from Australia, (Heravi A, Rehan A, and Thorpe D). Cluster 3 (green) includes two co-authors from Morocco and France (Abadie A and Chowdhury S). Cluster 4 (violet) represents three co-authors from Slovenia (Abina A, Batkovič T, and Cestnik B). Cluster 5 (orange) includes three co-authors from Turkiye (Abositta A, Adedokun MW, and Berberoğlu A). Cluster 6 (brown) with three co-authors from Jordan and United Arab Emirates (Abualfalayeh G, Al-Qudah S, and Al Qudah MA). Cluster 7 (pink) includes four co-authors from Egypt and Saudi Arabia (Agina MF, Ahmad N, Ahmed M, and Asiri A). Cluster 8 (gray) with two co-authors from Malaysia (Ahmad Amri Zainal Adnan and Arsalan Mujahid Ghouri). Cluster 9 (turquoise) represents three co-authors from Saudi Arabia (Almuteri SD, Ashi AK, and Bogari KJ). Finally, cluster 10 (peach) groups three co-authors from Colombia (Arrubla-Hoyos W, Cama-Pinto A, and Cama-Pinto D).

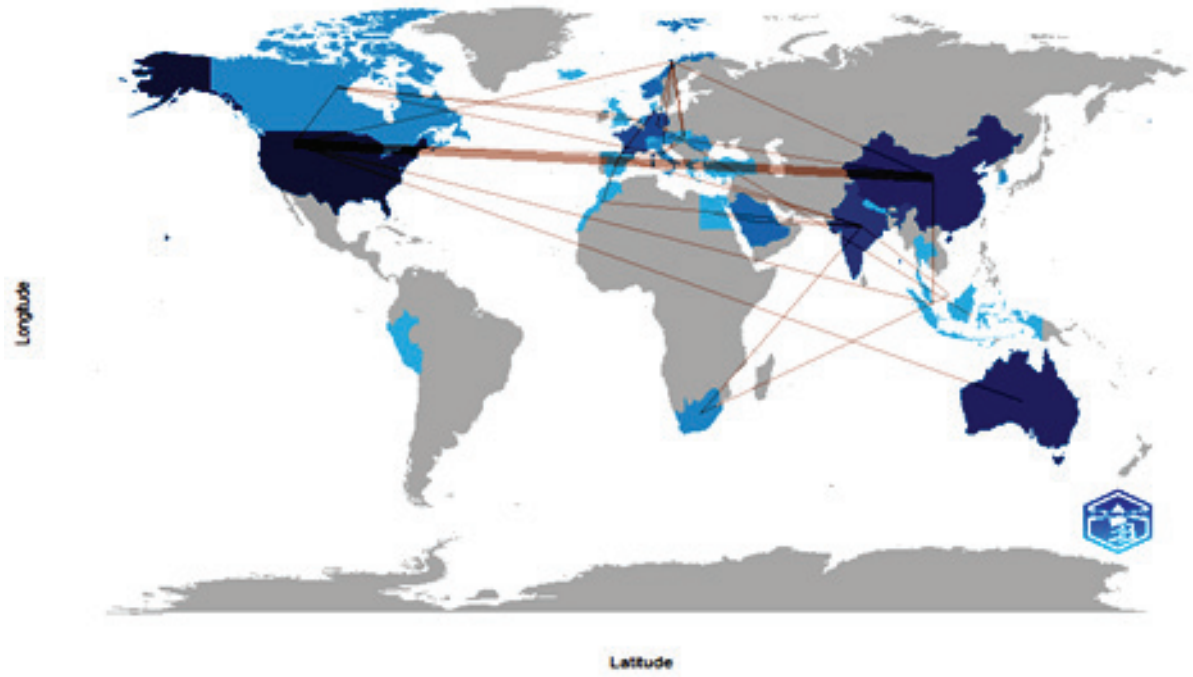
A total of ten interactive teams consisting of 30 scholars from 12 distinct countries were identified inside the productive co-authorship network. Six of these teams were nationally homogeneous, originating from: Australia (cluster 2), Slovenia (cluster 4), Turkiye (cluster 5), Malaysia (cluster 8), Saudi Arabia (cluster 9), and Colombia (cluster 10). The remaining four were multinational teams, featuring collaborations between co-authors from: cluster 1 (India & Saudi Arabia), cluster 3 (Morocco & France), cluster 6 (Jordan & United Arab Emirates), and cluster 7 (Egypt & Saudi Arabia).

Figure 8 illustrates the collaborative network among countries in artificial intelligence and leadership research. The thick line shows high frequency of collaboration among countries. The analysis reveals that the USA and China have the highest no. of collaborations, with 4 joint studies, representing the strongest and most frequent collaboration in the dataset. However, the research landscape is extremely fragmented, with limited sustained international engagement, as evidenced by the fact that all other country pairs only exhibit a single collaboration. Notably, countries such as India, Norway, and Italy appear in multiple one-time collaborations, suggesting sporadic rather than deep-rooted partnerships. The sparse and uneven nature of these collaborations' points to a highlighting the necessity for more robust and organized international networks to enhance the global comprehension of AI's impact on leadership practices across many contexts.

Figure 7. Author Collaboration Network

Source: Authors' elaboration using Biblioshiny package in R

Figure 8. Countries Collaboration

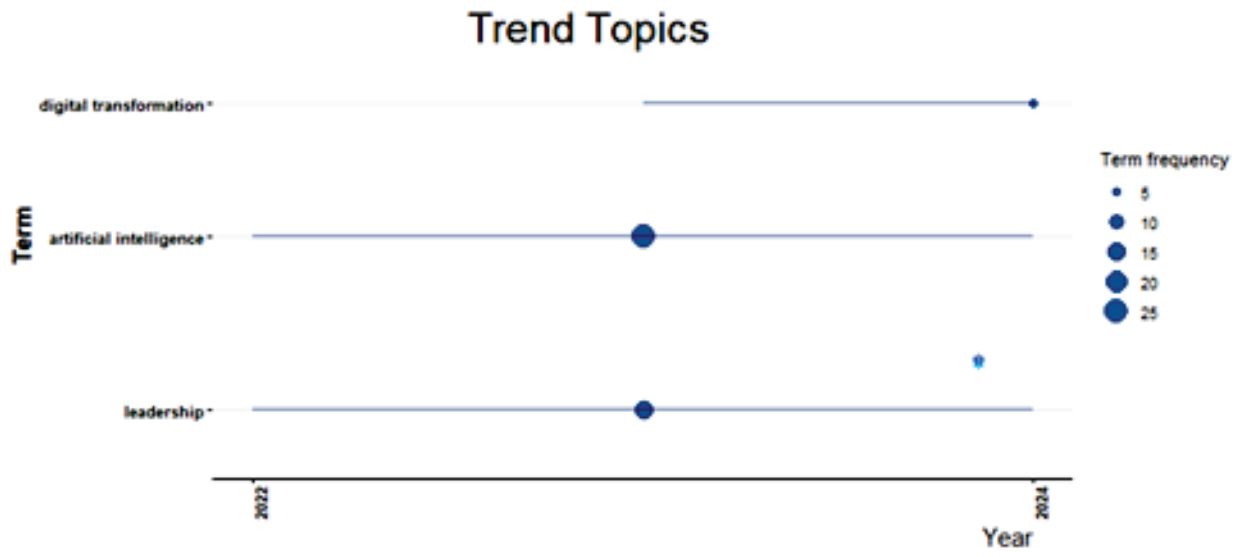


Source: Authors' elaboration using Biblioshiny package in R

4.5. Trend Topics

Figure 9 highlights the trending topics within the field, revealing that "artificial intelligence," "leadership," and "digital transformation" are emerging as critical areas of focus in AI-Leadership research. Significantly, "artificial intelligence" exhibited the highest term frequency with 27 occurrences in 2023, reflecting robust and ongoing research engagement. The term "leadership" was mentioned 13 times in 2023, while "digital transformation" was referenced 5 times in 2024. These trends suggest that future research could fruitfully explore the intersections of these topics, particularly as they continue to gain prominence in the literature.

Figure 9. Trending topic in AI – Leadership



Source: Authors' elaboration using Biblioshiny package in R

5. DISCUSSION AND FUTURE RESEARCH OPPORTUNITIES

The bibliometric analysis has illuminated the trends, patterns, and impact of artificial intelligence on leadership research. The findings provide a comprehensive overview of research retrieved from the Dimensions.ai database covering the period from 2019 to 2025*. The main objective of this research was to investigate thematic progression, collaboration patterns, identify emergent topics, and potential avenues for future research in this area.

To understand the research landscape and identify patterns and trends, four research questions were formulated. These questions were addressed through bibliometric analysis using the specialized Bibliometrix tool in RStudio. In order to answer the RQ1, focused on identifying the research trends in terms of contributing authors, publication sources, and countries. The research on the relationship between artificial intelligence and leadership has shown notable growth from 2019 to 2025*, as illustrated in Figure 2. The analysis demonstrated a distinct upward trajectory in the number of publications, peaking at 23 publications in 2024, reflecting a rising academic interest in this interdisciplinary area. This expansion shows a rising acknowledgment of AI's revolutionary power in strategies for leadership. In terms of impactful contributions, Table 4 presents the top ten most relevant articles based on total global citations (TGCs). The study by Huang and Rust (2021), published in the Journal of Service Research, stands out as the most cited work with 597 citations, indicating its significant impact in the field. Table 5 lists the ten most influential journals in terms of publication sources. Sustainability, published by MDPI, emerges as the leading journal in this domain, with 11 publications, 196 citations, and the highest h-index (6), highlighting its significant contribution to research on AI and leadership. Geographically, Table 6 show the top 10 corresponding author's countries in the context of the research theme. Australia ranks first, contributing six publications, five of which are single-country publications and one of which is a multi-country publication. China follows with five publications and is significantly more involved in international collaboration, as evidenced by its higher number of multi-country publications (MCP = 4). This suggests growing global interest and cooperation in this research area.

RQ2, delved into the main thematic areas and conceptual structures explored in the literature. The keyword analysis illustrates in Figure 4 identifies three dominant keywords: artificial intelligence (27 mentions), leadership (13 mentions), and digital transformation (5 mentions). These form also the motor theme cluster, as illustrated in the thematic map in Figure 6, emphasizing the core of current research, suggesting that the intersection of these areas forms the the basis for recent scholarly exploration. For additional insights, a Sankey diagram in bibliometric analysis is employed to map the connections among countries, journals, and keywords in the three-field plot in Figure 5. The analysis demonstrates that authors from India have published in three distinct journals more frequently than authors from any other country. Additionally, the Sustainability journal is the preferred venue for authors from India, Slovenia, and Saudi Arabia. Consistently, frequently used keywords across countries and journals include artificial intelligence, leadership, sustainability, AI, and digital transformation, which correlate the findings from the keyword frequency analysis. Overall, these bibliometric findings underscore the expanding research focus on AI and leadership studies.

To address RQ3, which investigated the collaboration patterns and dynamics among authors and countries in artificial intelligence and leadership, the bibliometric analysis employed co-authorship and country-level collaboration network analyses. Co-authorship network analysis in Figure 7 reveals 10 interactive teams consisting of 30 scholars from 12 distinct countries. Six teams were nationally based, reflecting a preference for domestic collaboration in Australia, Slovenia, Turkiye, Malaysia, Saudi Arabia, and Colombia. The remaining four teams engaged in international collaboration, with partnerships between India and Saudi Arabia, Morocco and France, Jordan and the UAE, and Egypt and Saudi Arabia, indicating preliminary steps towards international partnerships. The collaborative network among countries shown in Figure 8 reveals that the USA and China are the predominant partners, with four joint publications. However, most other collaborations occurred only once, indicating a fragmented landscape with limited long-term international engagement. Countries such as India, Norway, and Italy are involved in various one-time collaborations, pointing to sporadic rather than systematic partnerships. This fragmented and inconsistent collaboration points to a significant research gap (e.g. see, Bevilacqua et al. 2025; Zárate-Torres et al. 2025), emphasizing the necessity of more organized and robust international network partnerships to enhance the global comprehension of the impact of AI on leadership in a variety of contexts.

Regarding RQ4, which aimed to uncover rising research trends and potential future directions in the field of artificial intelligence and leadership, the analysis of trending topics illustrated in Figure 9 provides

valuable insights. The analysis of trending topics clearly indicates that "artificial intelligence," "leadership," and "digital transformation" are becoming increasingly significant focal points within the AI-Leadership research domain. These identified trends strongly suggest several potential avenues for future research. Considering the pivotal role of AI, future research may investigate particular AI applications within leadership frameworks, including AI-enhanced decision support systems, performance management tools, and AI-driven talent development platforms. On the other hand, digital transformation indicates a growing acknowledgment that the integration of AI into leadership is not an isolated occurrence, but rather a critical element of broader organizational digital transformation initiatives. Future research may explore the impact of AI-driven digital transformation on organizational structures, processes, and cultures, and how leadership must adapt to manage these changes effectively.

6. CONCLUSION AND LIMITATIONS

A bibliometric analysis of 60 articles retrieved from the Dimensions.ai database is conducted in this study, utilizing the Bibliometrix package in RStudio. It effectively maps the intellectual landscape of research on artificial intelligence and leadership from 2019 to 2025*, which is consistent with our fundamental objective to examine the most recent academic research in the field. The study provides essential insights into the current state of the field by examining publishing trends, prominent authors and sources, thematic developments, and collaboration networks, while also emphasizing potential avenues for future research in this dynamic and quickly expanding domain. Based on the descriptive analysis of publishing trends, there has been a significant and rapid increase in research output and a growing academic interest in the intersection of artificial intelligence and leadership. Moreover, the examination of prominent authors and sources demonstrates that the most pertinent articles emphasize the foundational works that have had a substantial impact on the field, while the examination of the top publication sources emphasizes the importance of key journals, in this case, Sustainability. Although Australia now leads in the volume of publications among corresponding author countries, China exhibits a stronger propensity for international collaboration. Furthermore, in the thematic developments, according to the keyword analysis, the dominant keywords were artificial intelligence, leadership, and digital transformation, which were also identified as motor themes on the thematic map. This cluster represents the core foundation of contemporary study in this field. On other hand three-field plot analysis highlighted India's diverse publication strategy. Collaboration analysis among authors and countries reveals primarily nationally homogeneous clusters with limited international partnerships. Despite strong ties between the USA and China, overall international engagement remains fragmented and sporadic, emphasizing the need for more coherent international research networks. Finally, the analysis of trending topics confirms the increasing prominence of "artificial intelligence," "leadership," and "digital transformation" within the literature. These trends indicate that future research will probably focus on how these relationships between these concepts are connected, especially looking at how AI-driven digital transformation is changing the basic elements of leadership theory and practice. In summary this bibliometric study offers a comprehensive examination of the research landscape at the intersection of AI and leadership. As AI evolves and its impact on businesses grows, further scholarly research in these suggested areas will be crucial for developing a comprehensive understanding of the evolving role of leadership in the age of artificial intelligence.

6.1. Limitations

This section outlines the limitations of the study. First, the scope of the available literature within the selected time frame (2015–2025*) and the use of the Dimensions.ai database constrain the review. Based on the selection criteria, no relevant papers were located before to 2019, and the data extraction date (March 9, 2025) implies that not all publications from 2025 are fully incorporated. Consequently, relevant studies published outside this period or in other databases may have been excluded, potentially creating gaps in the findings. Also, the exclusion of articles published after March 2025, given the rapid pace of research in this area, these articles could introduce new and relevant contributions to the literature.

Second limitation is that the research exclusively considers studies published in English, potentially excluding valuable research in other languages. Additionally, the analysis was limited to open-access publications, which may have excluded significant studies restricted by pay walls or other restrictions, which limits the comprehensiveness of the review. Furthermore, the study is confined to three main disciplinary areas: commerce, management, tourism and services, and journal quality was limited to those listed in ERA 2023. This disciplinary and journal quality focus

may exclude significant insights from other areas that overlap with AI and leadership.

Lastly, given the rapid advancement of AI technology, the literature reviewed may not fully represent the most recent developments or upcoming trends. As a result, certain findings may rapidly become outdated quickly as new AI applications and Leadership implications emerge.

Despite these limitations, this study aims to spark further scholarly discussion and encourage future research in this dynamic and increasingly important area of research. Acknowledging these limitations, future studies may expand upon this research to deliver a more comprehensive and nuanced examination of artificial intelligence in leadership.

References

Abbass, H. 2021. What is artificial intelligence? *IEEE Transactions on Artificial Intelligence 2* (2): 94-95.

Abina, A., Batkovič, T., Cestnik, B., Kikaj, A., Kovačič Lukman, R., Kurbus, M., and Zidanšek, A. 2022. Decision support concept for improvement of sustainability-related competences. *Sustainability 14* (14): 8539.

Abositta, A., Adedokun, M. W., and Berberoğlu, A. 2024. Influence of Artificial Intelligence on Engineering Management Decision-Making with Mediating Role of Transformational Leadership. *Systems 12* (12): 570.

Adnan, A. A. Z., Yunus, N. K. Y., and Ghouri, A. M. 2019. Does religiosity matter in the era of industrial revolution 4.0? *Asian Academy of Management Journal 24*: 67-77.

Aria, M., and Cuccurullo, C. 2017. bibliometrix: An R-tool for comprehensive science mapping analysis. *Journal of informetrics 11* (4): 959-975.

Avolio, B. J., Kahai, S., and Dodge, G. E. 2000. E-leadership: Implications for theory, research, and practice. *The leadership quarterly 11* (4): 615-668.

Barley, S. R., Bechky, B. A., and Milliken, F. J. 2017. The changing nature of work: Careers, identities, and work lives in the 21st century. *Academy of Management Discoveries 3* (2): 111-115.

Bevilacqua, S., Masárová, J., Perotti, F. A., and Ferraris, A. 2025. Enhancing top managers' leadership with artificial intelligence: insights from a systematic literature review. *Review of Managerial Science:* 1-37.

Bouncken, R. B., Kraus, S., and Roig-Tierno, N. 2021. Knowledgeand innovation-based business models for future growth: Digitalized business models and portfolio considerations. *Review of Managerial Science 15* (1): 1–14.

Bresciani, S., Ferraris, A., Romano, M., and Santoro, G. 2021. Digital leadership. In *Digital transformation management for agile organizations: A compass to sail the digital world* (pp. 97-115). Emerald Publishing Limited.

Bretas, V. P., and Alon, I. 2021. Franchising research on emerging markets: Bibliometric and content analyses. *Journal of Business Research* 133: 51-65.

Chatterjee, S., Rana, N. P., Dwivedi, Y. K., and Baabdullah, A. M. 2021. Understanding AI adoption in manufacturing and production firms using an integrated TAM-TOE model. *Technological Forecasting and Social Change* 170: 120880.

Chaudhuri, R., Chatterjee, S., Vrontis, D., and Chaudhuri, S. 2022. Innovation in SMEs, AI dynamism, and sustainability: The current situation and way forward. *Sustainability 14* (19): 12760.

Chowdhury, S., Dey, P., Joel-Edgar, S., Bhattacharya, S., Rodriguez-Espindola, O., Abadie, A., and Truong, L. 2023. Unlocking the value of artificial intelligence in human resource management through AI capability framework. *Human resource management review 33* (1): 100899.

Dey, P. K., Chowdhury, S., Abadie, A., Vann Yaroson, E., and Sarkar, S. 2024. Artificial intelligence-driven supply chain resilience in Vietnamese manufacturing small-and medium-sized enterprises. *International Journal of Production Research 62* (15): 5417-5456.

Dubey, R., Bryde, D. J., Foropon, C., Tiwari, M., Dwivedi, Y., and Schiffling, S. 2021. An investigation of information alignment and collaboration as complements to supply chain agility in humanitarian supply chain. *International Journal of Production Research 59* (5): 1586-1605.

Eberl, J. K., and Drews, P. 2021. Digital Leadership – Mountain or molehill? A literature review. *Innovation through information systems: Volume III: A collection of latest research on management issues*: 223-237.

El Sawy, O.A., Kræmmergaard, P., Amsinck H., and Vinther A. L. 2016. How LEGO built the foundations and enterprise capabilities for digital leadership. MIS quarterly executive: 15 (2): 174–20.

Fitzgerald, M., Kruschwitz, N., Bonnet, D., and Welch, M. 2014. Embracing digital technology: A new strategic imperative. *MIT sloan management review 55* (2): 1.

García-Lillo, F., Sánchez-García, E., Marco-Lajara, B., and Seva-Larrosa, P. 2023. Renewable energies and sustainable development: a bibliometric overview. *Energies 16* (3): 1211.

Ghavifekr, S., and Pei, X. 2023. Leading global digitalization in higher education. In *Global Perspectives on the Internationalization of Higher Education* (pp. 1-15). IGI Global.

Gil de Zúñiga, H., Goyanes, M., and Durotoye, T. 2024. A Scholarly Definition of Artificial Intelligence (AI): Advancing AI as a Conceptual Framework in Communication Research. *Political Communication* 41 (2): 317–334.

Haenlein, M., and 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.

Hanandeh, A., Qudah, M. A., Mansour, A., Al-Qudah, S., Abualfalayeh, G., Kilani, Q., and Khasawneh, M. A. 2024. The achievement of digital leadership sustainability and business performance through the implementation of business intelligence, artificial intelligence, and quality learning in private universities in Jordan. *Uncertain Supply Chain Management 12* (4): 2581-2586.

Henderikx, M., and Stoffers, J. 2022. An exploratory literature study into digital transformation and leadership: Toward future-proof middle managers. *Sustainability 14* (2): 687.

Herzog, C., Hook, D., and Konkiel, S. 2020. Dimensions: Bringing down barriers between scientometricians and data. *Quantitative science studies 1* (1): 387-395.

Huang, M. H., and Rust, R. T. 2021. Engaged to a robot? The role of AI in service. *Journal of Service Research 24* (1): 30-41.

İnel, M. 2019. An empirical study on measurement of efficiency of digital transformation by using data envelopment analysis. *Management Science Letters 9* (4): 549-556.

Islami, X., and Mulolli, E. 2020. A conceptual framework of transformational leadership as an influential tool in the team performance. *European Journal of Management Issues 28* (1-2): 13-24.

Islami, X., and Mulolli, E. 2024. Human-Artificial Intelligence in Management Functions: A Synergistic Symbiosis Relationship. *Applied Artificial Intelligence 38* (1): 1-44.

Islami, X., Mulolli, E., and Mustafa, N. 2025. Artificial intelligence and value-based strategy: A literature review and future research directions. *Management Review Quarterly* 76 (3).

Karakose, T., Kocabas, I., Yirci, R., Papadakis, S., Ozdemir, T. Y., and Demirkol, M. 2022. The development and evolution of digital leadership: A bibliometric mapping approach-based study. *Sustainability 14* (23): 16171.

Khairy, H. A., Ahmed, M., Asiri, A., Gazzawe, F., Abdel Fatah, M. A., Ahmad, N., and Agina, M. F. 2024. Catalyzing green work engagement in hotel businesses: Leveraging artificial intelligence. *Sustainability 16* (16): 7102.

Khan, S. A. R., Yu, Z., Golpira, H., Sharif, A., and Mardani, A. 2021. A state-of-the-art review and meta-analysis on sustainable supply chain management: Future research directions. *Journal of Cleaner Production 278*: 123357.

Kraus, S., Bouncken, R. B., and Yela Aránega, A. 2024. The burgeoning role of literature review articles in management research: an introduction and outlook. *Review of Managerial Science,18* (2): 299-314.

Kraus, S., Jones, P., Kailer, N., Weinmann, A., Chaparro-Banegas, N., and Roig-Tierno, N. 2021. Digital transformation: An overview of the current state of the art of research. *Sage Open 11* (3): 21582440211047576.

Larjovuori, R. L., Bordi, L., Mäkiniemi, J. P., and Heikkilä-Tammi, K. 2016. The role of leadership and employee well-being in organizational digitalization. *Tiziana Russo-Spenaand Cristina Mele 1159*: 1141-1154.

Larson, L., and DeChurch, L. A. 2020. Leading teams in the digital age: Four perspectives on technology and what they mean for leading teams. *The leadership quarterly 31* (1): 101377.

Lee, L. W., Dabirian, A., McCarthy, I. P., and Kietzmann, J. 2020. Making sense of text: artificial intelligence-enabled content analysis. *European Journal of Marketing 54* (3): 615-644.

Lee, Y. S. 2011. A comparison of leadership behaviors in the financial industry in the United States and Taiwan. *Journal of International Management Studies 6* (2): 1-12.

Lu, Q., Zhu, L., Xu, X., Whittle, J., Zowghi, D., and Jacquet, A. 2024. Responsible ai pattern catalogue: A collection of best practices for ai governance and engineering. *ACM Computing Surveys 56* (7): 1-35.

Lundvall, B. Å., and Rikap, C. 2022. China's catching-up in artificial intelligence seen as a co-evolution of corporate and national innovation systems. *Research Policy 51* (1): 104395.

Madanchian, M., Taherdoost, H., Vincenti, M., and Mohamed, N. 2024. Transforming Leadership Practices through Artificial Intelligence. *Procedia Computer Science 235*: 2101-2111.

McCarthy, J. 1956. What is artificial intelligence? Stanford University. Retrieved from https://www-formal.stanford.edu/jmc/whatisai.pdf (Accessed on April 18, 2025)

Mumali, F. 2022. Artificial neural network-based decision support systems in manufacturing processes: A systematic literature review. *Computers & Industrial Engineering 165*: 107964.

Nixon, P., Harrington, M., and Parker, D. 2012. Leadership performance is significant to project success or failure: a critical analysis. *International Journal of productivity and performance management 61* (2): 204-216.

Oberer, B., and Erkollar, A. 2018. Leadership 4.0: Digital leaders in the age of industry 4.0. *International journal of organizational leadership 7* (4): 404-412.

Ojeda-Beltrán, A., Solano-Barliza, A., Arrubla-Hoyos, W., Ortega, D. D., Cama-Pinto, D., Holgado-Terriza, J. A., and Cama-Pinto, A. 2023. Characterisation of youth entrepreneurship in Medellín-Colombia using machine learning. *Sustainability 15* (13): 10297.

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., and Moher, D. 2021. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *bmj*, *372*.

Peifer, Y., Jeske, T., and Hille, S. 2022. Artificial intelligence and its impact on leaders and leadership. *Procedia computer science 200*: 1024-1030.

Pilav-Velić, A., Černe, M., Trkman, P., Wong, S. I., and Kadić-Abaz, A. 2021. Digital or innovative: Understanding "Digital Literacy–practice–innovative work behavior" chain. *The South East European Journal of Economics and Business 16* (1): 107-119.

Quaquebeke, N. V., and Gerpott, F. H. 2023. The now, new, and next of digital leadership: How Artificial Intelligence (AI) will take over and change leadership as we know it. *Journal of Leadership & Organizational Studies 30* (3): 265-275.

Rademaker, T., Klingenberg, I., and Süß, S. 2023. Leadership and technostress: a systematic literature review. *Management Review Quarterly:* 1-66.

Rehan, A., Thorpe, D., and Heravi, A. 2024. Project manager's leadership behavioural practices–A systematic literature review. *Asia Pacific Management Review 29* (2): 165-178.

Rich, E.A. (1983). Artificial Intelligence. McGraw-Hill, New York.

Ruokonen, M., and Ritala, P. (2024). How to succeed with an AI-first strategy?. *Journal of Business Strategy 45* (6): 396-404.

Sheikh, H., Prins, C., and Schrijvers, E. 2023. Artificial intelligence: definition and background. In *Mission AI: The new system technology* (pp. 15-41). Cham: Springer International Publishing.

Simmons, A. B., and Chappell, S. G. 1988. Artificial intelligence-definition and practice. *IEEE journal of oceanic engineering 13* (2): 14-42.

Singh, V. K., Singh, P., Karmakar, M., Leta, J., and Mayr, P. 2021. The journal coverage of Web of Science, Scopus and Dimensions: A comparative analysis. *Scientometrics 126* (6): 5113-5142.

Song, Y., Chen, X., Hao, T., Liu, Z., and Lan, Z. 2019. Exploring two decades of research on classroom dialogue by using bibliometric analysis. *Computers & Education 137*: 12-31.

UNESCO. 2022. UNESCO recommendation on open science. Available from: https://doi.org/10.54677/MNMH8546

Wagner, D. N. 2020. Strategically managing the artificially intelligent firm. *Strategy & Leadership 48*(3): 19-25.

Yamin, M. A., Almuteri, S. D., Bogari, K. J., and Ashi, A. K. 2024. The Influence of Strategic Human Resource Management and Artificial Intelligence in Determining Supply Chain Agility and Supply Chain Resilience. *Sustainability 16* (7): 2688.

Zaccaro, S. J., and Bader, P. 2003. E-leadership and the challenges of leading e-teams: Minimizing the bad and maximizing the good. *Organizational Dynamics* 31 (4): 377-387.

Zárate-Torres, R., Rey-Sarmiento, C. F., Acosta-Prado, J. C., Gómez-Cruz, N. A., Rodríguez Castro, D. Y., and Camargo, J. 2025. Influence of Leadership on Human–Artificial Intelligence Collaboration. *Behavioral Sciences 15* (7): 873.

Zerfass, A., Hagelstein, J., and Tench, R. 2020. Artificial intelligence in communication management: a cross-national study on adoption and knowledge, impact, challenges and risks. *Journal of Communication Management 24* (4): 377-389.

Zhong, L. 2017. Indicators of digital leadership in the context of K-12 education. *Journal of Educational Technology Development and Exchange (JETDE) 10* (1): 3.

South East European Journal of Economics and Business
Volume 20 (2) 2025, 85-99
DOI: 10.2478/jeb-2025-0020

THE FUTURE OF WORK IN TRANSITION ECONOMIES: INTEGRATING AI, DIGITAL SKILLS, AND EMPLOYABILITY IN HIGHER EDUCATION

Anes Hrnjić, Amila Pilav-Velić, Nejra Hadžiahmetović-Milišić, Lejla Dedović

Abstract

This study examines the incorporation of soft skills, digital competencies, and artificial intelligence (AI) tools in higher education to improve student employability in Bosnia and Herzegovina, with broader relevance for the South East Europe region, where similar transition economies face parallel challenges in aligning education with the demands of digitally transformed labor markets. The research utilizes a mixed-methods approach, integrating quantitative survey data from University of Sarajevo students with qualitative insights from industry professionals. Research indicates that the concurrent enhancement of soft skills (such as communication and critical thinking) and digital competencies, in conjunction with the utilization of AI tools, markedly enhances students' preparedness for the contemporary labor market. The study emphasizes the essential role of autonomy in converting AI tool utilization into academic achievement and provides practical recommendations for educators, policymakers, and employers to address the skills gap in the digital economy.

Key words: *employability, artificial intelligence, higher education*

Anes Hrnjić, PhD (Corresponding author)
Assistant Professor
University of Sarajevo –
School of Economics and Business
Trg oslobođenja – Alija Izetbegović 1
Bosnia and Herzegovina
E-mail: anes.hrnjic@efsa.unsa.ba
ORCID: 0009-0006-826-4034

Amila Pilav-Velić, PhD
Full Professor
University of Sarajevo –
School of Economics and Business
Bosnia and Herzegovina
E-mail: amila.pilav-velic@efsa.unsa.ba
ORCID: 0000-0002-9269-4024

Nejra Hadžiahmetović-Milišić, MA
Senior Teaching Assistant
University of Sarajevo –
School of Economics and Business
Bosnia and Herzegovina
E-mail: nejra.hadziahmetovic@efsa.unsa.ba
ORCID: 0000-0002-8389-8391

Lejla Dedović, MA
Senior Teaching Assistant
University of Sarajevo –
School of Economics and Business
Bosnia and Herzegovina
E-mail: lejla.dedovic@efsa.unsa.ba
ORCID: 0000-0002-0377-0604

1. Introduction

The rapid pace of technological advancement, particularly in artificial intelligence (AI), has transformed the global business landscape. As organizations increasingly adopt AI-driven solutions, the demand for a workforce equipped with both technical and soft skills has grown exponentially (World Economic Forum 2020). However, there is a growing concern that higher education institutions are not adequately preparing students for this new reality, particularly in post-conflict and transition countries. This includes Bosnia and Herzegovina, a country where the mismatch between educational outcomes and labor market needs is a significant contributor to unemployment (Dogara et al. 2019). To uncover some of the related challenges, our main research question is: How does the integration of soft and digital skills, supported by GenAI tools, influence student employability and academic performance in higher education?

Consequently, this paper seeks to address the gap in the literature by exploring how the integration of soft and digital skills in higher education curricula, with a particular focus on the role of AI tools, might help in enhancing student employability. By combining qualitative and quantitative research methods, expert interviews, and student surveys, this study provides a comprehensive analysis of the current state of soft and digital skills among students and identify effective strategies for their development. Our findings suggests that GenAI content quality, perceived usefulness, and student autonomy are essential mediators of academic performance and loyalty to AI tools in contemporary higher education.

The paper is organized as follows. After introductory section, the next one provides literature review explaining soft skills, digital competencies, GenAI, and employability followed by research methodology. The results of SEM analysis and qualitative validation are then presented with a discussion as well as practical recommendations. Last section concludes with limitations and directions for future research.

2. Literature Review

Emerging technology, digitization, and workplace automation have revolutionized business, employment, and lifestyles. The labor market encounters substantial challenges due to the impact of technology breakthroughs on the economy, society, and quality of life in the digital era (Vasilescu et al. 2020). The rapid advancement of digital and robotic technologies is transforming and displacing human employment. Forecasts indicate that numerous corporate jobs would undergo significant transformations, necessitating contemporary capabilities (Goulart et al. 2021). Digital technologies supplant antiquated work ways, rendering straightforward activities more intricate and necessitating teamwork alongside both soft and digital competencies. Consequently, cultivating soft and digital skills is crucial for maximizing potential in the digital era and adjusting to alterations in work processes (Kelchevskaya and Shirinkina 2019).

In the contemporary technology environment, organizational skills encompass technical, methodological, social, and personal aspects, such as emotional intelligence and self-awareness. Soft and digital competencies must be cultivated alongside profession-specific technical skills. Intermittently employing both soft and digital talents facilitates network development and addresses intricate innovation challenges. Universities, as hubs of innovation, policy development, knowledge distribution, and resource generation, cultivate new professional capabilities that influence educational concepts and methodologies (Kurbanov et al. 2020). Emerging technology and innovations, sometimes absent from higher education curricula, provoke apprehensions over educational stagnation (Ilori and Ajagunna 2020). In Bosnia and Herzegovina, professionals in the real sector frequently indicate that curriculum fail to align with the requirements of employers and the labor market.

The deficiency of employable skills is a significant contributor to unemployment (Dogara et al. 2019). Consequently, higher education institutions must adapt to technology advancements to cultivate skills vital for future employability, as employment opportunities will be limited for those lacking them. In light of significant business uncertainty and escalating risks across multiple domains, including online security and environmental concerns linked to sustainable business practices, Generation Z, characterized by distinct values and traits, necessitates engagement in intricate processes of technological innovation, market development, and the modernization of decision-making within established industries. As activities grow increasingly intricate, it is essential to cultivate networks of future specialists capable of collaborating to address complicated issues. Global studies indicate that approximately 40% of worldwide employment is influenced by AI, especially cognitive-based positions in industrialized nations. Developed countries are more susceptible to AI yet are better equipped to reap its advantages (Cazzaniga et al. 2024). If individuals lack training in AI and digital transformation, the digital divide and income inequalities may exacerbate.

This study underscores the significance of

imparting soft and digital skills to university students for success in the evolving business landscape. These competencies are cultivated to enhance student employability and preparedness for the digital economy. Students will acquire communication, teamwork, critical thinking, and digital literacy skills through customized educational programs and seminars. This research recognizes AI's potential influence on labor market dynamics. The initiative suggests solutions to optimize AI's potential based on national development. Developed economies prioritize innovation, AI integration, and the oversight of regulatory frameworks to optimize the advantages of AI. Less affluent emerging countries, such as Bosnia and Herzegovina, must prioritize infrastructure and the cultivation of a digital workforce. Individuals and organizations must cultivate both soft and digital abilities concurrently to thrive in contemporary business. Communication, collaboration, and analytical reasoning are prioritized (Hurrell et al. 2013). Nonetheless, computer literacy and the utilization of digital tools are increasingly vital in the digital world (World Economic Forum 2020).

Social interest groups including educational institutions, students, alumni, and employers stress the necessity of matching soft skills for job performance (Crawford et al. 2011).

Soft skills are becoming more important in personal and professional settings. Understanding the link between AI and soft skills is vital as AI tools are integrated into more sectors. Personal and professional growth requires soft skill development. These competencies can improve efficiency, interpersonal relationships, and sustainable development, making the dynamic relationship between soft skills and AI bidirectional: AI tools automate routine tasks and provide analytical insights, while human soft skills provide an ethical framework, creativity, and emotional intelligence that AI lacks. Maximizing AI benefits while protecting and improving human-centered values requires understanding and cultivating this connection. The literature highlights the crucial soft abilities that interact with AI and they are presented in the Table 1 below.

Table 1. Soft skills

Soft Skill	Definition/Description	Key Findings and References
1. Commitment	The ability to start, manage, and finish an activity, involving keeping promises, emotional investment in work, error prevention, and goal setting.	– Escolà-Gascón and Gallifa (2022): Commitment involves analyzing mistakes and setting goals. – Faraj (2022): Dedication is crucial for AI success. – He et al. (2023): AI knowledge reduces job uncertainty and improves task execution. – Jurczuk and Florea (2022): Continuous learning is vital in AI-influenced business environments.
2. Originality	Creative thinking, inventiveness, and problem-solving for non-traditional approaches.	– El Tabal (2020): Originality enables unconventional solutions. – Baltà-Salvador et al. (2025): ChatGPT can enhance idea development and remove creative blocks. – Wingström et al. (2022) and Cascini (2022): Co-creativity (human-AI collaboration) improves idea generation. – Kim and Maher (2023): AI may reinforce established patterns rather than introduce originality. – Lee (2022): Over-reliance on AI may lead to mental laziness. – Baltà-Salvador et al. (2025): No significant difference in creativity between AI and human-generated ideas; AI should complement human creativity.
3. Integrity	Moral or ethical balance between thoughts, feelings, and actions.	– Zehr (1998): Integrity grows in importance in informational business environments. – Currie (2023): AI's potential to spread misinformation raises integrity concerns. – Jeyarani and Al-Busaidi (2023): AI does not negatively impact integrity if used responsibly.

4. Entrepreneurial Orientation	Traits like innovation, proactivity, risk-taking, and decision-making in uncertainty.	– Escolà-Gascón and Gallifa (2022): Entrepreneurs are self-confident and persuasive. – Hruby (2024): AI adoption is driven by entrepreneurial mindset. – Baldegger, Caon, and Sadiku (2020): Entrepreneurial firms use AI for HR and operations. – Somiá and Vecchiarini (2024): AI's impact on entrepreneurial inclination varies; some benefit in opportunity recognition, others worry about AI dependence.
5. Critical Thinking	Analyzing events from multiple perspectives to minimize losses and make informed judgments.	– QAInn et al. (2020) and Shanta and Wells (2022): Critical thinking is essential in fast-paced environments. – Darwin et al. (2024): AI aids in research and data analysis but lacks contextual nuance.
6. Thoroughness	Using rational explanations, evidence, and credible sources to justify ideas.	– Escolà-Gascón and Gallifa (2022): Involves validating information and avoiding flaws. – Ejjamija (2024): AI speeds up data extraction but lacks deep theoretical understanding. – Anis and French (2023): Human judgment remains essential for critical analysis.
7. Inefficiency	Linked to low self-esteem and difficulty learning new tasks; can be mitigated by resilience and stress management.	– Escolà-Gascón and Gallifa (2022): Resilience reduces inefficiency. – Hooda et al. (2022): AI helps via personalized feedback and early intervention but risks over-dependence.
8. Accuracy	Precision and attention to detail, crucial in fields like medicine and engineering.	– Escolà-Gascón and Gallifa (2022): Involves error prevention and critical analysis. – Russell and Norvig (2016): AI excels in pattern recognition. – Hung and Sun (2020): Human oversight ensures ethical AI use.
9. Uncertainty	Ability to function without clear guidelines; involves heuristics and intuition.	– Kahneman (2011): Humans use intuition in ambiguity. – Escolà-Gascón and Gallifa (2022): Critical thinking is key in uncertain decisions.
10. Engagement	Active participation and dedication to tasks, improving productivity and job satisfaction.	– Brynjolfsson and McAfee (2014): AI reduces cognitive load, increasing engagement. – Escolà-Gascón and Gallifa (2022): Involves responsibility and group participation.
11. Environmental Awareness	Understanding ecological and social aspects of the environment.	– Rolnick et al. (2022): AI aids in sustainability but requires human ethics. – Escolà-Gascón and Gallifa (2022): Promotes sustainability and waste reduction.
12. Teamwork	Collaboration requiring trust, communication, and shared accountability.	– Escolà-Gascón and Gallifa (2022): Adaptability is key in human-AI teamwork. – De Prada, Mareque, and Pino-Juste (2022): Higher academic years improve teamwork skills.
13. Autonomy	Independent learning and decision-making.	– Bostrom (2014): Human agency prevents over-reliance on AI. – Mulgan (2016): AI supports autonomy but critical thinking is essential. – Escolà-Gascón and Gallifa (2022): Self-motivation is crucial.
14. Honesty	Integrity and authenticity in relationships.	– Liu et al. (2012): AI sentiment analysis can enhance honest communication. – Escolà-Gascón and Gallifa (2022): Involves ethical behavior and genuine thought.

Intelligent agents that perceive and act are the hallmark of artificial intelligence (AI) (Russell and Norvig 2016). This era has arrived, and transformative AI applications for end-users like ChatGPT-3 attracted over a million users in five days (Buchholz 2023). Users' rapid adoption shows AI's transformative power (Kelly et al. 2023). AI applications, software packages, and information systems are used in medicine (Kaul et al. 2020), healthcare (Secinaro et al. 2021), and even business tasks like PowerPoint presentations (Tyagi et al. 2021). Increasing productivity in routine and complex tasks by simplifying, automating, and reducing time is possible with AI technology. In addition to these areas generative AI will impact education (Jo 2023). Generational AI helps students and teachers perform their tasks efficiently (Lim et al. 2023), and it is believed to be the next frontier that will transform education (Cooper 2023). Generative AI uses user input to generate written, visual, audio, or image data (Jo 2023). Education is increasingly using it for learning and development (Cooper 2023). Large language models (LLMs) underpin generative AI (Kasneci et al. 2023). LLMs are AI architectures trained on massive amounts of data, including images (Carlini et al. 2021). Their main goal is to mimic, understand, and generate human-like language (Wei et al. 2022). Generative AI accelerates teacher assessment (Qadir 2023), generates and simplifies student content (Lim et al. 2023), supports scientists' research, personalized tutors (Cooper 2023), and automates student tasks. Many companies and startups target educators, including teachers and students, with generative AI tools (Su and Yang 2023). These deployments let educators, especially students, choose generative AI tools for learning. AI is evaluated through following dimensions presented in Table 2 below.

Table 2. AI dimensions/factors

Factor	Definition/Description	Key Findings and References
1. Content Quality	Generative AI's ability to produce diverse, high-quality content (text, images, music, etc.) that meets user needs.	– Epstein and Hertzmann (2023): AI can generate high-quality music, videos, and images. – Ahmad et al. (2023): AI-written content impacts student experience. – Louie et al. (2020): Content should be useful, relevant, and appealing. – Kim et al. (2022): Quality depends on coherence, creativity, accuracy, and relevance. – Liu et al. (2023): Accurate AI content aids exam success. – Pavlik (2023): Relevant content reduces student effort. – Muller et al. (2022): Creative AI content supports skill development.
2. Distrust	Users perceive GenAI as unreliable, non-transparent, or harmful due to inaccuracies, misinformation, privacy risks, or lack of regulation.	– Shin (2021): Mistrust stems from response inaccuracy. – Zhou et al. (2023): Fear of misinformation. – Awad and Kröger (2020): Privacy/data security concerns. – McKnight et al. (2002): Distrust leads to cautious AI use. – Langer and Landers (2021): Distrust is higher in education, medicine, and finance.
3. Adoption	User integration of GenAI into education/careers, driven by perceived usefulness, ease of use, and trust.	– Davis (1989) and Venkatesh and Davis (2000): TAM model highlights usefulness and ease of use. – Dwivedi et al. (2023): Adoption increases if AI boosts productivity. – Selwyn (2022): Institutional integration shapes attitudes. – Dzindolet et al. (2002): Usefulness is key for adoption. – Vert (2023): AI's immediate utility drives adoption. – Weisz et al. (2021): Subjective/objective assessments determine usefulness. – Castelli and Manzoni (2022): Functionality, reliability, and adaptability increase usefulness. – Lodge et al. (2023): Students evaluate content relevance for learning.

4. Usefulness	Generative AI's perceived value in meeting user needs (e.g., skill development, exam prep).	– Lv (2023): Functionality impacts usefulness. – Dwivedi et al. (2023): Reliability and adaptability boost satisfaction. – Castelli and Manzoni (2022): AI aids skill development and exam prep.
5. Loyalty	User commitment to AI products, influenced by trust, product quality, and privacy.	– Gul (2014): Trust precedes loyalty. – McMullan and Gilmore (2003): Consistency builds loyalty. – Siau and Wang (2018): Positive experiences foster loyalty. – Carvalho and de Oliveira Mota (2010): Trust is key in education. – Kim and Frick (2011): Attractiveness encourages use. – Fogel and Kvedar (2018) and Manheim and Kaplan (2019): Privacy concerns affect loyalty. – Kirienko et al. (2021): Privacy protections are critical. – McClure (2018): AI should assist, not replace, humans.
6. Satisfaction	Psychological state from meeting needs via AI's shortand long-term benefits.	– Giese and Cote (2000): Widely studied in marketing/IS. – Geyskens et al. (1999): Driven by need fulfillment. – Khalifa and Liu (2004): Systems must meet needs for sustained use. – Ouyang et al. (2022) and Xia et al. (2023): AI meets learning needs. – Malakul and Park (2023): AI supports academic and career goals. – Yilmaz and Yilmaz (2023): Subjective assessment matters. – Bozkurt (2023): AI differs from traditional IS.

Recent interest in employability has grown due to unfavorable labor market conditions in many economies. An extensive body of literature on this topic can be divided into three slightly overlapping research areas, each of which is relevant and has improved employability understanding. The first area of research examines national workforce employability, including government policies and skills strategies, and industrial sector employability. This approach, which emerged from changes in work and employment at the end of the 20th century, has helped define employability as a concept with "internal" (e.g., individual skills, internal labor market) and "external" (demand for certain occupations, external labor market) dimensions (Hillage and Pollard 1998).

Employability in HRM and work and career psychology is the second research area (Baruch 2001; Forrier and Sels 2003). Employability is the ability to retain or find work, and work experience gives skills and flexibility. Employers often promote this type of employability over job security. This research includes individuals' perceptions of their ability to find or retain desired employment, employees' willingness to develop their skills within the organization (Van Dam 2004), self-confidence and work relationships (Schyns et al. 2007), re-engagement in work, and obesity's impact on employability. These studies have helped define employability as a multidimensional construct (Fugate et al. 2004; Thijssen et al. 2008) and develop models to assess professional workers' perceptions.

In the third area of research, academics are increasingly involved in employability, particularly by integrating skills into teaching curricula (Gedye et al. 2004; Rothwell 2008). The initial fragmented application of skills in educational modules has evolved into comprehensive learning and teaching strategies, including students' expectations of employability before graduation, skill integration into curricula, and graduate employment analysis. There are a few studies on postgraduate employability (Hay and Hodgkinson 2006; Morse 2006) and national contexts (Tomé 2007; Zhiwen 2008), but they are often country-specific and have limited generalizability. For business management students, employability is "the perceived ability to gain sustainable employment that matches the level of qualifications" (Rothwell et al. 2008). Research shows that undergraduates have modest expectations due to a realistic view of the labor market. The employability scale was studied to create a career counseling and professional guidance diagnostic tool. Employability is a popular concept, but empirical studies on what it means to people—their experiences, aspirations, and perception of their ability to compete in the labor market—are scarce. This study builds on previous research on professional worker employability (Rothwell and Arnold 2007) to examine individual employability.

3. Methodology

This study adopted a mixed-methods approach, combining an online quantitative survey with structural equation modeling (SEM) and a qualitative validation phase. Data were collected via LimeSurvey among students at the University of Sarajevo who had experience using GenAI tools (n=218; 32.4% response rate). Survey items were based on TAM, TPB, and trust-based models. SEM analysis was conducted using SmartPLS 4.0, including bootstrapping (5,000 resamples) and CFA. Expert interviews were conducted with professionals from education and industry to validate survey findings. This methodology was chosen for its robustness in handling latent variables composed of multiple measurement items and its capability to analyze complex mediating and serial mediation effects (Kline 2015; Hair et al. 2022).

4. Results and Discussion

Reliability and validity tests

Using Hair et al. (2010) guidelines, construct dimensionality was assessed before hypotheses testing. The measurement model's goodness-of-fit indices, shown in Table 1, indicate good data fit. The chi-square to degrees of freedom ratio (χ^2/df) is 2.294, which is within the acceptable range (< 3). The Root Mean Square Error of Approximation (RMSEA) is 0.077 and the Standardized Root Mean Square Residual (SRMR) is 0.062, both below 0.08. The Further Comparative Fit Index (CFI) is 0.909, above the 0.90 threshold, confirming model fit. Several reliability and internal consistency measures were taken. Cronbach's alpha (α) coefficients, both standardized and unstandardized, exceed the minimum threshold of 0.70 (Hair et al. 2010) with values ranging from 0.846 to 0.952 and 0.841 to 0.952, respectively. These findings show high internal consistency and reliability for all latent constructs. Cronbach's alpha, a standard measure of scale reliability, indicates that construct items measure the same concept. All constructs have Composite Reliability (CR) values between 0.833 and 0.952, exceeding the recommended 0.70. This shows that each construct accurately represents its indicators. The constructs' convergent validity is confirmed by Average Variance Extracted (AVE) values between 0.502 and 0.800, which exceed the 0.50 threshold (Hair et al. 2010). Discriminant validity was assessed using the Fornell-Larcker criterion (Fornell and Larcker 1981). This criterion requires each construct's square root of the AVE to be greater than its correlation with any other construct. In Panel B of Table 3, all constructs meet this condition, indicating that each construct is distinct and shares more variance with its own indicators than with other model constructs.

Table 3. CFA results of measurement model (DFL)

PANEL A: Model fit of measurement model

	ChiSqr	df	ChiSqr/df	RMSEA	SRMR	CFI
Goodness of fit stats	830.249	362.000	2.294	0.077	0.062	0.909

PANEL B: Results of reliability and validity tests of measurement model

Dimensions	CR	AVE	α (standardized)	α (unstandardized)	AP	USF	QLT	LOY	AUT	SAT
ACADEMIC PERFORMANCE (AP)	0.862	0.508	0.860	0.860	0.713					
USEFULENESS (USF)	0.874	0.587	0.876	0.874	0.216	0.766				
QUALITY (QLT)	0.833	0.502	0.846	0.841	0.200	0.821	0.709			
LOYALTY(LOY)	0.912	0.729	0.917	0.915	0.258	0.835	0.774	0.854		
AUTONOMY (AUT)	0.898	0.687	0.897	0.896	0.616	0.240	0.223	0.288	0.829	
SATISFACTION (SAT)	0.952	0.800	0.952	0.952	0.206	0.653	0.796	0.798	0.230	0.894

PANEL A: the observed norm (χ 2 /df should be less than 3), RMSEA (should be less than 0.08), SRMR (should be less than 0.08), and CFI (should be greater than 0.9) (Hair et al. 2010).

PANEL B: Fornell-Larcker criterion: Squared-Root of AVE in diagonal (cursive) and factors correlations below the diagonal.

Hypotheses testing

After establishing the reliability and validity of the measurement model, the proposed structural models were evaluated using the Structural Equation Modeling (SEM) approach with the Maximum Likelihood (ML) estimation method. The overall model fit was also assessed by examining key goodness-of-fit (GoF) indices. Results are presented in Table 4.

The model fit indices showed a good fit to the observed data (χ^2 = 865.981; df = 369; χ^2/df = 2.347; RMSEA = 0.079; SRMR = 0.070; CFI = 0.909). These findings confirm the structural paths' robustness and enable further interpretation of the hypothesized relationships. The structural model analysis shows several significant and theoretically grounded relationships that explain how students' perceptions of GenAI-generated content's accuracy, objectivity, relevance, and usefulness for task execution and learning affect satisfaction, loyalty, autonomy, and academic performance. Usefulness (USF) and Loyalty (LOY) have a significant relationship (H1: β = 0.611, t = 5.110, p < 0.001). GenAI analysis showed that student engagement, reliance, and continued use of digital learning tools will improve when students' opinions are assessed on learning improvement, faster task execution, or exam preparation.

The correlation between Quality (QLT) and Usefulness (USF) was significant (H2: β = 0.821, t = 16.574, p < 0.001). GenAI outputs were evaluated by students for accuracy, objectivity, clarity, and relevance. These dimensions directly affect the tool's academic usefulness. As previously found, content quality drives perceived usefulness and trust in digital tools, as students are more likely to value and rely on AI tools that consistently deliver reliable and meaningful results. Quality (QLT) did not significantly impact Loyalty (LOY) (H3: β = -0.122, p = 0.405), indicating that good GenAI outputs alone are not enough to build user loyalty. According to the literature, AI tool loyalty requires trust, which is built through consistent, reliable, and problem-free user experiences (Gul 2014; Siau and Wang 2018). Students' loyalty is also influenced by privacy, usability, and AI's perceived ability to meet their learning needs, not just technical accuracy (Carvalho and de Oliveira Mota 2010; Kirienko et al. 2021).

Quality (QLT) significantly impacts Satisfaction (SAT) (H4: β = 0.796, t = 19.172, p < 0.001), indicating that students who view GenAI outputs as accurate, clear, and relevant report higher tool satisfaction. The literature suggests that satisfaction arises when an information system meets short-term academic needs and long-term development goals (Ouyang et al. 2022; Malakul and Park 2023). Geyskens et al. (1999) and Khalifa and Liu (2004) also note that satisfaction is a subjective psychological state based on how well GenAI meets user needs, which include task completion, learning support, and skill-building.

The relationship between Loyalty (LOY) and Academic Performance (AP) is not significant (H5: β = 0.089, p = 0.200), indicating that affective commitment to GenAI alone is not enough to improve academic outcomes. Instead, students' ability to autonomously apply AI tools to their learning appears to determine such outcomes. This supports literature warning that loyalty without internalised self-regulatory

Table 4. Direct effects and fit indices

Test	Path	β	SE	t	p	Result
Direct effects						
H1	Usefulness (USF) → Loyalty (LOY)	0.611	0.119	5.110	0.000	Supported
H2	Quality (QLT) → Usefulness (USF)	0.821	0.050	16.574	0.000	Supported
H3	Quality (QLT) → Loyalty (LOY)	-0.122	0.147	0.832	0.405	Not significant
H4	Quality (QLT) → Satisfaction (SAT)	0.796	0.041	19.172	0.000	Supported
H5	Loyalty (LOY) → Academic performance (AP)	0.089	0.069	1.281	0.200	Not significant
H6	Loyalty (LOY) → Autonomy (AUT)	0.288	0.085	3.377	0.001	Supported
H7	Autonomy (AUT) → Academic performance (AP)	0.590	0.069	8.562	0.000	Supported
H8	Satisfaction (SAT) → Loyalty (LOY)	0.497	0.096	5.179	0.000	Supported

Standardized betas, standard errors and t-statistics reported.

R^2 (AP) = 0.386; R^2 (USF) = 0.673; R^2 (LOY) = 0.812; R^2 (AUT) = 0.083; R^2 (SAT) = 0.633

Model fit: df = 369, χ2 = 865.981, χ2/df = 2.347; RMSEA = 0.079; GFI: 0.779; SRMR = 0.070

[a] p < 0.01. [b] p < 0.05. [ns] Not significant.

competencies may lead to dependency rather than empowerment and improved student performance (Escolà-Gascón and Gallifa 2022; Faraj 2022). Loyalty (LOY) significantly impacts Autonomy (AUT) (H6: β = 0.288, t = 3.377, p = 0.001), indicating that students who use GenAI tools more are more capable of independent learning. This is important because it shows that trust in AI can improve but not replace human engagement (Bostrom 2014; Mulgan 2016). According to Escolà-Gascón and Gallifa (2022), autonomy is a key competence in AI-supported learning because it allows students to make informed choices and avoid passive technology use.

Moreover, Autonomy (AUT) significantly predicted Academic Performance (AP) (H7: β = 0.590, t = 8.562, p < 0.001), highlighting its crucial role in AI-enhanced education Students who reported higher GenAI independence also performed better, supporting the idea that students with better soft skills are better positioned to benefit from AI systems (Cazzaniga et al. 2024; Crawford et al. 2011) than those who only develop digital skills. The study found a significant relationship between Satisfaction and Loyalty (H8: β = 0.497, t = 5.179, p < 0.001), indicating that students who found GenAI enjoyable and useful were more likely to continue using it. According to research, academic satisfaction forms the emotional basis for trust, which is necessary for AI tool loyalty (Geyskens et al. 1999; Gul 2014).

We tested indirect effect statistical significance with bootstrapping with 5,000 resamples. Unstandardized coefficients and 95% bias-corrected confidence intervals were calculated using this method, improving indirect pathway evaluation accuracy and reliability. Multiple indirect and serial mediation effects were statistically significant. These findings explain how students' perceptions of GenAI tool content quality, satisfaction, and usefulness affect academic performance, with a focus on autonomy, a key soft skill. Results are in Table 5.

In H9 (QLT → SAT → LOY; β = 0.395, t = 4.714), students who view GenAI content as accurate, relevant, and clear are more satisfied, leading to increased loyalty to GenAI. This supports literature that states satisfaction is a psychological state resulting from the fulfillment of academic and developmental needs and that information systems like GenAI support both short-term goals (e.g., exam preparation) and long-term learning development. According to H10 (QLT → USF → LOY; β = 0.501, t = 4.521), the perception of GEN AI usefulness (defined as value, reliability, and adaptability of AI-generated output) positively affects loyalty. According to the literature, students value content that supports learning, saves time, and adapts to their goals, so perceived usefulness is a key factor in GenAI adoption and use. Again, H11 (LOY → AUT → AP; β = 0.170, t = 2.907) confirms that loyalty alone is insufficient to impact academic performance without promoting autonomy. The literature defines autonomy as self-motivation, independent learning, and decision-making (Escolà-Gascón and Gallifa, 2022). Again, AI can provide support through personalized recommendations, but autonomy is necessary to avoid over-reliance on AI and preserve critical thinking (Bostrom 2014; Mulgan 2016). H12 (QLT → SAT → LOY → AUT → AP; β = 0.067, t = 2.586) confirms a full serial mediation pathway, linking perceived quality to academic performance via satisfaction, loyalty, and autonomy. In AI-supported environments that require self-regulation, autonomy is needed to turn engagement into meaningful learning outcomes (Escolà-Gascón and Gallifa 2022). Conversely, H13 (QLT → USF → LOY → AP; β = 0.044, t = 1.233) was not statistically significant. This confirms previous findings that usefulness and loyalty do not affect academic performance without autonomy. AI tools may improve procedural

Table 5. Indirect effects and serial mediations (CB-SEM bootstrapping results)

Test	Path	β	SE	t	LLCI	ULCI	Results
Indirect effects							
H9	QLT → SAT → LOY	0.395	0.084	4.714	0.249	0.573	Supported
H10	QLT → USF → LOY	0.501	0.111	4.521	0.308	0.741	Supported
H11	LOY → AUT → AP	0.170	0.058	2.907	0.061	0.286	Supported
H12	QLT → SAT → LOY→AUT→ AP	0.067	0.026	2.586	0.023	0.123	Supported
H13	QLT→USF→ LOY→AP	0.044	0.036	1.233	-0.022	0.124	Not supported
H14	QLT→USF→ LOY→AUT → AP	0.085	0.040	2.142	0.025	0.178	Supported

Standardized betas, standard errors and t-statistics reported. LLCI represents 5.0% confidence interval, ULCI represents 95% confidence interval; 5,000 bootstrapped samples.

[a] p < 0.01. [b] p < 0.05. [ns] Not significant.

learning, but they cannot improve understanding without internalized soft skills and independent learning strategies that allow tailoring outputs to specific needs (Lee, 2022). Finally, H14 (QLT → USF → LOY → AUT → AP; $\beta = 0.085$, $t = 2.142$) confirms that reintroducing autonomy in mediation restores significance. The literature emphasizes that autonomy as a soft skill is essential to transforming digital engagement into academic achievement and that self-directed AI tool use is more effective than passively relying on outputs. This emphasises human-led approach again (Escolà-Gascón and Gallifa 2022; Bostrom 2014).

Findings show that GenAI content's perceived quality and usefulness promote satisfaction and loyalty, but only autonomy can translate these perceptions into academic success. This emphasises the need for educational programmes that actively promote autonomy and other soft skills needed for digital learning environments as well as AI tools.

The use of AI in education raises ethical and practical issues. Responsible and transparent use of AI tools with clear ethical guidelines is essential. In order to prepare students for the digital economy, educational programs must be constantly updated to meet labor market demands. Although insightful, the findings have several limitations. First, the study only included University of Sarajevo students, which may limit its applicability to other regions or educational institutions. A more diverse sample of Bosnia and Herzegovina and international organizations would improve knowledge. Second, self-reported statistics may be biased since students may overestimate their AI skills and utilization. To improve dependability, future studies may use longitudinal or direct observational data.

5. Conclusion

This study examined how the integration of soft skills, digital competencies, and generative AI (GenAI) tools can enhance student employability in higher education, with a particular focus on the context of Bosnia and Herzegovina. Using a mixed-methods approach that combined quantitative surveys and qualitative interviews with experts, the research uncovered several important insights about the factors influencing student engagement with AI tools and their overall academic development. Notably, the study found that content quality, perceived usefulness, student autonomy, and satisfaction all play significant roles in shaping academic performance and fostering loyalty toward AI applications.

One of the key findings was the importance of high-quality AI-generated content. When the content produced by GenAI tools is accurate, relevant, and creatively structured, it significantly boosts student satisfaction and enhances perceptions of usefulness, thereby contributing to improved learning outcomes. However, the benefits of these tools are not automatic. The study emphasized that students' ability to use AI autonomously is crucial. While AI increases efficiency and streamlines academic tasks, true educational value emerges only when students engage with these tools through self-regulated learning. Without this autonomy, there is a risk that AI loyalty could result in dependency rather than genuine academic growth.

Trust remains another critical factor. Despite increasing exposure to GenAI, many students still harbor concerns about the accuracy of AI outputs, data privacy, and ethical implications, especially in high-stakes educational environments. Nevertheless, the study found that these concerns can be partially mitigated when students perceive the tools as useful and feel satisfied with their outputs, which in turn encourages broader adoption.

Importantly, the study also addressed the intersection between education and the labor market. It found that developing both soft skills—such as critical thinking, collaboration, and adaptability—and digital competencies is essential for preparing students for modern workplace demands. These capabilities not only complement AI use but also close the gap between academic training and employer expectations. Ultimately, the research underscores that AI should not be viewed as a standalone solution in education. Rather, it must be integrated into a balanced and human-centered learning environment. Educational institutions have a responsibility to design curricula that foster both AI literacy and the essential soft skills needed to navigate an increasingly digital economy.

Beyond the national context, these findings carry important implications for the wider South East Europe region, where many countries share comparable socio-economic structures, educational system legacies, and labor market dynamics shaped by post-transition reforms. The demonstrated link between AI tool integration, soft skill development, and employability suggests a scalable framework for regional adoption, particularly in addressing skill mismatches and preparing graduates for cross-border mobility within an increasingly digitalized European economy. By fostering collaborative higher education–industry partnerships, harmonizing AI literacy and soft skills training across curricula, and investing in digital infrastructure, policymakers and universities across South East Europe can collectively strengthen their human capital competitiveness. This regional alignment would not only reduce the digital divide but also

position the region as a proactive participant in the evolving global knowledge economy.

To build on these findings, several practical recommendations are proposed for key stakeholders. For educators, there is a clear need to integrate AI tools meaningfully within pedagogical frameworks. This can involve designing assignments that use GenAI for initial brainstorming or drafting phases, followed by student-led critical analysis and revision. Educators should also offer AI literacy workshops that address ethical use, bias awareness, and source validation. Promoting student autonomy is equally important, and instructors should teach strategies for self-regulated learning, such as goal-setting and reflective practices. Personalized AI feedback can be beneficial, but students must be encouraged to actively shape their own educational journeys. Policymakers have a role to play in reforming curricula across disciplines to include modules focused on both soft skills and digital competencies. These efforts should align closely with the needs of the labor market.

Stronger partnerships between universities and industries can help co-develop learning pathways that reflect real-world applications of AI. Addressing the digital divide is also essential. Employers should improve higher education collaboration. Internships or real-world initiatives where students apply AI to business problems can bridge theory and practice. Along with technical talents, hiring should prioritize soft skills like adaptability and ethics. This study should be expanded using a number of methods, including comparative cross-national investigations of AI's impact on education. Investigating AI in vocational education and lifelong learning could enrich the discipline. Additionally, ethical frameworks are needed, especially for academic plagiarism, algorithmic transparency, and data protection. Students learn that while AI can improve efficiency and assistance, long-term competitiveness depends on critical thinking, creativity, and multidisciplinary approaches. Engaging in technical and humanistic subjects will help students adjust to a changing workforce worldwide.

References

Ahmad, N., Murugesan, S., and Kshetri, N. 2023. Generative artificial intelligence and the education sector. Computer 56 (6): 72-76.

Almeida, A. J. 2007. Employability, work contexts and labour market in Portugal. Sísifo: educational sciences journal, (2), 51-58.

Andrewson, J., and Mitchell, H. 2006. Employability for students: How to get the best from your education course. Escalate, Higher Education Academy Education Subject Centre, University of Bristol.

Anis, S., and French, J. A. 2023. Efficient, explicatory, and eqAItable: Why qualitative researchers should embrace AI, but cautiously. Business and Society 62 (6): 1139–1144.

Association of Graduate Careers Advisory Services (AGCAS), 2007. What do graduates do? Availbale from http://www.prospects.ac.uk/cms/ShowPage/ Home_page/ What_do_graduates_do__2007/p!eaLidbl.

Association of Graduate Careers Advisory Services (AGCAS). 2007. What do graduates do?

Awad, E., and Kröger, J. 2020. The responsible use of AI: Ethical concerns and practical solutions. AI and Society 35 (3): 637-650.

Baldegger, R., Caon, M., and Sadiku, K. 2020. Correlation between entrepreneurial orientation and implementation of AI in human resource management (HRM). Technology Innovation Management Review 10 (4): 72-79.

Baltà-Salvador, R., El-Madafri, I., Brasó-Vives, E., and Peña, M. 2025. Empowering engineering students through artificial intelligence (AI): Blended human–AI creative ideation processes with ChatGPT. Computer Applications in Engineering Education, 33(1), e22817.

Barrera, A. 2017. Social economy and critical thinking: Apontes for the analysis of the current scenario. Labor and Sociedad, 29, 517-535.

Baruch Y. 2001. Employability: A substitute for loyalty? Human Resource Development International, Volume http://www.informaworld.com/smpp/ title%7Econtent=t713701210%7Edb=all%7Etab=issueslist%7Ebranches=4–v44, (4), 543–566.

Baruch, Y. 2001. Employability: A substitute for loyalty? Human Resource Development International 4 (4): 543–566.

Bay, M., and McKeage, K. 2006. Improving soft skills and cognitive flexibility through an interdisciplinary approach. Journal of General Education 55 (1): 57–74.

Berntson, E., Sverke, M., and Marklund, S. 2006. Predicting perceived employability: human capital or labour market opportunities?. Economic and Industrial democracy 27 (2): 223-244.

Bozkurt, A. 2023. Generative artificial intelligence (AI) powered conversational educational agents: The inevitable paradigm shift. Asian Journal of Distance Education, 18(1).

Brown, P., Hesketh, A., and Williams, S. 2004. The mismanagement of talent: Employability and jobs in the knowledge economy. Oxford University Press, USA.

Brynjolfsson, E., and McAfee, A. 2014. The second machine age: Work, progress, and prosperity in a time of brilliant technologies. W. W. Norton and Company.

Buchholz, K. 2023. ChatGPT sprints to one million users. Statista. com. Available online at: https://www. statista.

com/chart/29174/time-to-one-million-users/(accessed March 1 2025).

Campos, D. B., de Resende, L. M. M., and Fagundes, A. B. 2020. The importance of soft skills for the engineering. Creative Education, 11, 1504-1520.

Carlini, N., Tramer, F., Wallace, E., Jagielski, M., Herbert-Voss, A., Lee, K.,.. and Raffel, C. 2021. Extracting training data from large language models. In 30th USENIX security symposium (USENIX Security 21) (2633-2650).

Carvalho, S. W., and de Oliveira Mota, M. 2010. The role of trust in creating value and student loyalty in relational exchanges between higher education institutions and their students. Journal of marketing for higher education 20 (1): 145-165.

Cascini, G., Nagai, Y., Georgiev, G. V., et al. 2022. Perspectives on design creativity and innovation research: 10 years later. International Journal of Design Creativity and Innovation 10 (1): 1–30.

Castelli, M., and Manzoni, L. 2022. Generative models in artificial intelligence and their applications. Applied Sciences 12 (9): 4127.

Cazzaniga and others. 2024. "Gen-AI: Artificial Intelligence and the Future of Work." IMF Staff Discussion Note SDN2024/001, International Monetary Fund, Washington, DC.

Cooper, G. 2023. Examining science education in ChatGPT: An exploratory study of generative artificial intelligence. Journal of science education and technology 32 (3): 444-452.

Cox, S., and King, D. 2006. Skill sets: An approach to embed employability in course design. Education + Training 48 (4): 262–274.

Crawford, E. R., LePine, J. A., and Rich, B. L. 2010. Linking job demands and resources to employee engagement and burnout: A theoretical extension and meta-analytic test. Journal of Applied Psychology 95 (5): 834–848.

Currie, G. M. 2023. Academic integrity and artificial intelligence: Is ChatGPT hype, hero or heresy? Seminars in Nuclear Medicine 53 (5): 719–730.

Darwin, D., Rusdin, D., Mukminatien, N., Suryati, N., Laksmi, E. D., and Marzuki. 2024. Critical thinking in the AI era: An exploration of EFL students' perceptions, benefits, and limitations. Cogent Education 11 (1): 2290342.

Davis, F. D. 1989. Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Quarterly 13 (3): 319-340.

De Grip, A., van Loo, J., and Sanders, J. 2004. The industry employability index: Taking account of supply and demand characteristics. International Labour Review 143 (3): 211–233.

De Prada, E., Mareque, M., and Pino-Juste, M. 2022. Teamwork skills in higher education: Is university training contributing to their mastery? Psicologia: Reflexão e Crítica 35 (5): 1-13. https://doi.org/10.1186/s41155-022-00207-1

Dogara G., Bin Saud M. S., Bin Kamin Y., et al. 2019. Developing soft skills through project-based learning in technical and vocational institutions. International Jrnl. of Recent Tech. and Engineering 8(3): 5872–5877.

Dwivedi, Y. K., Hughes, L., and Baabdullah, A. M. 2023. Artificial intelligence (AI) adoption: Examining the role of user perceptions and societal implications. Technological Forecasting and Social Change, 190, 122359.

Dwivedi, Y. K., Kshetri, N., Hughes, L., Slade, E. L., Jeyaraj, A., Kar, A. K.,.. and Wright, R. 2023. Opinion Paper:"So what if ChatGPT wrote it?" Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy. International journal of information management, 71, 102642.

Dzindolet, M. T., Pierce, L. G., Beck, H. P., and Dawe, L. A. 2002. The perceived utility of human and automated aids in a visual detection task. Human factors 44 (1): 79-94.

Ejjami, R. 2024. Integrative Literature Review 5.0: Leveraging AI and Emerging Technologies to Redefine Academic Research. International Journal for Multidisciplinary Research, 6(5).

Eke, D. O. 2023. ChatGPT and the rise of generative AI: Threat to academic integrity? Journal of Responsible Technology, 13, 100060.

El-Tabal, A. A. A. 2020. Soft skills and its impact on organizational creativity – A field study. Journal of Business and Retail Management Research 14 (3): 78-86.

Epstein, Z., Hertzmann, A., Investigators of Human Creativity, Akten, M., Farid, H., Fjeld, J., and Smith, A. 2023. Art and the science of generative AI. Science, 3806650., 1110-1111.

Escolà-Gascón, Á., and Gallifa, J. 2022. How to measure soft skills in the educational context: Psychometric properties of the SKILLS-in-ONE questionnaire. Studies in Educational Evaluation, 74, 101155.

Faraj, A. O. K. 2022. A proposal to employ artificial intelligence applications in developing Prince Sattam Bin Abdulaziz University students' future skills. Education Research International, 2022, 6433372.

Floridi, L. and Cowls, J. 2019. A unified framework of five principles for AI in society. Harvard Data Science Review, 1(1).

Fogel, A. L. and Kvedar, J. C. 2018. Artificial intelligence powers digital medicine. NPJ digital medicine 1 (1): 5.

Forrier, A., and Sels, L. 2003. The concept employability, a complex mosaic, International Journal of Human Resources Development and Management 3 (2): 102–104.

Fugate, M., Kinicki, A. J., and Ashforth, B. E. 2004. Employability: A psycho-social construct, its dimensions, and applications. Journal of Vocational Behavior, 65, 14–38.

Galxon, A., Costa, A., and Kallick, B. 2016. Dispositions: Reframing teaching and learning. Corwin Press.

Gedye, S., Fender, E., and Chalkley, B. 2004. Students' undergraduate expectations and post-graduation experiences of the value of a degree. Journal of Geography in Higher Education 28 (3): 381–396.

Geyskens, I., Steenkamp, J. B. E., and Kumar, N. 1999. A meta-analysis of satisfaction in marketing channel relationships. Journal of marketing Research 36 (2): 223-238.

Giese, J. L. and Cote, J. A. 2000. Defining consumer satisfaction. Academy of marketing science review 1 (1): 1-22.

Gough 2008. Problems in valuing graduate careers, Conference Paper 0067, Proceedings of Society for Research in Higher Education (SRHE) Annual Conference, Liverpool.

Gough, B. 2008. Problems in valuing graduate careers. Conference Paper 0067, Proceedings of Society for Research in Higher Education (SRHE) Annual Conference, Liverpool.

Goulart, V. G., Liboni, L. B., and Cezarino, L. O. 2021. Balancing skills in the digital transformation era: The future of jobs and the role of HE. Industry and Higher Education, doi:10.1177/09504222211029796

Gul, R. 2014. The relationship between reputation, customer satisfaction, trust, and loyalty. Journal of Public Administration and Governance 4 (3): 368-387.

Hair, J. F., Hult, G. T. M., Ringle, C. M., and Sarstedt, M. 2022. A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM) (3rd ed.). Sage Publications.

Hay, A., and Hodgkinson, M. 2006. Exploring MBA career success. Career Development International 11 (2): 108–124.

He, C., Teng, R., and Song, J. 2023. Linking employees' challenge-hindrance appraisals toward AI to service performance: The influences of job crafting, job insecurity and AI knowledge. International Journal of Contemporary Hospitality Management 36 (3): 975–994.

Hillage, J. and Pollard, E. 1998. Employability: developing a framework for policy analysis (Vol. 107). London: DfEE.

Hooda, M., Rana, C., Dahiya, O., Rizwan, A., and Hossain, M. S. 2022. Artificial intelligence for assessment and feedback to enhance student success in higher education. Mathematical Problems in Engineering, 2022, 5215722.

Hruby, V. 2024. Exploring AI Adoption Dynamics and Entrepreneurial Orientation in Czech Chemical SMEs: A Pilot Study Perspective. Scientific Papers of the University of Pardubice, Series D: Faculty of Economics and Administration.

Hung, L. and Sun, K. 2020. How Will AI Change/Impact Management and Business World. Artificial Intelligence and Its Impact on Business, 17-37.

Hurrell, S. A., Scholarios, D., and Thompson, P. 2013. More than a feeling: The role of emotions in negotiating the transition to new employment. Human Relations, Volu. 66 (Issue 6), 869–888.

Ilori M. O. and Ajagunna I. 2020. Re-imagining the future of education in the era of the fourth industrial revolution. Worldwide Hospitality and Tourism Themes Vol. 12 (Issue 1): 3–12.

Jeyarani, M. and Al-Busaidi, A. 2023. New role of leadership in AI era: Educational sector. SHS Web of Conferences, 156, 09005.

Jo, A. 2023. The promise and peril of generative AI. Nature 614 (1): 214-216.

Jurczuk, A., and Florea, A. 2022. Future-oriented digital skills for process design and automation. Human Technology 18 (2): 122–142.

Kahneman, D. 2011. Thinking, fast and slow. Farrar, Straus and Giroux.

Kasneci, E., Seßler, K., Küchemann, S., Bannert, M., Dementieva, D., Fischer, F.,.. and Kasneci, G. 2023. ChatGPT for good? On opportunities and challenges of large language models for education. Learning and individual differences, 103, 102274.

Kaul, V., Enslin, S., and Gross, S. A. 2020. History of artificial intelligence in medicine. Gastrointestinal endoscopy 92 (4): 807-812.

Kelchevskaya N. R. and Shirinkina E. V 2019. Regional determinants of effective use of human capital in the digital economy. Economy of Region Vol. 15 (Issue 2): 465–482.

Kelly, S., Kaye, S. A., and Oviedo-Trespalacios, O. 2023. What factors contribute to the acceptance of artificial intelligence? A systematic review. Telematics and Informatics, 77, 101925.

Khalifa, M. and Liu, V. 2004. The state of research on information system satisfaction. Journal of Information Technology Theory and Application (JITTA) 5 (4): 4.

Kim, J. W., Messerschmidt, M., and Graves, W. S. 2022. Enhancement of Partially Coherent Diffractive Images Using Generative Adversarial Network. AI 3 (2): 274-284.

Kim, J. and Maher, M. L. 2023. The effect of AI-based inspiration on human design ideation. International Journal of Design Creativity and Innovation 11 (2): 81–98.

Kim, K. J. and Frick, T. W. 2011. Changes in student motivation during online learning. Journal of Educational Computing Research 44 (1): 1-23.

Kline, R. B. 2015. Principles and Practice of Structural Equation Modeling (4th ed.). The Guilford Press.

Koivisto, M. and Grassini, S. 2023. Best humans still outperform artificial intelligence in a creative divergent thinking task. Scientific Reports, 13, 13601.

Kurbanov, R. A., Belyalova A. M., Yarygina N. A., et al. 2020. Student attitude to future profession in field of IT at university training stage. International Jrnl. of Psychosocial Rehabilitation Vol.24 (Issue 4):5019–5026.

Lane, D., Puri, A., Cleverly, P., Wylie, R., and Rajan, A. 2000. Employability: Bridging the Gap Between Rhetoric and Reality; Second Report: Employee's Perspective. London: Create Consultancy/Professional Development

Foundation. Li F., Ding X. et Morgan WJ 2009. Higher education and the starting wages of graduates in China, International Journal of Educational Development, 29, 374-381.

Langer, M. and Landers, R. N. 2021. The future of AI in workplace decision-making: Trust and skepticism. Computers in Human Behavior, 125, 106955.

Lee, H. K. 2022. Rethinking creativity: Creative industries, AI and everyday creativity. Media, Culture and Society 44 (3): 601–612.

Leitch S. (Ed.). 2006. Leitch review of skills: Prosperity for all in the global economy – world class skills (final report), HMSO/HM Treasury, London, ISBN10: 0-11-840486-5.

Leitch, S. (Ed.). 2006. Leitch review of skills: Prosperity for all in the global economy – World class skills (Final Report). HMSO/HM Treasury.

Li, F., Ding, X., and Morgan, W. J. 2009. Higher education and the starting wages of graduates in China. International Journal of Educational Development, 29, 374–381.

Lim, W. M., Gunasekara, A., Pallant, J. L., Pallant, J. I., and Pechenkina, E. 2023. Generative AI and the future of education: Ragnarök or reformation? A paradoxical perspective from management educators. The international journal of management education 21 (2): 100790.

Liu, B., Hu, M., and Cheng, J. 2012. Opinion observer: Analyzing and comparing opinions on the Web. Proceedings of the 14th International Conference on World Wide Web (342-351).

Liu, Y., Yang, Z., Yu, Z., Liu, Z., Liu, D., Lin, H., and Shi, S. 2023. Generative artificial intelligence and its applications in materials science: Current situation and future perspectives. Journal of Materiomics 9 (4): 798-816.

Lodge, J. M., Thompson, K., and Corrin, L. 2023. Mapping out a research agenda for generative artificial intelligence in tertiary education. Australasian Journal of Educational Technology 39 (1): 1-8.

Louie, R., Coenen, A., Huang, C. Z., Terry, M., and Cai, C. J. (2020, April). Novice-AI music co-creation via AI-steering tools for deep generative models. In Proceedings of the 2020 CHI conference on human factors in computing systems (1-13).

Lv, Z. 2023. Generative artificial intelligence in the metaverse era. Cognitive Robotics, 3, 208-217.

Maedche, A., Legner, C., Benlian, A., Berger, B., Gimpel, H., Hess, T., and Söllner, M. 2019. AI-based digital assistants: Opportunities, threats, and research perspectives. Business and Information Systems Engineering, 61, 535-544.

Majid, S., Eapen, C. M., Aung, E. M., and Oo, K. T. 2019. The Importance of Soft Skills for Employability and Career Development: Students and Employers' Perspectives. IUP Journal of Soft Skills, 13(4).

Malakul, S. and Park, I. 2023. The effects of using an auto-subtitle system in educational videos to facilitate learning for secondary school students: learning comprehension, cognitive load, and satisfaction. Smart Learning Environments 10 (1): 4.

Manheim, K. and Kaplan, L. 2019. Artificial intelligence: Risks to privacy and democracy. Yale JL and Tech., 21, 106.

McCardle, S., Waters, L., Briscoe, J. P., and Hall, D. T. 2007. Employability during unemployment: Adaptability, career identity, and human and social capital. Journal of Vocational Behavior, 71, 247–264.

McClure, P. K. 2018. "You're fired, " says the robot: the rise of automation in the workplace, technophobes, and fears of unemployment. Social Science Computer Review 36 (2): 139-156.

McKnight, D. H., Choudhury, V., and Kacmar, C. 2002. Developing and validating trust measures for e-commerce: An integrative typology. Information Systems Research 13 (3): 334-359.

McMullan, R. and Gilmore, A. 2003. The conceptual development of customer loyalty measurement: A proposed scale. Journal of Targeting, Measurement and Analysis for Marketing, 11, 230-243.

Meireles, M. C. and Bonifácio, B. 2015. Use of agile methods and problem-based learning in software engineering teaching: An experience report. In 8th Brazilian Product Development Management Congress (180-189). Cairó: IFRN.

Morse, S. M. 2006. Assessing the value: Work based learning placements for post-graduate human resource development students, Journal of. European Industrial Training 30 (9): 735–755.

Mulgan, T. 2016. Superintelligence: Paths, dangers, strategies.

Muller, M.; Chilton, L.B.; Kantosalo, A.; Martin, C.P.; Walsh, G. 2022. GenAICHI: Generative AI and HCI. Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems Extended Abstracts, New Orleans, LA, USA, 29 April–5 May 2022; 1–7.

OCDE. 2016. Resport titled: Skills for a digital world: 2016 OECD Ministerial Meeting on the Digital Economy. OECD Publishing.

Ouyang, F., Zheng, L., and Jiao, P. 2022. Artificial intelligence in online higher education: A systematic review of empirical research from 2011 to 2020. Education and Information Technologies 27 (6): 7893-7925.

Paraponaris, A., Saliba, B., and Ventelou, B. 2005. Obesity, weight status and employability: Empirical evidence from a French national survey. Economics and Human Biology 3 (2): 241–258.

Pavlik, J. V. 2023. Collaborating with ChatGPT: Considering the implications of generative artificial intelligence for journalism and media education. Journalism and mass communication educator 78 (1): 84-93.

Qadir, J. (2023, May). Engineering education in the era of ChatGPT: Promise and pitfalls of generative AI for

education. In 2023 IEEE global engineering education conference (EDUCON) (1-9).

QAInn, S., Hogan, M., Dwyer, C., Finn, P., and Fogarty, E. 2020. Development and validation of the student-educator negotiated critical thinking dispositions scale (SENCTDS). Thinking Skills and Creativity 38 (4): 100710–17.

Rolnick, D., Donti, P. L., Kaack, L. H., Kochanski, K., Lacoste, A., Sankaran, K.,.. and Bengio, Y. 2022. Tackling climate change with machine learning. ACM Computing Surveys (CSUR) 55 (2): 1-96.

Rothwell, A. and Arnold, J. 2007. Self-perceived employability: Development and validation of a scale. Personnel Review 36 (1): 23–41.

Rothwell, A., Herbert, I., and Rothwell, F. 2008. Self perceived employability: Construction and initial validation of a scale for university students. Journal of Vocational Behavior 73 (1): 1–12.

Russell, S. J. and Norvig, P. 2016. Artificial intelligence: a modern approach. Pearson.

Schyns, B., Torka, N., and Gösling, T. 2007. Turnover intention and preparedness for change: Exploring leader-member exchange and occupational self-efficacy as antecedents of two employability predictors. Career Development International 12 (7): 660–679.

Secinaro, S., Calandra, D., Secinaro, A., Muthurangu, V., and Biancone, P. 2021. The role of artificial intelligence in healthcare: a structured literature review. BMC medical informatics and decision making, 21, 1-23.

Selwyn, N. 2022. Education and AI: The ongoing transformation of learning environments. Learning, Media and Technology 47 (1): 1-18.

Shanta, S. and Wells, J. G. 2022. T/E design-based learning: Assessing student critical thinking and problem-solving abilities. International Journal of Technology and Design Education 32 (1): 267–285.

Shin, D. 2021. The effects of explainability and causability on perception, trust, and acceptance: Implications for explainable AI. International Journal of Human-Computer Studies, 154, 102684.

Siau, K. and Wang, W. 2018. Building trust in artificial intelligence, machine learning, and robotics. Cutter business technology journal 31 (2): 47.

Somiá, T. and Vecchiarini, M. 2024. Navigating the new frontier: The impact of artificial intelligence on students' entrepreneurial competencies. International Journal of Entrepreneurial Behavior and Research 30 (11): 236-260.

Su, J. and Yang, W. 2023. Unlocking the power of ChatGPT: A framework for applying generative AI in education. ECNU Review of Education 6 (3): 355-366.

Thijssen, J. G. L., Van der Heijden, B. I. J. M., and Rocco, T. 2008. Toward the Employability-Link Model: Current Employment Transition to Future Employment Perspectives. Human Resource Development Review 7 (2): 165–183.

Tomé, E. 2007. Employability, skills and training in Portugal (1988–2000): Evidence from official data. Journal of European Industrial Training 31 (5): 336–357.

Tyagi, A. K., Fernandez, T. F., Mishra, S., and Kumari, S. (2020, December). Intelligent automation systems at the core of industry 4.0. In International conference on intelligent systems design and applications (1-18). Cham: Springer International Publishing.

Van Dam, K. 2004. Antecedents and consequences of employability orientation. European Journal of Work and Organizational Psychology 13 (1): 29–51.

Vasilescu M. D., Serban A. C., Dimian G. C., et al. 2020. Digital divide, skills and perceptions on digitalisation in the European Union—towards a smart labour market. PLoS ONE 15 (Issue 4): e0232032.

Venkatesh, V. and Davis, F. D. 2000. A theoretical extension of the technology acceptance model: Four longitudinal field studies. Management Science 46 (2): 186-204.

Vert, J. P. 2023. How will generative AI disrupt data science in drug discovery?. Nature Biotechnology 41 (6): 750-751.

Wei, J., Wang, X., Schuurmans, D., Bosma, M., Xia, F., Chi, E., and Zhou, D. 2022. Chain-of-thought prompting elicits reasoning in large language models. Advances in neural information processing systems, 35, 24824-24837.

Weisz, J. D., Muller, M., Houde, S., Richards, J., Ross, S. I., Martinez, F., and Talamadupula, K. (2021, April). Perfection not required? Human-AI partnerships in code translation. In Proceedings of the 26th International Conference on Intelligent User Interfaces (402-412).

Wheeler, J. 2016. Emotional intelligence and leadership: A review of the progress, controversy, and criticism. Journal of Management Development, Vol. 35 (Issue 2), 310–324.

Wingström, R., Hautala, J., and Lundman, R. 2022. Redefining creativity in the era of AI? Perspectives of computer scientists and new media artists. Creativity Research Journal 36 (2): 177–193.

World Economic Forum. 2020. The Future of Jobs Report 2020. Retrieved online from the official website:

Xia, Q., Chiu, T. K., and Chai, C. S. 2023. The moderating effects of gender and need satisfaction on self-regulated learning through Artificial Intelligence (AI). Education and Information Technologies 28 (7): 8691-8713.

Yilmaz, R. and Yilmaz, F. G. K. 2023. The effect of generative artificial intelligence (AI)-based tool use on students' computational thinking skills, programming self-efficacy and motivation. Computers and Education: Artificial Intelligence, 4, 100147.

Zhiwen, G. and van der Heijden, B. I. J. M. 2008. Employability enhancement of business graduates in China. Education + Training 50 (4): 289–304.

Zhou, X., Li, Y., and Zhu, X. 2023. Misinformation in AI-generated content: A growing challenge for trust in digital technologies. Journal of AI Research 67 (1): 101-123.

South East European Journal of Economics and Business
Volume 20 (2) 2025, 100-119
DOI: 10.2478/jeb-2025-0021

IS CULTURAL DISTANCE BENEFICIAL? EVIDENCE FROM OUTWARD FDI FLOWS IN AN EMERGING MARKET CONTEXT

Emre Bilgiç, Fevzi Ölmez, Ines Kersan Skabic

Abstract

This research explores the impact of cultural distance (CD) on Türkiye's outward foreign direct investment (OFDI) by examining Hofstede's six cultural dimensions, focusing on a country that shares several similarities with other Southeast European (SEE) countries. Using panel ordinary least squares, random effect, and quantile regression models, the study analyzes Türkiye's OFDI to 26 partner countries from 2001 to 2022. The findings reveal a statistically significant positive effect of CD on OFDI, consistent across all cultural dimensions. This research enhances the limited literature on the relationship between CD and OFDI in Türkiye. The divergent findings provide new insights, highlighting the importance of understanding the nuanced dynamics between CD, cultural incongruence, and cultural conflicts in FDI. These results underscore the necessity for a contextual approach in examining the interplay between cultural factors and FDI, offering a more comprehensive understanding of how CD influences OFDIs.

Key Words: *Cultural Distance, Outward FDI, Türkiye, Panel Quantile Regression*

JEL Classification*: A13, E02, F21*

Emre Bilgiç [a]
Assistant Professor, Department of International Trade and Business, Faculty of Economics and Administrative Sciences, İzmir Bakircay University, 35000, İzmir, Türkiye,
E-mail: emre.bilgic@bakircay.edu.tr
ORCID: 0000-0003-1392-5320

Fevzi Ölmez [b] (Corresponding Author)
Research Assistant, Department of International Trade and Business, Faculty of Economics and Administrative Sciences, İzmir Bakircay University, Address: Gazi Mustafa Kemal Neighbourhood, Kaynaklar Street, 35665, Seyrek / Menemen / İzmir / Türkiye.
E-mail: fevzi.olmez@bakircay.edu.tr
ORCID: 0000-0003-3847-2778

Ines Kersan Skabic [c]
Professor, Department of National and International Economics, Faculty of Economics and Tourism "Dr. Mijo Mirkovic", Juraj Dobrila University of Pula, 52100, Pula, Croatia
E-mail: ikersan@unipu.hr
ORCID: 0000-0001-7905-368X

1. INTRODUCTION

In consideration of FDIs, one of the central topics is the analysis of factors that influence a host country's attractiveness to foreign investors, that comprises the economic and institutional determinants. This article aims to contribute to literature by focusing on one such institutional factor - cultural distance (CD) - as a determinant of FDIs, exploring its implications in greater depth.

Within the scope of FDI, culture has been explored through various conceptualizations, including: cultural similarity, cultural proximity, cultural attractiveness, and CD (Johanson and Vahlne 1977; Li, Zhao, and Shen 2017; Fiorini et al. 2021). Culture constitutes a component of investment risk, it is closely associated with trust and value systems, and contributes to transaction costs. Cultural differences can influence individual behavior and, in turn, pose challenges for conducting business internationally. The literature addresses this

issue through the concept of CD, defined as the extent to which the shared norms and values in one country differ from those in another (Kogut and Singh 1988). The most widely used approaches to measure CD are those introduced by Hofstede (1984) and Hofstede and Minkov (2010).

There is no definitive evidence supporting either a consistently positive or negative impact of CD on FDIs (Kim and Gray 2009). This ambiguity arises from the context-dependent nature of CD, implying that its significance may vary across investor countries.

Therefore, this paper seeks to contribute to literature by providing a detailed analysis of the influence of CD on Turkish OFDIs. Türkiye, an emerging market, represents a compelling case as a country that aspires to align with Western norms while retaining distinct cultural foundations making Türkiye a unique context for examining the relationship between CD and FDIs. Only a limited number of studies have considered culture as a significant explanatory variable (Adamoglou and Kyrkilis 2018) of FDI in/from Türkiye. Moreover, when CD is incorporated into the analysis, these studies typically focus on a broader set of host countries rather than Türkiye specifically (Kayalvizhi and Thenmozhi 2018; Steigner, Riedy, and Bauman 2019; Kristjánsdóttir and Karlsdóttir 2020). This reveals a notable gap in literature concerning the role of CD in FDIs of Türkiye. In response, this study focuses on a more multifaceted analysis of CD using the dimensions proposed by Hofstede (2010).

The contributions of this paper are threefold: (i) by examining the underexplored relationship between CD and FDI, the study contributes to the advancement of literature; (ii) the focus on Türkiye offers a context-specific perspective that may generate novel insights; and (iii) the findings will provide actionable knowledge for MNCs and other stakeholders seeking to establish or expand economic ties with Türkiye. To offer a comprehensive understanding and generate robust results, this study employs three econometric methods panel ordinary least squares (POLS), random effects (RE), and panel quantile regression (PQ).

2. LITERATURE REVIEW

FDI location choices have traditionally been explained within the framework of neoclassical economic theory (Behrman 1969). However, when the uncertainties and risks associated with investing abroad, as well as the institutional differences between home and host countries, are considered, the explanatory power of neoclassical models appears limited. Herein, it becomes crucial to consider the degree of similarity/divergence between the institutional environments of home and host countries, as these shape MNCs' FDI behavior (Johanson and Vahlne 1977). Accordingly, examining the role of culture-as a relatively underexplored institutional factor in FDIs-represents a meaningful effort to advance understanding of the determinants of FDI.

2.1. Understanding the Dimensions of Culture

Hofstede's cultural dimensions are among the most widely applied models for conceptualizing culture. Initially developed by Hofstede (1984) and expanded by Hofstede (2001) and Minkov (2007), the framework comprised six dimensions of national culture: uncertainty avoidance (UNAV), power distance (POWD), masculinity (MAS), individualism (IND), indulgence (INR) and time orientation (LTOR). These six dimensions and their relevance to business activities are summarized in Table 1. While each dimension carries

Table 1. Hofstede Cultural Dimensions

Dimensions	Explanation	Implications in Practice
POWD	It refers to the extent to which members of a culture expect and accept that power is distributed unequally in society.	It has implications in organizational structure, possibility of participative management, and leadership style.
IND	It is an indicator of the extent to which individuals are autonomous within society.	It has implications in decision making, reward systems and ethics&values in the organization.
MAS	It refers to the extent to which the dominant values in a society are related to masculine or feminine roles.	It has implications in motivation, networking and rewards valued by individuals.
UNAV	It refers to the extent to which members of a society can adapt to situations that are uncertain or not clearly defined and structured.	It has implications in attitudes towards corporate planning, budgeting, control systems and risk taking.
LTOR	It is about how long a period the expectations, goals and plans of individuals in a society cover in the future.	It has implications in the level of focus on past and traditions, duration of plans, and resistance to change.
INR	It is an indicator of the extent to which human impulses are normalized in a society.	It has implications in auditing and obedience to rules.

distinct practical implications, they collectively illustrate how societies address fundamental challenges they encounter. As such, these dimensions are considered influential in shaping the behaviors and decision-making processes of individuals and organizations, including those related to FDI.

2.2. The Concept of Cultural Distance and Its Influence on FDIs

The concept of distance began to attract attention in the 1970s, notably through the notion of psychic distance within the framework of the Uppsala internationalization model (Johanson and Wiedersheim-Paul 1975). Kogut and Singh (1988) introduced the concept of CD by converting Hofstede's (1984) national culture dimensions into a composite index. CD is defined as the extent to which the shared norms and values in one country differ from those in another (Kogut and Singh 1988). Theoretically, it is argued that greater CD between home and host countries impedes FDIs due to diminished social legitimacy and increased information and management costs (Grosse and Trevino 1996; Yiu and Makino 2002). However, empirical evidence remains mixed (Nayak and Scheib 2020, Kapás and Czeglédi 2020). In a meta-analysis, Bailey (2018) found that CD reduces a country's attractiveness for FDI and negatively impacts IFDIs. Regarding Hofstede's cultural dimensions, some studies utilize the raw scores provided by Hofstede Insights, while others incorporate these scores into measures of CD (Kayalvizhi and Thenmozhi 2018; Steigner, Riedy, and Bauman, 2019; Izadi, Rashid, and Izadi, 2023). Tang (2012) demonstrated that CD in POWD, UNAV, and MAS discourages FDI, while CD in IND promotes it. Conversely, Kristjánsdóttir and Karlsdóttir (2020) found that CD, measured by POWD, IND, MAS, and UNAV, has an insignificant effect on OFDIs. Findings in literature remain inconclusive, highlighting the need for a more contextualized understanding of the relationship between CD and FDI.

2.3. Determinants of FDI Flows in Türkiye

Studies on FDIs in Türkiye have mainly focused on macroeconomic determinants (Aybar 2016; Binatlı and Sohrabji 2019; Khudari, Sapuan, and Fadhil 2021), while the institutional environment has been examined to a relatively lesser extent (Acaravci et al. 2018; Heavilin and Songur 2020). Also, the culture as determinant of FDIs has been rarely examined. Demirbag, Tatoglu, and Glaister (2009) provided the analysis based on foreign affiliates of Turkish MNEs and found no evidence supporting the effect of CD on the equity ownership mode of Turkish MNEs. Aybar (2016) identified a significant and negative relationship between cultural proximity and Turkish OFDI, treating cultural proximity as a single variable and analyzing data for 14 countries over the period 2002–2011. The present study distinguishes itself from these earlier works in terms of sample size, time frame, and the comprehensiveness with which it conceptualizes CD.

2.4. Hypotheses Development

The concept of psychic distance (including CD) was first popularized by the Uppsala School and is frequently employed to explain both export behavior and FDIs (Johanson and Wiedersheim-Paul 1975). The central argument is that MNEs' ability to recognize and assess business opportunities in foreign markets is impeded by factors that disrupt the flow of information between countries. These disruptions not only reduce awareness but also heighten risk by increasing the likelihood of misinterpreting/mismanaging opportunities. Herein, CD emerges as a factor that elevates both information and management costs. Furthermore, CD creates challenges related to social legitimacy; as the cultural gap widens, it becomes increasingly difficult for MNEs to understand and relate to local populations (Yiu and Makino 2002), thereby complicating the execution of FDI. Considering literature on the Uppsala model and the role of social legitimacy, the research hypotheses are:

> H1: As the CD (in terms of IND; INR; LTOR, MAS, POWD and UNAV) increases, OFDIs of Türkiye decreases towards the host country.

3. DATA AND RESEARCH METHOD

The study investigates the role of CD on Türkiye's OFDIs to its twenty-six partner countries Algeria, Austria, Azerbaijan, Belgium, Brazil, Bulgaria, China, Egypt, France, Georgia, Germany, Indonesia, Iran, Jordan, Kazakhstan, Luxembourg, Malta, the Netherlands, Pakistan, Russia, Saudi Arabia, Spain, Switzerland, Tunisia, the United Kingdom and the United States. Data sources vary according to availability and empirical analysis covers the annual period 2001-2022 (Table 2).

By considering variables' integration degrees, we initialize our research by employing POLS under the assumptions that there are no omitted variables

Table 2. Variable Definition

Variable	Definition	Source
lnOFDI	OFDI per share of each partner in Türkiye's total OFDI	Central Bank of the Republic of Türkiye
lnGDP	Real GDP of each partner country	World Bank
lnBREX	The real bilateral exchange rate between Türkiye and its each partner country	World Bank
CPI	Consumer price index of Türkiye and its twenty-six FDI partners countries	International Monetary Fund
lnIND	Individualism vs collectivism	https://www.hofstede-insights.com
lnINR	Indulgence vs restraint	https://www.hofstede-insights.com
lnLTOR	Long-term orientation vs short-term normative orientation	https://www.hofstede-insights.com
lnMAS	Masculinity vs femininity	https://www.hofstede-insights.com
lnPOWD	Power distance index	https://www.hofstede-insights.com
lnUNAV	Uncertainty avoidance index	https://www.hofstede-insights.com

and heteroscedasticity in error term. We establish six different models to block correlation between independent variables in the context of national cultural dimension. Guiding Haq et al. (2018), Neves, Almeida, and Vieira (2022) and Izadi, Rashid, and Izadi (2023) studies, our theoretical models are as follows:

$$lnOFDI_{n,t} = \alpha_1 + \lambda_{11} lnGDP_{n,t} + \lambda_{12} lnBREX_{n,t} + \lambda_{13} lnIND_{n,t} + u_{1t} \quad (1)$$

$$lnOFDI_{n,t} = \alpha_2 + \lambda_{21} lnGDP_{n,t} + \lambda_{22} lnBREX_{n,t} + \lambda_{23} lnINR_{n,t} + u_{2t} \quad (2)$$

$$lnOFDI_{n,t} = \alpha_2 + \lambda_{31} lnGDP_{n,t} + \lambda_{32} lnBREX_{n,t} + \lambda_{33} lnLTOR_{n,t} + u_{3t} \quad (3)$$

$$lnOFDI_{n,t} = \alpha_4 + \lambda_{41} lnGDP_{n,t} + \lambda_{42} lnBREX_{n,t} + \lambda_{43} lnMAS_{n,t} + u_{4t} \quad (4)$$

$$lnOFDI_{n,t} = \alpha_5 + \lambda_{51} lnGDP_{n,t} + \lambda_{52} lnBREX_{n,t} + \lambda_{53} lnPOWD_{n,t} + u_{5t} \quad (5)$$

$$lnOFDI_{n,t} = \alpha_6 + \lambda_{61} lnGDP_{n,t} + \lambda_{62} lnBREX_{n,t} + \lambda_{63} lnUNAV_{n,t} + u_{6t} \quad (6)$$

$$u_{k,t} = e_{k,t} + \delta_t + v_{k,t} \quad (7)$$

where $n(n=1,2,3,...,N)$ and $t(t=1,2,3,...,T)$ refer to cross-sections and time dimensions. For all models, $k(k=1,2,3,...,K)$ presents each model error term that includes $e_{k,t}$ (unobservable individual effects), δ_t (unobservable time effects) and $v_{k,t}$ (remainder residual). $lnOFDI_{n,t}$ is per share of each partner country in Türkiye's total real OFDIs. On the one hand, while $lnGDP_{n,t}$ states real GDP, $lnBREX_{n,t}$ denotes the real bilateral exchange rate between Türkiye and FDI partner countries. The lnBREX is defined as the number of domestic currencies per foreign currency, and it is transformed from nominal to real term according to consumer price indexes of partner countries. Cultural components are tested separately in each model to preserve their uniqueness and to reduce collinearity problems that may occur due to their high integration of these components (Izadi, Rashid, and Izadi 2023). To do this, we follow Kogut and Singh (1988) calculation technique for each cultural dimension namely $lnIND_{n,t}$ (individualism vs collectivism), $lnINR_{n,t}$ (indulgence vs restraint), $lnLTOR_{n,t}$ (long-term vs short-term orientation), $lnMAS_{n,t}$ (masculinity vs femininity), $lnPOWD_{n,t}$ (power distance index) and $lnUNAV_{n,t}$ (uncertainty avoidance index). Variables in the estimated models are used in natural logarithms.

In the predicted models, if the variables have their own unobservable individual and time effects, estimating these models with Fixed Effects (FE) or Random Effects (RE) model gives more consistent results[a]. It is appropriate to use the FE model to make inferences about the set of cross-sectional units and the RE model to make inferences about the population from which the cross-sectional data units come (Atici and Guloglu 2006). In other words, unobservable individual and time effects are correlated with explanatory variables, FE model should be performed. However, if this relation is not justified, the RE model gives more consistent results and should be performed (Erdem and Nazlioglu 2008). To specify the correct model form, there is a pre-testing Hausman Test proposed by Hausman and Taylor (1981) to determine whether there is a relationship between unobservable

individual with time effects and explanatory variables.

POLS estimator gives unbiased and consistent results if the following assumptions are satisfied: (i) the error term has zero mean and constant variance (homoscedasticity), (ii) the error term's distribution is normal, (iii) its normal distribution is identical (i, i, d). Nonetheless, satisfying the classical regression assumptions is difficult due to the complexity of socioeconomic data. Ignoring the socioeconomic data characteristic may be biased and inefficient POLS outcomes (Lin and Xu 2017). Moreover, classical linear regressions focus on the conditional mean value impact of independent variables on dependent variables. This fact may lead to under/overestimation of the relevant coefficient, and even failure to detect a significant relationship between the variables, if there is. However, PQ allows us to have several advantages over linear regressions. In first, there is no need for presumptions regarding the formation of the moment function. In second, this method relatively provides accurate and robust results when there are cases of outliers and fat tail distribution (Bera et al. 2016). In last, PQ also pays regard to normality and heteroscedasticity presumptions that error term may include. At this point, to avoid these assumptions and present a detailed picture of our research question we employ PQ that is proposed by Koenker and Bassett (1978) and equation is as below:

$$Q_{Y_{n,t}}(\tau|X_{n,t}) = X_{n,t}^{\tau}\,\gamma_{\tau} \tag{8}$$

where $Q_{Y_{n,t}}(\tau|X_{n,t})$ refers to the dependent variable's τth quantile, $X_{n,t}^{\tau}$ consists of explanatory variables as specified in previous models for τth quantile[b]. $\gamma\tau$ denotes the coefficients of independent variables in the τth quantile. To consider more disaggregated quantiles and reach detailed inferences, we determine the τ as ten decimal divisions.

4. EMPIRICAL FINDINGS

We conduct our empirical analysis in four-steps in three subsections namely POLS, RE and PQ results[c]. Initially, we begin with detecting variables' unit root or stationary properties to determine appropriate estimator. To do this, first generation Levin, Lin, and Chun (LLC, 2002) and Fisher-type ADF (Maddala and Wu 1999) tests are carried out, and our evidence illustrates that the null hypothesis of unit root is rejected for all variablesd at least in one model (Appendix Table A1).

4.1. POLS Results

We employ POLS, FE, and RE models to clarify which method tends to yield biased results, which one produces unbiased outcomes, which approach integrates elements of both biased and unbiased methodologies, and which method consistently delivers stable results. This approach gives us allowance to reach more accurate and reliable empirical outcomes to examine the impact of CDs on Türkiye's OFDIs to host countries. Herein, we utilize POLS under the assumption of there is no individual and time effects, cross-sectional dependence, and heteroscedasticity in the second step.

As depicted in Table 3, statistically significant effects on OFDIs of Türkiye are negatives for GDP, and positives for the lnBREX in all sample. Likewise, when the impacts of CDs are significantly positive for all except IND. 1% increase in the lnGDP of the host country leads to a 0.06% rise in lnOFDI in Model II, whereas it decreases by 0.22% and 0.12% in Model III and IV, respectively. Conversely, lnBREX exhibits a positive effect on lnOFDI. Across all models, a 1% appreciation in the lnBREX has resulted in an increase of 0.16%, 0.18%, 0.07%, 0.08%, 0.18%, and 0.18% in lnOFDI, respectively.

Regarding CDs, a positive relationship is observed between lnOFDI and CD with the host countries in terms of all culture dimensions. However, this

Table 3. POLS results

Variable	Model I	Model II	Model III	Model IV	Model V	Model VI
Constant	-5.958*** [-9.898]	-6.227*** [-9.897]	-3.980*** [-6.118]	1.909*** [3.293]	-0.570 [-1.048]	-4.260*** [-5.395]
lnGDP	0.039 [1.645]	0.058** [2.232]	0.000 [0.018]	-0.211*** [-10.846]	-0.115*** [-5.490]	-0.019 [-0.671]
lnBREX	0.162*** [6.536]	0.178*** [7.886]	0.070*** [4.056]	0.077*** [2.899]	0.180*** [7.979]	0.176*** [7.359]
lnIND	0.024 [1.986]					
lnINR		0.157*** [4.156]				
lnLTOR			0.641*** [10.768]			
lnMAS				0.456*** [10.093]		
lnPOWD					0.470*** [51.888]	
lnUNAV						0.061*** [4.189]
Obs.	572	572	572	572	572	572
PesaranCD	0.836	0.794	0.858	0.318	0.331	0.702
R^2	0.039	0.050	0.130	0.309	0.208	0.045

Note: "***", "**" and "*" denote the significance of the statistics in the models at the 1%, 5% and 10% levels. In the Pesaran_{CD} test introduced by Pesaran (2004), the null hypothesis, which suggests the absence of cross-sectional dependence, is not rejected in all models. The numbers in parentheses are the t-ratios. White cross-section (period cluster) is used for computing the coefficient standard errors.

relationship is only statistically insignificant in Model I. A 1% increase in lnINR, lnLTOR, lnMAS, lnPOWD, and lnUNAV leads to a respective increase of 0.16%, 0.64%, 0.46%, 0.47%, and 0.06% in lnOFDI.

4.2. RE Model Results

Excluding individual and time effects in analysis may bring biased results, potentially leading to erroneous economic policy decisions. To address this concern and account for unobserved characteristics and time-specific factors in our data, we first employ an F-test across all models. Additionally, we conduct the Hausman test proposed by Hausman and Taylor (1981) to determine whether these effects are best represented as fixed or random effects model. The test results reveal the presence of individual effects in cross-sections, with these effects being random in each model (Table 4). Consequently, we proceed to estimate the one-way RE model while considering individual effects in the series as the third step.

RE analyses have provided similar outcomes as in POLS predictions. Even though lnGDP effects are the same in Model III and IV, the number of statistically significant impacts of the lnBREX have decreased against before. Particularly, three CD variables have insignificant effects on lnOFDI, however, their overall robust impacts are positive in all models. The impact of lnGDP on lnOFDI exhibits a negative pattern across all models, although statistical significance is only observed in Model IV and Model V. 1% increase in lnGDP leads to a decrease of 0.25% and 0.19% in lnOFDI to these countries in Model IV and Model V, respectively. Conversely, the lnBREX demonstrates a positive effect on lnOFDI. Except Model IV, 1% appreciation in the lnBREX between Türkiye and its OFDI partners results in an increase of 0.24%, 0.24%, 0.18%, 0.23%, and 0.26% in lnOFDI, respectively.

Table 4. RE model results

Variable	Model I	Model II	Model III	Model IV	Model V	Model VI
Constant	-1.720 [-0.605]	-1.801 [-0.616]	-1.023 [-0.320]	2.968 [1.435]	1.475 [0.621]	0.577 [0.185]
lnGDP	-0.117 [-0.996]	-0.113 [-0.921]	-0.121 [-1.084]	-0.249*** [-3.422]	-0.187* [-1.984]	-0.190 [-1.591]
lnBREX	0.237** [2.205]	0.240** [2.439]	0.177** [2.118]	0.127 [1.331]	0.227** [2.527]	0.256*** [2.539]
lnIND	0.027 [0.390]					
lnINR		0.043 [0.198]				
lnLTOR			0.421 [1.166]			
lnMAS				0.455** [2.391]		
lnPOWD					0.483*** [10.624]	
lnUNAV						0.132** [2.528]
Obs.	572	572	572	572	572	572
PesaranCD	0.285	0.275	0.276	0.106	0.105	0.224
R²	0.009	0.009	0.013	0.044	0.027	0.013
Fcross-sections	48.720***	48.243***	44.787***	34.979***	41.306***	48.593***
Fperiod	-1.642	-1.614	-1.480	-1.288	-1.480	-1.687
Hausmanchi-square	4.367	4.862	5.649	4.260	3.795	2.241

Note: "***", "**" and "*" denote the significance of the statistics in the models at the 1%, 5% and 10% levels. In the $Pesaran_{CD}$ test introduced by Pesaran (2004), the null hypothesis, which suggests the absence of cross-sectional dependence, is not rejected in all models. The numbers in parentheses are the t-ratios. White cross-section (period cluster) is used for computing the coefficient standard errors. $F_{cross\text{-}sections}$ and F_{period} represent the unobserved individual and time effect test statistics. $Hausman_{chi\text{-}square}$ is the test for zero correlation between individual random effects and independent variables.

Similarly, consistent with the results obtained from the POLS analysis, we observe a positive relationship between OFDI and all culture dimensions. However, significant effects are only evident in Model IV, V and VI. Specifically, a 1% increase in lnMAS, lnPOWD, and lnUNAV leads to respective increases of 0.46%, 0.48%, and 0.13% in Türkiye's OFDI. When heteroscedasticity and non-linearity are present, conventional panel estimators may produce results that lack reliability. Additionally, methods solely focusing on providing the conditional expectation (mean value) might hinder the accurate assessment of the entire dataset. To address these limitations and yield more reliable and robust outcomes, we employ PQ alongside POLS and RE in the fourth step of our analysis. This approach allows us to present a comprehensive portrayal of the effects of lnGDP, lnBREX, and CDs on OFDIs from Türkiye, considering both heterogeneity and non-linearity in addition to the conditional expectation.

4.3. PQ Results

In fourth step, to enhance the comprehensibility of the PQ findings, we have segmented them into six models, mirroring the structure adopted previous approaches. The PQ has robust results consistent with those of previous estimators. In each model, almost all of lnGDP's significant effects are negative. Nevertheless, lnBREX positively affects lnOFDI in all quantiles, and a significant portion of these effects are positive. In other words, when Türkiye's national currency depreciates, FDIs increase. Similarly, the CD variables present robust results across all estimation methods. Almost all of their significant and/or insignificant effects are positive throughout models, and the signs of the effects remain the same even when the prediction method is changed. This suggests that increasing CD between the relevant sample and Türkiye promotes OFDI.

In Model I of the PQ analysis, a 1% rise in lnGDP is associated with a 0.08% decline in lnOFDI from Türkiye to countries experiencing high IFDIs (Table 5). Conversely, a 1% appreciation in lnBREX yields an increase in lnOFDI ranging from 0.14% to 0.28% across all quantiles, irrespective of the magnitude of OFDIs from Türkiye. Notably, this relationship exhibits greater elasticity in countries with substantial IFDIs (in high quantiles). Likewise, the impact of lnIND on lnOFDI is consistently positive and significant across all quantiles. Specifically, a 1% surge in lnIND leads to a corresponding lnOFDI increase ranging from 0.17% to 0.66%. Interestingly, it is observed that lnIND exerts a more pronounced influence on lnOFDI as the levels of IFDIs in recipient countries ascend from the 0.10 to the 0.90 quantile range.

Table 5. Model I and Model II PQ Results

	Variable	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90
MODEL I	*Constant*	-8.752** [-2.039]	-3.149* [-1.695]	-4.605*** [-2.960]	-4.727*** [-3.279]	-5.252*** [-4.162]	-4.675*** [-3.737]	-2.432** [-2.032]	-0.967 [-1.055]	0.800 [1.151]
	lnGDP	0.072 [0.457]	-0.091 [-1.218]	-0.014 [-0.227]	-0.000 [-0.008]	0.035 [0.719]	0.034 [0.739]	-0.019 [-0.452]	-0.038 [-1.191]	-0.076*** [-2.965]
	lnBREX	0.213*** [3.923]	0.140** [2.190]	0.136*** [4.491]	0.147*** [5.084]	0.177*** [6.131]	0.227*** [7.925]	0.277*** [10.335]	0.207*** [6.697]	0.266*** [11.082]
	lnIND	0.165*** [2.633]	0.292*** [4.935]	0.312*** [6.804]	0.275*** [5.577]	0.274*** [5.920]	0.306*** [6.145]	0.413*** [7.717]	0.584*** [11.479]	0.664*** [18.177]
	Obs.	544								
	Slope Equality Stat	169.759***								
	Symmetric Quantiles Stat	55.330***								
	Pseudo R^2	0.082								
		0.10	**0.20**	**0.30**	**0.40**	**0.50**	**0.60**	**0.70**	**0.80**	**0.90**
MODEL II	*Constant*	-7.715 [-1.445]	-0.764 [-0.392]	-4.704*** [-3.648]	-4.548*** [-3.419]	-5.524*** [-3.995]	-6.697*** [-4.963]	-5.627*** [-4.011]	-2.716** [-2.566]	0.571 [0.518]
	lnGDP	0.017 [0.088]	-0.214*** [-2.717]	-0.031 [-0.599]	-0.023 [-0.441]	0.023 [0.424]	0.088* [1.697]	0.083* [1.744]	-0.003 [-0.094]	-0.098** [-2.439]
	lnBREX	0.153** [2.464]	0.060 [0.907]	0.116*** [3.242]	0.130*** [4.368]	0.142*** [4.904]	0.176*** [6.192]	0.217*** [7.355]	0.205*** [7.412]	0.215*** [8.483]
	lnINR	0.070 [0.557]	-0.048 [-0.874]	0.040 [0.877]	0.002 [0.042]	-0.042 [-0.801]	0.015 [0.230]	0.145* [1.753]	0.205** [2.772]	0.311 [5.687]
	Obs.	566								
	Slope Equality Stat	99.935***								
	Symmetric Quantiles Stat	76.214***								
	Pseudo R^2	0.033								

Note: "***", "**" and "*" denote the significance of the statistics in the models at the 1%, 5% and 10% levels. The Koenker and Bassett (1982a) test examines the equality of slope coefficients named Slope Equality Stat. The symmetric quantiles test presented Symmetric Quantiles Stat entails conducting the Newey and Powell (1987) test of conditional symmetry.

In Model II, a 1% increase in lnGDP corresponds to reductions of 0.21% and 0.10% in lnOFDI for countries with low and high FDI reception (0.20th and 0.90th quantiles), respectively. In contrast, for countries with a middle FDI reception, lnOFDI increases by 0.09% and 0.08% in 0.70th and 0.80th quantiles. Additionally, a 1% increase in lnBREX results in an lnOFDI increase ranging from 0.12% to 0.22% across all quantiles (except 0.20th quantile) in countries with high IFDI. Regarding the impact of lnINR on lnOFDI, predominantly statistically insignificant findings are observed. However, in countries experiencing high IFDIs, this effect is reported as positive and statistically significant. Specifically, a 1% increase in lnINR leads to lnOFDI increases of 0.15% and 0.21% in the 0.70th and 0.80th quantiles. This suggests that the influence of lnINR on lnOFDI is more pronounced in countries where Türkiye directs a higher volume of FDI.

Findings of Model III in Table 6, the effects of lnGDP mirror those observed in Model II. A 1% increase in lnGDP is associated with decreases of 0.16%, 0.21%, 0.18%, and 0.08% in lnOFDI across low and high quantiles (0.10th, 0.20th, 0.30th, 0.90th). On the contrary, for countries receiving mid-level of FDI, lnOFDI increases by 0.12% and 0.10% in the sixth and seventh quantiles. While the effect of lnBREX on lnOFDI is positive across all quantiles, statistical significance is observed only in the 0.20th, 0.50th, 0.60th, 0.70th, and 0.80th quantiles. A 1% increase in lnBREX leads to lnOFDI increases of 0.09%, 0.05%, 0.08%, 0.11%, and 0.16%. Similarly, the long-term versus short-term orientation exhibits a positive and statistically significant effect across all quantiles except the 0.30th quantile. 1% increase in lnLTOR results in lnOFDI increases ranging from 0.53% to 0.99%. Notably, the elasticity of this effect is higher in countries with low and high FDI reception compared to those with moderate FDI levels.

Table 6. Model III and Model IV PQ Results

	Variable	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90
MODEL III	*constant*	-1.706 [-0.771]	0.517 [0.459]	-0.138 [-0.102]	-3.723** [-2.391]	-5.180*** [-3.814]	-6.677*** [-6.399]	-5.719*** [-5.073]	-1.169 [-0.895]	0.986 [1.196]
	lnGDP	-0.155** [-1.986]	-0.213*** [-5.028]	-0.177*** [-3.442]	-0.022 [-0.353]	0.047 [0.878]	0.123*** [3.060]	0.103** [2.514]	-0.044 [-0.975]	-0.073** [-2.438]
	lnBREX	0.060 [1.300]	0.086* [1.757]	0.016 [0.304]	0.049 [1.343]	0.053* [1.655]	0.076*** [2.796]	0.114*** [4.611]	0.161*** [6.691]	0.007 [0.153]
	lnLTOR	0.649*** [7.716]	0.646*** [9.804]	0.582 [6.892]	0.534*** [5.685]	0.555*** [6.453]	0.615*** [8.007]	0.574*** [8.199]	0.573*** [6.873]	0.990*** [9.171]
	Obs.	566								
	Slope Equality Stat	147.479***								
	Symmetric Quantiles Stat	67.128***								
	Pseudo R^2	0.094								
		0.10	**0.20**	**0.30**	**0.40**	**0.50**	**0.60**	**0.70**	**0.80**	**0.90**
MODEL IV	*constant*	2.085* [1.664]	0.933 [0.784]	0.091 [0.076]	-0.788 [-0.578]	-0.665 [-0.448]	-2.866** [-2.246]	-0.480 [-0.255]	4.309** [2.163]	8.759*** [7.655]
	lnGDP	-0.275*** [-5.718]	-0.218*** [-4.845]	-0.174*** [-3.832]	-0.130** [-2.484]	-0.118** [-2.081]	-0.018 [-0.409]	-0.089 [-1.375]	-0.241*** [-3.643]	-0.375*** [-9.611]
	lnBREX	0.033 [0.386]	0.038 [0.774]	0.062 [1.168]	0.038 [0.954]	0.017 [0.479]	0.029 [0.828]	0.031 [0.803]	0.074** [2.259]	0.074*** [2.792]
	lnMAS	0.603*** [9.477]	0.519*** [10.032]	0.442*** [9.525]	0.417*** [7.964]	0.459*** [7.884]	0.462*** [6.986]	0.429*** [5.767]	0.457*** [5.700]	0.571*** [11.614]
	Obs.	547								
	Slope Equality Stat	114.345***								
	Symmetric Quantiles Stat	75.458***								
	Pseudo R^2	0.126								

Note: "***", "**" and "*" denote the significance of the statistics in the models at the 1%, 5% and 10% levels. The Koenker and Bassett (1982a) test examines the equality of slope coefficients named Slope Equality Stat. The symmetric quantiles test presented Symmetric Quantiles Stat entails conducting the Newey and Powell (1987) test of conditional symmetry.

In contrast to the results observed in other models, all effects of lnGDP on lnOFDI are negative in Model IV. The magnitude of these statistically significant effects varies across quantiles. 1% increase in lnGDP leads to reductions in lnOFDI ranging from 0.12% to 0.38%. On the contrary, 1% appreciation in lnBREX results in lnOFDI increases of 0.07% exclusively in countries with high FDI levels. Consistent with findings from previous models, increases in lnMAS are associated with higher FDIs from Türkiye to relevant countries. Specifically, 1% increase in lnMAS in countries with low, medium, and high FDI reception leads to lnOFDI increases ranging from 0.42% to 0.60% across all quantiles. This underscores the attractiveness of FDI in those countries, as evidenced by the positive association between increased masculinity and heightened FDIs.

The predicted results from Model V indicate that, irrespective of countries' low, middle, and high levels of FDI reception (across all quantiles except the 0.60th quantile), an increase in the income of these countries significantly and negatively impacts FDIs originating from Türkiye (Table 7). 1% increase in lnGDP leads to reductions in lnOFDI ranging from 0.11% to 0.26%. Furthermore, examining the effects of the lnBREX on lnOFDI reveals that 1% increase in lnBREX results in lnOFDI increases within the range of 0.11% to 0.23%. This suggests that as the Turkish Lira depreciates, Turkish investors are incentivized to increase their investments in relevant countries. The findings of CD, it is observed that an increasing lnPOWD between countries not only fails to restrict but actually enhances bilateral FDIs (particularly OFDI from Türkiye). 1% increase in lnPOWD leads to lnOFDI increases of up to 0.71%, with a minimum increase of 0.35% across all quantiles. It is worth noting that the effect of lnPOWD on lnOFDI is most pronounced in countries with low levels of FDI reception, with this dominance diminishing as the level of FDI reception increases.

Finally, it is important to highlight that the findings from Model VI exhibit notably similar characteristics to

Table 7. Model V and Model VI PQ Results

	Variable	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90
MODEL V	*constant*	1.919 [0.893]	-0.182 [-0.108]	-1.003 [-0.746]	-1.120 [-0.834]	0.532 [0.386]	-1.282 [-0.953]	0.176 [0.156]	1.940* [1.938]	3.520*** [3.569]
	lnGDP	-0.257*** [-3.217]	-0.164** [-2.540]	-0.120** [-2.390]	-0.111** [-2.196]	-0.161*** [-3.132]	-0.077 [-1.596]	-0.113*** [-2.913]	-0.159*** [-4.675]	-0.193*** [-5.495]
	lnBREX	0.202*** [3.841]	0.110** [2.184]	0.124*** [3.520]	0.119*** [4.456]	0.133*** [4.963]	0.192*** [7.735]	0.229*** [10.490]	0.233*** [10.069]	0.210*** [7.624]
	lnPOWD	0.706*** [6.635]	0.561*** [7.766]	0.485*** [7.802]	0.398*** [7.211]	0.387*** [8.016]	0.350*** [8.386]	0.351*** [10.473]	0.393*** [13.178]	0.433*** [15.465]
	Obs.	566								
	Slope Equality Stat	77.640***								
	Symmetric Quantiles Stat	47.364***								
	Pseudo R^2	0.149								
		0.10	**0.20**	**0.30**	**0.40**	**0.50**	**0.60**	**0.70**	**0.80**	**0.90**
MODEL VI	*constant*	-10.604 [-1.619]	-5.030** [-2.527]	-3.438* [-1.829]	-2.219 [-1.037]	-1.193 [-0.546]	-0.745 [-0.453]	-1.780 [-1.374]	0.351 [0.273]	7.299** [2.518]
	lnGDP	0.116 [0.491]	-0.036 [-0.477]	-0.069 [-1.002]	-0.100 [-1.279]	-0.121 [-1.502]	-0.116* [-1.897]	-0.050 [-1.110]	-0.117*** [-2.679]	-0.344*** [-3.541]
	lnBREX	0.153* [1.840]	0.146 [1.607]	0.138*** [3.593]	0.155*** [4.616]	0.176*** [5.492]	0.221*** [7.350]	0.210*** [6.591]	0.215*** [7.102]	0.283*** [8.633]
	lnUNAV	0.012 [0.138]	0.113* [1.891]	0.154*** [3.163]	0.101** [2.032]	0.145*** [2.728]	0.156*** [2.678]	0.173*** [2.760]	0.180*** [2.874]	0.184** [2.091]
	Obs.	521								
	Slope Equality Stat	70.585***								
	Symmetric Quantiles Stat	57.212***								
	Pseudo R^2	0.051								

Note: "***", "**" and "*" denote the significance of the statistics in the models at the 1%, 5% and 10% levels. The Koenker and Bassett (1982a) test examines the equality of slope coefficients named Slope Equality Stat. The symmetric quantiles test presented Symmetric Quantiles Stat entails conducting the Newey and Powell (1987) test of conditional symmetry.

those of Model I. In Model VI, akin to Model I, 1% increase in lnGDP results in decreases of 0.12%, 0.12%, and 0.34% at the 0.60th, 0.80th, and 0.90th quantiles (for countries with high IFDI). Conversely, 1% increase in lnBREX leads to lnOFDI increases ranging from 0.14% to 0.28% across all quantiles (excluding the 0.20th quantile), regardless of quantile levels. Notably, this relationship exhibits greater flexibility in countries experiencing significant IFDs. In terms of CD, an increase in uncertainty avoidance corresponds to heightened FDIs between countries. %1 increase in lnUNAV leads to rising lnOFDI ranging from 0.10 to 0.18. Interestingly, as IFDIs levels (quantiles) increase, the impact of lnUNAV also appears to intensify. However, it is important to note that the magnitude of this effect is constrained.

5. DISCUSSION AND CONCLUSION

This study examined the role of CD between host countries and Türkiye, a pivotal emerging economy, in OFDIs. Employing POLS, RE, and QE models, the analyses yielded consistent findings, revealing that as the CD between Türkiye and host countries increases across all cultural dimensions, OFDIs to those host countries escalate. These outcomes diverge from theoretical expectations regarding the adverse impact of CD on FDIs. While the research hypothesis was rejected, the principal assertion—that contextual comprehension may furnish significant insights into the discourse on the interplay between CD and FDIs, and that Türkiye may represent a distinctive case as an emerging market—was substantiated. These findings align with prior studies suggesting that companies should not invariably favor culturally proximate countries when making FDI decisions (Tang 2012).

FDI theories grounded in Institutional Theory and Transaction Cost Theory typically assert that various forms of distance, notably CD, impede FDIs between nations due to diminished social legitimacy and heightened information and management costs, which are construed as manifestations of escalated uncertainty stemming from CD (Grosse and Trevino 1996; Yiu and Makino 2002). Nevertheless, alternative mechanisms arising from the distinctive contextual characteristics can counteract the anticipated nexus between CD and FDIs. Herein, the legal framework in Türkiye and the host countries may play pivotal roles. For instance, Malik (2023) observed that a low legal distance and high CD amplify the inclination towards FDI, emphasizing that legal distance and CD can interact and should not be regarded as mutually exclusive. Similarly, Steigner, Riedy, and Bauman (2019) focused on the dependency of the impact of CD on FDI on the legal origin of the source country, demonstrating that FDI from civil law countries tends to flow more towards destinations characterized by higher MAS, UNAV, and INR scores, and lower LTOR scores. Given Türkiye's classification as a civil law country and the variability in legal distance between Türkiye and most countries in the sample, these findings appear reasonable. Li, Zhao, and Shen (2021) showed that bilateral investment treaties serve as a surrogate for the institutional environment of the host country, mitigating investment uncertainties stemming from CD. Considering that Türkiye has either signed or in force a total of 121 investment agreements between 1962 and 2024, May (UN Trade and Development 2024), it can be inferred that these agreements mitigate uncertainties stemming from CD for Turkish firms. Zdziarski et al. (2017) proposed that being integrated/embedded into country networks is crucial for encouraging adventurous FDI and this integration allows firms to swiftly acquire knowledge, which helps them navigate the uncertainties arising from significant CD and other kinds of distances. Moreover, Jimenez et al. (2017) examined the role of vicarious experience on FDIs and concluded that the increased representation of companies from a particular home country in the host nation mitigates the adverse effects of CD. Considering these studies, it can be asserted that Turkish firms exhibit a collaborative stance within host countries. This collaborative approach serves to minimize the adverse effects of CD, enabling them to adopt a focused strategy towards opportunities within the host country. Also, Nayyar, Mukherjee, and Varma (2022) argue that both developed and emerging economies are significant destinations for strategic asset-seeking FDI. Given the heterogeneity of the research sample, which includes both types of economies, it may be suggested that the strategic asset-seeking motives of Turkish firms could lead them to overlook CD. Moreover, Bailey and Li (2015) find that host country's local demand mitigates the negative relationship between geographic, cultural, and administrative distance and OFDIs. Accordingly, it can be argued that, in the Turkish context, the moderating effect of host country demand may have transformed the negative impact of CD on OFDIs into a positive one.

This study has three main contributions. First, the findings enhanced the rare empirical elaboration of the nexus between CD and FDI. This is important because each empirical finding supports/rejects the common idea in literature, thereby, the extent to which the idea closely reflects reality is illustrated. Second, contradicting results of this study have shown that considering specific cases is important to reach

new perspectives and to have contextual understanding. Herein, it is illustrated that Turkish companies do not perceive CD as a barrier due to several possible reasons such as legal distance and legal origin, existence of bilateral investment treaties, and networks and vicarious experience of Turkish companies. This situation also shows the necessity of inclusion of additional variables into discussions. Third, the positive impact of CD on OFDIs indicates that CD might not be equal to or related with cultural incongruence/conflicts. Therefore, this research remarks the requirement of conceptual clarification between CD, cultural incongruence, and cultural conflicts.

Although this study specifically investigates Türkiye's OFDI, its findings offer valuable implications for the broader SEE region. Türkiye shares several economic, institutional, and historical characteristics with other SEE countries, such as transitional or emerging market structures, increasing internationalization efforts, and the pursuit of strategic assets in developed economies. Additionally, Türkiye maintains strong and expanding economic ties with SEE countries, reinforcing its role as a regional economic actor. From a cultural standpoint, Türkiye exhibits notable similarities with other SEE countries. For example, UNAV scores are comparably high across the region—Bosnia and Herzegovina (87), Bulgaria (85), Croatia (80), Greece (100), North Macedonia (87), Romania (90), Serbia (92), and Türkiye (85)—suggesting a shared cultural orientation. These commonalities strengthen the relevance of the Turkish case to regional investment behavior. The observed positive relationship between CD and Türkiye's OFDI challenges the conventional view that cultural dissimilarity discourages cross-border investments. This unexpected result may reflect a broader pattern among firms in the SEE region, where strategic motivations outweigh the adverse effects of CD. Moreover, the capacity of firms to navigate/even leverage CD may signal a shift in the internationalization strategies of SEE-based MNCs. Herein, Türkiye's experience provides a valuable point of reference for understanding how firms from similar SEE economies respond to CD in their OFDI decisions, thereby contributing to the development of regionally grounded investment theory and policy.

This study offers significant policy implications, particularly underscored by the case study of Türkiye, which demonstrates the potential for converting the negative effects of CD into positive outcomes. This research establishes a connection between such outcomes and various factors, including bilateral investment agreements, vicarious experience, and networking activities. Consequently, it is recommended that policymakers in nations where companies suffer from CD consider augmenting the number of bilateral investment agreements and facilitating networking events aimed at fostering closer ties among companies. Moreover, given the apparent resilience of Turkish companies to cultural barriers, policymakers in Türkiye are encouraged to adopt measures that promote cultural exchange and facilitate political dialogues emphasizing the value of cultural diversity, thus safeguarding against the transformation of positive impacts into negative ones. Furthermore, to sustain these positive outcomes, policymakers in Türkiye are advised to increase the number of bilateral investment agreements and enhance networking opportunities. Nonetheless, it is essential to approach these policy recommendations with caution, considering the temporal and sample constraints of this study.

This study also has future research recommendations. Future studies should incorporate diverse contextual settings to offer novel insights. Specifically, exploration of emerging markets warrants attention, encompassing both inward and outward FDI. Given the significance of FDI attraction for economic advancement and the pivotal role of overseas investments in facilitating knowledge dissemination, comprehending the influence of CD holds paramount importance, particularly within the context of emerging economies. Moreover, it would be advantageous to consider the effects of various contextual variables, such as bilateral investment treaties, supplementary metrics capturing the notion of distance, legal origin of the host countries, and vicarious experiences. Such an inquiry may augment the existing knowledge base. Additionally, to achieve a more profound comprehension, researchers may consider stratifying the research sample into more homogeneous cohorts based on economic development/regional proximity, subsequently comparing these groups concerning the impact of CD. Such an approach would facilitate the elucidation of differences across distinct groups.

This study has several constraints. Primarily, methodic limitations are evident, notably the short time interval, data mismatches on heterogeneity of FDIs and the restricted sample size. Furthermore, the omission of significant contextual variables, such as bilateral investment treaties, economic conditions/policies, physic and legal dimensions, as well as the legal origin of the host nation, represents a limitation. Considering these variables could yield a more comprehensive understanding. Despite these constraints, the study's findings offer distinctive insights into literature.

Necessary Footnotes

a. Even though CD variables are time-invariant features in each cross-section, they substantially change across the cross-sections. Hence, it is possible to examine national cultural dimensions in the model by using the FE model.

b. In PQ analysis, CDs are taken separately as POLS, FE and RE models.

c. We would like to thank anonymous referees for suggesting considering geographical distance to augment empirical model as a gravity. Although there are not any drastically changes in the outcomes, results of all models are presented as supplementary material.

d. Mean and variance of CD variables are constant and zero. Hence, their unit root/stationary characteristics cannot be analyzed because of time-invariant conditions.

Statements and Declarations

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Competing interest: The authors declare that they have no conflict of interest.

References

Acaravci A., Artan, S., Erdogan S., and Bostan Gokturk T. 2018. Institutional quality, real income and foreign direct investment relationship in Turkey. Journal Of Mehmet Akif Ersoy University Economics and Administrative Sciences Faculty 5 (2): 132-145.

Adamoglou X. and Kyrkilis D. 2018. FDI entry strategies as a function of distance—the case of an emerging market: Turkey. Journal of the Knowledge Economy 9 (4): 1348-1373.

Atici C. and Guloglu B. 2006. Gravity model of Turkey's fresh and processed fruit and vegetable export to the EU: A panel data analysis. Journal of International Food & Agribusiness Marketing 18 (3-4): 7-21.

Aybar S. 2016. Determinants of Turkish outward foreign direct investment. Transnational Corporations Review 8 (1): 79-92.

Bailey N. 2018. Exploring the relationship between institutional factors and FDI attractiveness: A meta-analytic review. International Business Review 27 (1): 139-148.

Bailey N. and Li S. 2015. Cross-national distance and FDI: The moderating role of host country local demand. Journal of International Management 21 (4): 267-276.

Behrman J.N. 1969. Some patterns in the rise of the multinational enterprise. The Int. Exec. 11: 1-2.

Bera A. K., Galvao Jr A. F., Montes-Rojas G. V., and Park S. Y. 2016. Asymmetric laplace regression: Maximum likelihood, maximum entropy and quantile regression. Journal of Econometric Methods 5(1): 79-101.

Binatlı A.O. and Sohrabji N. 2019. Factors influencing foreign direct investment flows into Turkey. Entrepreneurial Business and Economics Review 7 (2): 1347-1373.

Demirbag M., Tatoglu E., and Glaister K. W. 2009. Equity-based entry modes of emerging country multinationals: Lessons from Turkey. Journal of World Business 44 (4): 445-462.

Erdem E. and Nazlioglu S. 2008. Gravity Model of Turkish Agricultural Exports to The European Union. Paper presentation at the meeting of International Trade and Finance Association Conference.

Fiorini M., Giovannetti G., Lanati M., and Santi F. 2021. Asymmetric cultural proximity and greenfield foreign direct investment. The World Economy 44 (9): 2572-2603.

Grosse R. and Trevino L. J. 1996. Foreign direct investment in the United States: An analysis by country of origin. Journal of International Business Studies 27: 139-155.

Haq M., Hu D., Faff R., and Pathan S. 2018. New evidence on national culture and bank capital structure. Pacific-Basin Finance Journal 50: 41-64.

Hausman J. A. and Taylor W. E. 1981. Panel data and unobservable individual effects. Econometrica: Journal of the Econometric Society 49 (6): 1377-1398.

Heavilin J. and Songur H. 2020. Institutional distance and Turkey's outward foreign direct investment. Research in International Business and Finance 54: 101299.

Hofstede G. 1984. Culture's consequences: International differences in work-related values, Sage, Beverly Hills, CA.

Hofstede G. 2001. Culture's consequences: comparing values, behaviors, institutions and organizations across nation. Sage Publications.

Hofstede G., Hofstede G.J., and Minkov M. 2010. Cultures and organizations. McGrawHill, London.

Izadi S., Rashid M., and Izadi P. 2023. Direct and indirect influence of national culture on foreign direct investment. Research in International Business and Finance 66: 102037.

Jimenez A., Jiménez D., Ordeñana X., and Puche-Regaliza J. C. 2017. Cultural distance and foreign direct investment: the moderating effect of vicarious experience. European Journal of International Management 11 (2): 153-180.

Johanson J. and Vahlne J. 1977. The internationalization process of the firm – a model of knowledge development and increasing market commitments. Journal of International Business Studies 8 (1): 23-32.

Johanson J. and Wiedersheim-Paul F. 1975. The internationalization of the firm: Four Swedish cases. Journal of Management Studies 12: 305–322.

Kapás J. and Czeglédi P. 2020. The impact of culture on FDI disentangled: separating the "level" and the "distance" effects. Economia Politica 37 (1): 223-250.

Kayalvizhi P. N. and Thenmozhi M. J. E. M. R. 2018. Does quality of innovation, culture and governance drive FDI?: Evidence from emerging markets. Emerging Markets Review 34: 175-191.

Khudari M., Sapuan N. M., and Fadhil M. A. 2021. The impact of political stability and macroeconomic variables on foreign direct investment in Turkey. In International Conference on Business and Technology, 485-497. Cham: Springer International Publishing.

Kim, Y., and Gray, S.J. 2009. An assessment of alternative empirical measures of cultural distance: Evidence from the Republic of Korea: APJM. Asia Pacific Journal of Management 26 (1): 55-74.

Koenker, R., and Bassett Jr, G. 1978. Regression quantiles. Econometrica: Journal of the Econometric Society 46 (1): 33-50.

Kogut, B., and Singh, H. 1988. The effect of national culture on the choice of entry mode. Journal of International Business Studies 19: 411-432.

Kristjánsdóttir H. and Karlsdóttir F. B. 2020. UK foreign direct investment in the OECD, culture and geography. Baltic Journal of Economic Studies 6 (5): 8-14.

Levin A., Lin C. F., and Chu C. S. J. 2002. Unit root tests in panel data: Asymptotic and finite-sample properties. Journal of Econometrics 108 (1): 1-24.

Li S., Zhao L., and Shen H. 2021. Foreign direct investment and institutional environment: the impact of bilateral investment treaties. Applied Economics 53 (30): 3535-3548.

Lin B. and Xu B. 2017. Which provinces should pay more attention to CO2 emissions? Using the quantile regression to investigate China's manufacturing industry. Journal of Cleaner Production 164: 980-993.

Maddala G. S. and Wu S. 1999. A comparative study of unit root tests with panel data and a new simple test. Oxford Bulletin of Economics and Statistics 61 (S1): 631-652.

Malik T. H. 2023. Legal and cultural contingencies in the foreign portfolio versus foreign direct investment decisions across countries: An institutional fit perspective. Journal of the Knowledge Economy: 1-33.

Minkov M. 2007. What makes us different and similar: A new interpretation of the world values survey and other cross-cultural data. Klasika y Stil Publishing House.

Nayak B. S. and Scheib D. 2020. Cultural logic of German foreign direct investment (FDI) in service sector. Journal of Economic Structures 9 (1): 1-13.

Nayyar R., Mukherjee J., and Varma S. 2022. Institutional distance as a determinant of outward FDI from India. International Journal of Emerging Markets 17 (10): 2529-2557.

Neves M. E., Almeida D., and Vieira E. S. 2022. The cultural dimension in companies' leverage: New evidence using panel data for a European macroeconomic context. Cross Cultural and Strategic Management, 29 (3): 589-617.

Pesaran M. H. 2004. General diagnostic tests for cross section dependence in panels. Available at SSRN 572504.

Steigner T., Riedy M. K., and Bauman A. 2019. Legal family, cultural dimensions, and FDI. International Journal of Managerial Finance 15 (3): 285-314.

Tang L. 2012. The direction of cultural distance on FDI: attractiveness or incongruity? Cross Cultural Management: An International Journal 19 (2): 233-256.

UN Trade and Development. 2024. Investment Policy Hub: Türkiye. Retrieved from https://investmentpolicy.unctad.org/international-investment-agreements/countries/214/t-rkiye

UNCTAD 2023. World investment report 2023. Retrieved from https://unctad.org/publication/world-investment-report-2023.

Yiu D. and Makino S. 2002. The choice between joint venture and wholly owned subsidiary: An institutional perspective. Organization Science 13 (6): 667-683.

Zdziarski M., Światowiec-Szczepańska J., Troilo M., and Małys Ł. 2017. Adventurous foreign direct investment. Central European Management Journal 25 (2): 117-138.

APPENDIX A

Table A1. Unit Root Tests Results

	Fisher ADF		LLC	
Variable	**Chi-Square Stat**	**Prob.**	**LLC Stat**	**Prob.**
Model without Level and Trend				
lnOFDI	45.164	0.738	-2.255**	0.012
lnGDP	172.538***	0.000	-2.658***	0.004
lnBREX	51.476	0.494	-2.171**	0.015
Model with Level				
lnOFDI	72.211**	0.033	-4.364***	0.000
lnGDP	36.146	0.954	0.221	0.587
lnBREX	15.563	0.999	7.783	0.999
Model with Level and Trend				
lnOFDI	36.886	0.944	-1.783**	0.037
lnGDP	62.569	0.150	-1.387**	0.083
lnBREX	81.304***	0.006	-4.098***	0.000

Note: Fisher ADF refers to Maddala and Wu (1999), and LLC presents Levin, Lin and Chun (2002) unit root tests. Maximum number of lags is set to 3 and the optimal number of lags is determined by Akaike information criterion. "***", "**" and "*" denote the significance of the statistics in the models at the 1%, 5% and 10% levels.

TABLE A2. Outward foreign direct investment of Turkey — Pooled ordinary least squares results

Variable	Model I	Model II	Model III	Model IV	Model V	Model VI
constant	-5.389*** [-8.323]	-5.400*** [-8.559]	-3.154*** [-4.373]	1.541*** [3.237]	0.130 [0.215]	-3.002*** [-4.565]
lnGDP	-0.028 [-1.176]	-0.008 [-0.361]	-0.033 [-1.344]	-0.174*** [-6.866]	-0.146*** [-6.311]	-0.072*** [-2.998]
lnBREX	0.167*** [9.026]	0.178*** [10.249]	0.075*** [6.330]	0.091*** [4.840]	0.180*** [10.758]	0.181*** [10.233]
lnDIST	**0.178 [1.705]**	**0.125 [1.330]**	**0.019 [0.181]**	**-0.093 [-0.980]**	**0.028 [0.277]**	**0.040 [0.418]**
lnIND	0.041*** [3.787]					
lnINDULGENCE		0.109*** [4.712]				
lnLTOR			0.616*** [11.330]			
lnMAS				0.371*** [27.606]		
lnPOWD					0.454*** [48.359]	
lnUNAV						0.076*** [7.944]
Obs.	572	572	572	572	572	572
Pesaran$_{CD}$	0.514	0.532	0.386	0.609	0.783	0.564
R^2	0.062	0.068	0.188	0.329	0.299	0.076

Note: "***", "**" and "*" denote the significance of the statistics in the models at the 1%, 5% and 10% levels. In the Pesaran$_{CD}$ test introduced by Pesaran (2004), the null hypothesis, which suggests the absence of cross-sectional dependence, is not rejected in all models. The numbers in parentheses are the t-ratios. White cross-section (period cluster) is used for computing the coefficient standard errors.

TABLE A3. Outward foreign direct investment of Turkey — Random effect results

Variable	Model I	Model II	Model III	Model IV	Model V	Model VI
constant	-5.248 [-0.910]	-4.784 [-0.880]	-4.027 [-0.689]	0.620 [0.181]	-0.531 [-0.120]	-1.451 [-0.270]
lnGDP	-0.091 [-1.914]	-0.095 [-1.663]	-0.091 [-1.357]	-0.142* [-2.026]	-0.119* [-1.803]	-0.117* [-1.957]
lnBREX	0.225** [2.127]	0.222** [2.208]	0.193** [2.745]	0.151 [1.498]	0.215** [2.291]	0.239** [2.324]
lnDIST	**0.396** **[0.509]**	**0.308** **[0.440]**	**0.264** **[0.387]**	**-0.086** **[-0.175]**	**0.013** **[0.023]**	**0.025** **[0.037]**
lnIND	0.091 [0.908]					
lnINDULGENCE		-0.067 [-0.323]				
lnLTOR			0.252 [0.561]			
lnMAS				0.346*** [4.077]		
lnPOWD					0.429*** [6.037]	
lnUNAV						0.132*** [2.951]
Obs.	572	572	572	572	572	572
Pesaran$_{CD}$	0.737	0.74	0.726	0.703	0.800	0.718
R^2	0.012	0.012	0.013	0.033	0.030	0.018
$F_{cross\text{-}sections}$	56.701***	56.530***	53.176***	48.354***	49.628***	56.505***
F_{period}	-2.269	-2.252	-2.08	-1.953	-2.003	-2.282

Note: "***", "**" and "*" denote the significance of the statistics in the models at the 1%, 5% and 10% levels. In the Pesaran$_{CD}$ test introduced by Pesaran (2004), the null hypothesis, which suggests the absence of cross-sectional dependence, is not rejected in all models. The numbers in parentheses are the t-ratios. White cross-section (period cluster) is used for computing the coefficient standard errors. $F_{cross\text{-}sections}$ and F_{period} represent the unobserved individual and time effect test statistics.

TABLE A4. Outward foreign direct investment of Turkey — Model I and Model II PQ Results

	Variable	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90
MODEL I	*constant*	-7.298** [-1.966]	-1.754 [-0.998]	-5.081*** [-3.805]	-5.047*** [-3.921]	-6.738*** [-5.126]	-7.366*** [-7.073]	-6.856*** [-6.159]	-3.783* [-1.912]	1.016 [0.737]
	lnGDP	0.064 [0.418]	-0.108 [-1.199]	0.039 [0.059]	-0.028 [-0.391]	-0.074 [-0.950]	-0.116* [-1.665]	-0.104 [-1.611]	-0.020 [-0.373]	-0.035 [-0.434]
	lnBREX	0.172*** [2.797]	0.078 [1.360]	0.124*** [3.523]	0.134*** [4.126]	0.165*** [5.755]	0.181*** [7.029]	0.220*** [8.436]	0.181*** [5.309]	0.228*** [7.006]
	lnDIST	**-0.194 [-1.171]**	**-0.185 [-1.027]**	**-0.166 [-0.940]**	**0.094 [0.676]**	**0.503** [2.142]**	**0.767*** [3.742]**	**0.732*** [3.233]**	**0.143 [0.422]**	**-0.322 [-0.955]**
	lnIND	0.068 [0.740]	0.107 [1.130]	0.105 [1.253]	0.058 [0.677]	-0.02098 [-0.805]	-0.025 [-1.339]	-0.009 [-0.473]	0.017 [0.700]	0.029 [1.602]
	Obs.	572								
	Slope Equality Stat	152.174***								
	Symmetric Quantiles Stat	76.541***								
	Pseudo R^2	0.043								
		0.10	**0.20**	**0.30**	**0.40**	**0.50**	**0.60**	**0.70**	**0.80**	**0.90**
MODEL II	*constant*	-6.233 [-1.613]	-0.789 [-0.404]	-4.635*** [-3.580]	-4.988 [-3.589]	-6.885*** [-5.080]	-7.549*** [-7.261]	-6.097 [-3.887]	-1.695 [-0.872]	1.467 [1.366]
	lnGDP	0.001 [0.005]	-0.161* [-1.710]	0.014 [0.208]	-0.036 [-0.495]	-0.068 [-0.867]	-0.108 [-1.532]	-0.065 [-0.866]	0.033 [0.590]	0.082 [1.507]
	lnBREX	0.154*** [2.608]	0.045 [0.820]	0.105*** [3.018]	0.135*** [4.243]	0.165*** [5.704]	0.187*** [7.101]	0.226*** [8.739]	0.202*** [8.334]	0.228*** [12.743]
	lnDIST	**-0.135 [-0.703]**	**-0.181 [-1.030]**	**-0.163 [-0.925]**	**0.109 [0.471]**	**0.512** [2.131]**	**0.775*** [3.762]**	**0.537 [1.634]**	**-0.241 [-0.695]**	**-0.721*** [-2.951]**
	lnINDULGENCE	0.021 [0.287]	-0.033 [-0.599]	0.047 [1.024]	0.034 [0.661]	0.018 [0.342]	0.001 [0.026]	0.107 [1.230]	0.248*** [2.813]	0.357*** [6.005]
	Obs.	572								
	Slope Equality Stat	139.005***								
	Symmetric Quantiles Stat	78.959***								
	Pseudo R^2	0.042								

Note: "***", "**" and "*" denote the significance of the statistics in the models at the 1%, 5% and 10% levels. The Koenker and Bassett (1982a) test examines the equality of slope coefficients named Slope Equality Stat. The symmetric quantiles test presented Symmetric Quantiles Stat entails conducting the Newey and Powell (1987) test of conditional symmetry.

TABLE A5. Outward foreign direct investment of Turkey — Model III and Model IV PQ Results

	Variable	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90
MODEL III	*constant*	-3.043 [-1.379]	0.392 [0.341]	0.185 [0.143]	-3.272** [-2.034]	-5.229*** [-3.721]	-6.668*** [-5.856]	-5.817*** [-4.845]	-2.571 [-1.618]	0.953 [1.036]
	lnGDP	-0.168* [-1.800]	-0.243*** [-4.298]	-0.149** [-2.106]	0.002 [0.027]	0.067 [0.965]	0.124** [2.066]	0.103 [1.414]	-0.071 [-1.311]	0.013 [0.134]
	lnBREX	0.055 [1.173]	0.079 [1.515]	0.002 [0.038]	0.037 [1.013]	0.049 [1.471]	0.077*** [2.587]	0.112*** [3.833]	0.167*** [6.878]	0.008 [0.145]
	lnDIST	**0.204** **[0.930]**	**0.122** **[0.783]**	**-0.136** **[-0.780]**	**-0.154** **[-0.916]**	**-0.058** **[-0.331]**	**-0.004** **[-0.018]**	**0.012** **[0.046]**	**0.267** **[1.159]**	**-0.290** **[-0.779]**
	lnLTOR	0.643*** [7.993]	0.656*** [9.715]	0.591*** [7.161]	0.507*** [5.393]	0.580*** [6.473]	0.613*** [7.253]	0.574*** [7.071]	0.564*** [6.565]	0.978*** [8.141]
	Obs.	572								
	Slope Equality Stat	161.055***								
	Symmetric Quantiles Stat	69.398***								
	Pseudo R^2	0.092								
		0.10	**0.20**	**0.30**	**0.40**	**0.50**	**0.60**	**0.70**	**0.80**	**0.90**
MODEL IV	*constant*	1.751 [1.154]	0.277 [0.248]	-0.001 [-0.001]	-0.120 [-0.091]	-2.142 [-1.474]	-3.527*** [-2.944]	-2.853 [-1.432]	2.177 [1.088]	7.737*** [7.971]
	lnGDP	-0.208** [-2.343]	-0.073 [-1.056]	-0.163*** [-2.550]	-0.168*** [-2.745]	-0.142** [-2.015]	-0.184** [-2.420]	-0.098 [-1.484]	-0.223*** [-4.396]	-0.168** [-2.307]
	lnBREX	0.075 [1.145]	0.096** [2.204]	0.0878 [1.466]	0.029 [0.828]	0.044 [1.434]	0.054** [2.125]	0.124*** [3.833]	0.151*** [6.778]	0.148*** [9.328]
	lnDIST	**-0.234** **[-1.367]**	**-0.442***** **[-2.752]**	**-0.045** **[-0.237]**	**0.025** **[0.144]**	**0.240** **[1.106]**	**0.619***** **[2.838]**	**0.303** **[1.203]**	**0.176** **[0.728]**	**-0.594**** **[-2.289]**
	lnMAS	0.396*** [3.424]	0.372*** [15.640]	0.362*** [16.156]	0.357*** [15.420]	0.352*** [13.736]	0.342*** [10.889]	0.287*** [5.769]	0.321*** [8.276]	0.423*** [18.545]
	Obs.	572								
	Slope Equality Stat	171.980***								
	Symmetric Quantiles Stat	140.415***								
	Pseudo R^2	0.156								

Note: "***", "**" and "*" denote the significance of the statistics in the models at the 1%, 5% and 10% levels. The Koenker and Bassett (1982a) test examines the equality of slope coefficients named Slope Equality Stat. The symmetric quantiles test presented Symmetric Quantiles Stat entails conducting the Newey and Powell (1987) test of conditional symmetry.

TABLE A6. Outward foreign direct investment of Turkey — Model V and Model VI PQ Results

	Variable	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90
MODEL V	*constant*	-2.779 [-1.458]	-0.972 [-0.522]	-0.828 [-0.583]	-1.291 [-0.894]	0.034 [0.023]	-0.868 [-0.572]	-0.422 [-0.296]	1.992 [1.545]	4.457*** [5.353]
	lnGDP	-0.430*** [-4.186]	-0.254*** [-3.887]	-0.106* [-1.880]	-0.120** [-2.084]	-0.150** [-2.358]	-0.063 [-1.049]	-0.108** [-2.139]	-0.144*** [-2.609]	0.065 [0.830]
	lnBREX	0.259*** [5.429]	0.128*** [2.660]	0.112*** [3.430]	0.127*** [4.570]	0.131*** [4.856]	0.181*** [6.901]	0.226*** [10.118]	0.228*** [9.377]	0.231*** [11.584]
	lnDIST	**1.211*** **[3.971]**	**0.421*** **[1.697]**	**-0.069** **[-0.422]**	**0.056** **[0.328]**	**0.026** **[0.149]**	**-0.096** **[-0.513]**	**0.054** **[0.247]**	**-0.056** **[-0.227]**	**-0.981*** **[-3.504]**
	lnPOWD	0.806*** [9.883]	0.612*** [7.250]	0.497*** [7.847]	0.410*** [7.407]	0.397*** [7.665]	0.378*** [7.870]	0.349*** [9.008]	0.395*** [11.392]	0.471*** [14.244]
	Obs.	572								
	Slope Equality Stat	79.659***								
	Symmetric Quantiles Stat	64.179***								
	Pseudo R^2	0.148								
		0.10	**0.20**	**0.30**	**0.40**	**0.50**	**0.60**	**0.70**	**0.80**	**0.90**
MODEL VI	*constant*	-6.911** [-2.064]	-2.450 [-1.317]	-3.222* [-1.657]	-1.705 [-0.685]	-3.528 [-1.278]	-2.904 [-1.197]	-0.791 [-0.422]	0.596 [0.358]	9.306*** [4.921]
	lnGDP	0.004 [0.030]	-0.158* [-1.906]	-0.012 [-0.171]	-0.097 [-1.227]	-0.124 [-1.552]	-0.117 [-1.598]	-0.022 [-0.396]	-0.099** [-2.026]	-0.351*** [-2.945]
	lnBREX	0.133** [1.975]	0.078 [0.935]	0.125*** [3.500]	0.138*** [4.533]	0.172*** [5.804]	0.210*** [7.420]	0.213*** [7.646]	0.213*** [7.518]	0.273*** [7.214]
	lnDIST	**-0.088** **[-0.487]**	**0.018** **[0.089]**	**-0.241** **[-1.155]**	**-0.092** **[-0.365]**	**0.288** **[0.866]**	**0.250** **[0.702]**	**-0.231** **[-0.809]**	**-0.094** **[-0.394]**	**-0.185** **[-0.564]**
	lnUNAV	-0.069 [-1.461]	-0.031 [-1.226]	0.033 [1.299]	0.054* [1.814]	0.049 [1.497]	0.075** [2.220]	0.153*** [5.185]	0.180*** [6.940]	0.304*** [10.449]
	Obs.	572								
	Slope Equality Stat	145.920***								
	Symmetric Quantiles Stat	52.259***								
	Pseudo R^2	0.048								

Note: "***", "**" and "*" denote the significance of the statistics in the models at the 1%, 5% and 10% levels. The Koenker and Bassett (1982a) test examines the equality of slope coefficients named Slope Equality Stat. The symmetric quantiles test presented Symmetric Quantiles Stat entails conducting the Newey and Powell (1987) test of conditional symmetry.

South East European Journal of Economics and Business
Volume 20 (2) 2025, 120-133
DOI: 10.2478/jeb-2025-0022

SUSTAINABLE CONSUMPTION BEHAVIOR AMONG GENERATION Z IN CROATIA: UNDERSTANDING ACTIONS AND ATTITUDES IN THE CONTEXT OF GLOBAL ECOLOGICAL CHALLENGES

Halida Sarajlić, Lordan Kondić, Ana Lincender

Abstract

Addressing growing environmental and economic pressures requires a better understanding of how younger consumers engage in sustainable consumption. This study examines sustainable consumption behavior among Generation Z in Croatia, focusing on the effects of unneeded consumption, saving orientation, and product reusability on environmentally sustainable behavior (ESB). A quantitative survey was conducted on a sample of 334 respondents, and the data were analyzed using confirmatory factor analysis and linear regression. The results reveal that unneeded consumption has no statistically significant effect on ESB, while saving orientation and product reusability positively influence pro-environmental behavior. These findings suggest that Croatian Gen Z consumers adopt sustainable practices primarily when they provide tangible economic or practical benefits. By integrating the Theory of Planned Behavior and the Value-Belief-Norm framework, the study contributes to understanding the role of economic pragmatism and moral motivation in shaping youth sustainability, offering context-specific insights for post-transition EU economies.

Keywords: *sustainable consumption, environmentally sustainable behavior, product reusability, unneeded consumption, saving orientation, Generation Z.*

JEL classification: *M31*

1. INTRODUCTION

In the contemporary era, humanity faces an array of profound challenges that impact the economy and business sectors. These challenges include environmental degradation, public health crises, demographic shifts, and other significant global issues. As these factors intertwine, they pose a complex influence on economic stability and business operations worldwide, necessitating a strategic response that aligns with sustainable development principles.

The United Nations' Sustainable Development Goals (SDGs) emphasize the urgent need to address global challenges, with almost half out of the 17 goals directly related to environmental sustainability. These goals call for a systemic transformation in resource consumption

Halida Sarajlić, spec. oec.
Lecturer, Corresponding Author
Algebra Bernays University
Gradišćanska ulica 24, 10000 Zagreb, Croatia
E-mail: halida.sarajlic@algebra.hr
ORCID: https://orcid.org/0000-0001-9040-1278

Lordan Kondić, PhD
Lecturer
Algebra Bernays University, Croatia
E-mail: lordan.kondic@algebra.hr
ORCID: https://orcid.org/0009-0002-9934-5238

Ana Lincender
Student
Algebra Bernays University, Croatia
E-mail: alince1@algebra.hr

and production, highlighting the broader imperative of aligning economic growth with environmental stewardship (UN 2015). In this context, the European Union has embraced global sustainability initiatives. The European Green Deal, which sets ambitious targets for climate neutrality by 2050, underscores the importance of creating a framework that supports a sustainable transition across all member states, aligning with the UN SDGs on environmental sustainability and beyond (European Commision 2024). Croatia, as an EU member, has implemented a range of sustainability measures aligned with EU and UN initiatives, focusing on renewable energy, energy efficiency, and waste management, while also enhancing sustainable across all sectors of economy to mitigate climate change (Knez, Štrbac, and Podbregar 2022).

To achieve the ambitious goals set forth by the UN and the EU, it is imperative that all segments of society, including the economy, public institutions, and the general population, actively participate in sustainability efforts. Engaging a broad spectrum of stakeholders, from businesses to individuals, is essential for fostering a culture of sustainability that supports long-term environmental and economic resilience. The involvement of young consumers is particularly crucial, as their choices and behaviors can significantly influence the success of sustainability initiatives (Aceleanu et al. 2015; Gajović et al. 2023; Tewari et al. 2022). This influence is particularly salient given that younger generations of consumers have the potential to shape the pro-environmental behaviors of their peers and family members, thereby amplifying the impact of sustainability efforts across broader social networks (Muralidharan and Xue 2016).

Generation Z constitutes 40% of the global population (Andruszkiewicz et al. 2023), and as they increasingly enter the workforce and assume specialist, expert, and leadership roles within the business sector, they are poised to become a pivotal force in driving the global economy. Compared to previous generations, Generation Z's technological savviness makes them more inclined toward ethical consumerism, showing a stronger preference for green products and a deeper commitment to environmental sustainability (Djafarova and Foots 2022; Francis and Hoefel 2018; Lavuri, Jusuf, and Gunardi 2021; Robichaud and Yu 2021). However, despite their stated environmental values, there is often a discrepancy between their expressed attitudes and actual behaviors regarding sustainability (Aschemann-Witzel and Niebuhr Aagaard 2014; Nguyen et al. 2018; Lisboa, Vitorino, and Antunes 2022), also observed when comparing Generation Z to older generations (Ham et al. 2022). Although many consumers express intentions to buy ethically or sustainably, only a small proportion translate these intentions into actual purchasing behavior (Campbell 1963; Weigel 1983). Research further suggests that the alignment between attitudes and behaviors is stronger when individuals hold specific attitudes toward engaging in particular environmentally friendly actions, such as recycling, rather than toward general environmental concerns (Gupta 2021). This attitude-behavior gap highlights the need for further research into strategies for promoting consistent eco-friendly behavior among young people, especially in today's challenging economic context where motivating sustainable consumption is crucial.

The objective of the research was to assess and explore sustainable consumption behaviors among young consumers. The analysis is based on a sample of 334 Generation Z consumers in Croatia. A regression analysis was conducted to determine the effect of three independent variables (unneeded consumption, saving orientation, and product reusability) on the dependent variable environmental sustainability behavior (ESB). These variables were measured using a four-dimensional Sustainable Consumption Behavior scale (Doğan, Bulut, and Kökalan 2015).

Given the importance of aligning Croatia's practices with the European Union's sustainability goals, understanding the sustainable consumption patterns of young consumes, Generation Z, is essential for shaping effective strategies (Fischer, Böhme, and Geiger 2017; Ziesemer, Hüttel, and Balderjahn 2021) at both national and EU levels. As this demographic group is poised to drive future economic trends, their consumption habits and the potential alignment, or discrepancy, between their attitudes and behaviors are critical areas of investigation.

2. THEORETICAL FRAMEWORK AND RESEARCH HYPOTHESIS

2.1. The multi-faceted nature of sustainability and sustainable consumption among Generation Z

The concept of sustainability is broad and evolving, defined across various fields in ways that reflect its multi-dimensional nature. The most widely recognized definition, introduced by the Brundtland Report in 1987, emphasizes intergenerational equity in resource use, describing it as a development approach that meets current needs without compromising the ability of future generations to fulfill their own (Hajian and Kashani 2021). Sustainability is also viewed as a balance encompassing environmental, health-related,

ethical, and economic dimensions (Reisch, Eberle, and Lorek 2013).

Furthermore, the concept is increasingly approached through systems thinking, focusing on maintaining the resilience and health of ecological and social systems amid growing pressures from human activities (Olsson, Galaz, and Boonstra 2014). From a business perspective, sustainability involves practices that promote long-term economic growth while preserving natural resources and avoiding irreversible environmental damage, thereby aligning profitability with ethical responsibility (Rausch, Baier, and Wening 2021). These perspectives converge on a core principle: achieving development that harmonizes environmental, social, and economic goals to secure well-being now and in the future (Booi-Chen and Teck-Chai 2009), while also encompassing the continuous delivery of adaptable programs, interventions, and behaviors that maintain benefits over time (Moore, Mascarenhas, and Straus 2017).

When it comes to consumer behavior, sustainable practices involve consumption patterns that minimize negative environmental, social, and economic impacts while still satisfying personal needs and desires. According to Carrero et al. (2020), sustainable consumption includes purchasing environmentally friendly products, reducing consumption by simplifying lifestyles, and engaging in activism to promote societal change. Such behavior is influenced by intrinsic factors like personal values and ethics, as well as extrinsic factors such as social norms, available infrastructure, and economic incentives (Lisboa, Vitorino, and Antunes 2022), and it can also result from anti-consumption practices, where intentionally limiting or avoiding consumption reduces environmental impact (Ziesemer, Hüttel, and Balderjahn 2021).

Given the increasing societal emphasis on sustainability, it becomes important to understand how different consumer groups interpret and adopt sustainable consumption. Among them, Generation Z has emerged as a particularly influential cohort, both as current consumers and as future decision-makers shaping sustainability trends.

Generation Z, born roughly between the mid-1990s and early 2010s, is recognized as a cohort of digital natives who are highly informed about global issues and deeply aware of the importance of sustainability (Chen, Yan, and Liew 2023; Ewe and Tjiptono 2023). As tech-savvy individuals with constant access to digital platforms (Ninan, Roy, and Cheriyan 2020), they are particularly engaged with environmental and social issues through digital channels, which significantly shape their attitudes and expectations toward sustainability (Silveira et al. 2024). Their relationship with sustainability is driven by a mix of personal values, social influences, and growing demands for companies to adopt ethical practices. This is reflected in their support for brands that prioritize corporate social responsibility (CSR), with many actively rewarding such companies through their purchasing choices (Narayanan 2022; Wang et al. 2021). The consumer behavior of this cohort signals a shift toward more value-driven and ethical consumption patterns, influencing both market trends and societal norms (Bogueva and Marinova 2022).

While this generation expresses a strong preference for eco-friendly products and sustainable practices, factors such as convenience, cost, and the availability of green alternatives continue to pose significant barriers (Liang, Li, and Lei 2022; Ziesemer, Hüttel, and Balderjahn 2021). Research also indicates that many young consumers have a limited understanding of broader sustainability concepts like the circular economy, which restricts their ability to fully engage in sustainable consumption (Gazzola et al. 2020).

In Croatia, these global trends are similarly observed. Croatian Generation Z consumers are digitally savvy and active online (Perić, Mamula, and Delić 2020). While they acknowledge the significance of sustainability, they often view sustainability as a responsibility of those in leadership positions (Krstinić, Nižić, and Butković 2023). Financial constraints, limited information, and perceived inconveniences related to sustainable choices are among the significant barriers to sustainable consumption (Nikolić et al. 2022; Šebek, Sarajlić, and Jurković 2022), aligning with global research findings (Dąbrowski et al. 2022; Sheoran and Kumar 2020).

2.2. Theoretical framework and research hypotheses

The study of sustainable consumption behavior has drawn on multiple theoretical frameworks attempting to explain why individuals engage, or fail to engage, in environmentally responsible behavior. Among these, two complementary approaches have been particularly influential: the Theory of Planned Behavior (TPB) (Ajzen 1991) and the Value-Belief-Norm (VBN) theory (Stern 2000).

The TPB explains behavior through three key determinants: attitude toward the behavior, subjective norms, and perceived behavioral control. Together, these shape the individual's behavioral intention, which predicts actual behavior. The model has been extensively applied to sustainable consumption (Kara and Min 2024), as it accounts for rational and

volitional processes driving consumer decision-making. However, TPB has also been criticized for overlooking moral and normative motivations, which are key factors when analyzing behavior tied to environmental values (Harland, Staats, and Wilke 1999).

The VBN theory complements this limitation by embedding sustainability behavior in a moral and values-based process. It postulates a causal chain linking personal values (biospheric, altruistic, or egoistic) to environmental beliefs, awareness of consequences, and activation of personal norms that motivate pro-environmental actions (Stern 2000). Recent research further supports this perspective, showing that sustainability-related decisions among younger generations are primarily driven by internalized moral values and identity-based responsibility (Lopes et al. 2024), while the development of sustainability competencies and knowledge from diverse sources reinforces these values and strengthens pro-environmental attitudes (Cyfert et al. 2024).

Integrating TPB and VBN offers a comprehensive framework connecting cognitive–rational determinants (attitudes, perceived control) with moral–normative forces (values, personal norms). While TPB clarifies how individuals form intentions to act sustainably, VBN explains why they feel morally compelled to do so (Loo et al. 2023; Theocharis et al. 2025). The integration of these theories thus enhances explanatory power, capturing the complex mechanisms behind sustainability behavior among younger consumers.

Unneeded consumption and ESB. Unneeded consumption, characterized by impulsive or excessive purchasing, often contradicts sustainable behavior. The phenomenon is well-documented in studies highlighting the negative environmental impact of overconsumption. Consumers engaging in unneeded consumption prioritize immediate gratification over long-term sustainability, resulting in higher levels of waste and resource depletion (Klug and Niemand 2021). It reflects low perceived behavioral control within TPB and weak norm activation within VBN (Lopes et al. 2024). Research reveals that younger generations, particularly Generation Z, generally show lower tendencies toward unneeded consumption compared to older generations, as they are more attuned to sustainability concerns (Bulut, Kökalan Çımrin, and Doğan 2017). However, other studies indicate that Generation Z's strong online presence makes them susceptible to impulsive purchasing behaviors driven by digital platforms, leading to overconsumption (Ah Fook and McNeill 2020). The ease of access to online shopping options and tailored marketing strategies significantly influence their impulsive buying behavior (Xiong 2020; Yusak, Mohd, and Yusran 2022), and excessive buying behavior (often influenced by digital marketing, peers, and social comparison) undermines sustainability goals (Bloodhart and Swim 2020). This duality within Generation Z highlights the complexity of their consumption habits and the tension between their sustainability aspirations and behaviors influenced by digital convenience. Within the integrated TPB-VBN framework, unneeded consumption reflects both low perceived behavioral control and weak norm activation, leading to a lower likelihood of engaging in sustainable actions. Individuals who frequently engage in unneeded or impulsive consumption are expected to demonstrate lower levels of ESB, therefore the following hypothesis is proposed:

H1: Unneeded consumption negatively affects ESB.

Saving orientation and ESB. A saving mindset is closely linked to optimizing resource use, aligning with sustainability goals by promoting behaviors like purchasing energy-efficient products and effectively managing electricity consumption (Bulut, Kökalan Çımrin, and Doğan 2017). Future-oriented consumers are especially inclined to prioritize long-term savings by investing in pro-environment products, recognizing that these choices benefit both financial savings and pro-environmental goals (Tangari and Smith 2012). This suggests a strong correlation between saving orientation and environmentally sustainable behavior, with those who are saving-oriented more likely to adopt sustainable practices focused on resource management and energy-saving devices (Chiu, Kuo, and Liao 2020; Gadenne et al. 2011; Shrestha et al. 2021; Tan, Ooi, and Goh 2017). This also aligns with TPB's perceived control and with the VBN's altruistic values, where financial self-discipline is perceived as part of responsible resource management (Kara and Min 2024). A stronger saving orientation indicates higher self-control and an awareness of the consequences of overconsumption, promoting environmentally responsible behavior. Saving-oriented individuals are therefore more likely to translate their pro-environmental intentions into action, as saving behavior simultaneously satisfies rational (economic) and moral (sustainability-related) motivations. Based on this reasoning, the following hypothesis is proposed:

H2: Saving orientation positively affects ESB.

Product reusability and ESB. Product reusability is a key component of sustainability, emphasizing the importance of extending product lifecycles and reducing waste. In the context of this research, product reusability encompasses both the reuse of products or their components after their originally intended lifecycle and the practice of borrowing instead of purchasing new products. Consumers who prioritize reusability are more likely to adopt sustainable practices, seeking to maximize the value of products while minimizing environmental impact (Muranko et al. 2021). Additionally, there is broad consumer support for product reuse, with second-hand products generally being well-accepted (Cao, Lu, and Zhu 2022). This is particularly relevant for Generation Z, who are increasingly aware of the environmental consequences of disposable products but still consume fewer sustainable goods compared to other generations (Park and Lin 2018), therefore encouraging greater engagement in reuse practices among this cohort is critical. By focusing on product reusability, consumers can significantly reduce resource consumption and environmental degradation, thereby aligning their behavior with broader sustainability goals (Narayanan 2022). Product reusability links to personal moral norms and awareness of consequences in VBN (Stern 2000; Cyfert et al. 2024), as well as to the behavioral control dimension of TPB, since the ease or feasibility of reusing products directly affects action. Studies suggest that young consumers' willingness to reuse products reflects both moral concern and perceived capability to engage in circular behavior (Pšurný et al. 2024). Within the TPB-VBN integration, reusability behavior represents the alignment of perceived behavioral control and moral obligation: individuals act sustainably when they both believe they can and feel they should. Given this reasoning, H3 is as follows:

H3: Product reusability positively affects ESB.

3. DATA AND METHODOLOGY

3.1. Sample and data collection

Quantitative research was used to collect data from respondents regarding their attitudes about ESB and how this behavior is correlated with unneeded consumption, saving orientation, and product reusability. The questionnaire was distributed in two waves. First from July 28th to August 11th 2023, and second, from 20th to 26th October 2025, through various channels, including WhatsApp, Instagram Story, Reddit, Discord, and Facebook groups. A snowball sampling technique was used for data collection. In parallel, an initial group of participants was selected from graduate students of Digital Marketing at Algebra Bernays University College in Zagreb, Croatia. The final sample, collected across both waves, consisted of 334 respondents aged 18–30. Females represented 62.6% of the sample, with the 18–21 age group being the most dominant (49.4%). Two software packages were used for data analysis: SPSS and JASP (for CFA).

3.2. Measurement instrument

Questionnaire is based on the Sustainable Consumption Behavior Scale (SCBS) developed by Doğan et al. (2015). The SCBS is a tool for assessing sustainable consumption practices across four dimensions: ESB, unneeded consumption, saving orientation, and product reusability. It originally consists of 17 items, rated on a five-point Likert scale (1 = never, 5 = always). Each dimension captures a specific aspect of consumption behavior: ESB assesses eco-conscious purchasing, unneeded consumption reflects impulsive or excessive shopping, saving orientation measures resource conservation efforts (e.g., energy efficiency), and product reusability evaluates the tendency to reuse products rather than discard them. The item "I buy products from companies that support environmental responsibility" was excluded from the original ESB construct in this research due to conceptual inconsistency. As Delmas and Burbano (2011) explain, corporate environmental claims are frequently affected by greenwashing, which creates significant information asymmetry and leads to consumer misperception. Because consumers cannot reliably evaluate the actual environmental responsibility of companies, this item would capture perceived corporate image rather than genuine pro-environmental behavior, thereby compromising the construct's validity. In contrast, while the first item in the scale ("I buy cleaning products that cause less environmental harm") also refers to product-related information, it reflects a decision that consumers can directly evaluate and control through observable cues such as eco-labels or ingredient lists (Testa et al. 2015). Assessing corporate environmental responsibility, however, requires information beyond consumers' immediate knowledge and control, and therefore does not align with the theoretical definition of behavioral measures within the TPB and VBN frameworks. In this study, an attempt was made to examine whether unneeded consumption, saving orientation, and product

reusability, as independent variables, have an effect on ESB as the dependent variable through a linear regression model.

To assess the internal consistency of the measurement scales, Cronbach's alpha coefficients were calculated for each construct included in the study. According to Hair et al. (2019), Cronbach's alpha values of 0.70 or higher are generally considered acceptable, indicating satisfactory internal reliability. The initial analysis for ESB produced an alpha coefficient of 0.54, indicating low internal consistency. Item-level diagnostics revealed that the statement "I do not buy single-use packaged products." in ESB construct had a very low corrected item - total correlation (r = 0.09), suggesting that it did not align well with the underlying construct. After removing this item, Cronbach's alpha increased to 0.637, representing a noticeable improvement in internal reliability. Although the coefficient remains slightly below the conventional 0.70 threshold suggested by Hair et al. (2019), the revised scale demonstrates a satisfactory level of consistency for exploratory research. The scale measuring unneeded consumption demonstrated a Cronbach's alpha of 0.83, indicating very good internal consistency. This suggests that the items consistently measure the same underlying construct and provide reliable results. The saving orientation scale achieved a Cronbach's alpha coefficient of 0.84 after removing the item "In my household we use energy saving bulbs." (with the item included, the Cronbach alpha was 0.82), confirming very good reliability and strong internal consistency among items. This value exceeds the recommended threshold of 0.70, supporting the reliability of this measurement instrument. The scale assessing product reusability obtained a Cronbach's alpha value of 0.65. While this falls slightly below the ideal level of 0.70, it still indicates an acceptable level of internal consistency for early-stage or exploratory research (Hinton et al. 2014; Hair et al. 2019). After removing conceptually inconsistent items, the final version of the questionnaire comprised 14 items that were used for all subsequent analyses.

To confirm the dimensionality and validity of the measurement model, a confirmatory factor analysis (CFA) was conducted using maximum likelihood estimation. CFA was applied to assess how well the observed variables represent the underlying latent constructs: unneeded consumption, saving orientation, product reusability, and ESB. The procedure allowed for an evaluation of factor loadings, model fit indices, and construct validity (Hu and Bentler 1999). The confirmatory factor analysis supported the hypothesized four-factor structure, indicating that the items loaded significantly on their respective constructs. All standardized factor loadings exceeded the recommended threshold of 0.50 (Hair et al. 2019), demonstrating satisfactory indicator reliability. The fit indices (CFI, TLI, RMSEA, and SRMR) met the recommended cut-off values, confirming an acceptable overall model fit. Specifically, unneeded consumption, saving

Table 1. Kaiser-Meyer-Olkin (KMO) test

Indicator	MSA
I buy cleaning products that do not harm the environment.	0.834
I buy clothes made from natural materials.	0.805
I encourage my family and friends not to buy products that harm the environment.	0.837
I replace technological devices like phones even when unnecessary.	0.785
I buy new clothes even when I do not need them.	0.855
I buy products without prior thought or when they are unnecessary.	0.758
I buy new products even when I already have similar ones.	0.780
I buy food and drinks even when they are not necessary.	0.857
In my household, we buy energy-efficient appliances.	0.772
In my household, we buy electronic devices that consume less energy.	0.753
In my household, we are mindful of electricity consumption.	0.824
I reuse product packaging like glass or cardboard instead of throwing it away.	0.875
I borrow or rent products instead of purchasing them.	0.829
I reuse paper for taking notes or other purposes.	0.842
Overall	0.808

orientation, product reusability, and ESB were found to be distinct yet related dimensions of environmentally sustainable consumer behavior. Therefore, the CFA results confirm that the measurement model adequately represents the theoretical structure underlying the data.

As presented in Table 1, all MSAs are higher than 0.7. Bartlett's test of sphericity (df = 91) indicated that the correlation matrix differs significantly from an identity matrix ($p < .001$), confirming that the data are suitable for factor analysis.

The comparison between the baseline (independence) model and the hypothesized factor model indicated a substantial improvement in model fit. The baseline model, which assumes that all observed variables are uncorrelated, yielded a chi-square value of $\chi^2(91) = 2194.99$, representing a poor fit to the data. In contrast, the hypothesized factor model achieved a significantly lower chi-square value of $\chi^2(77) = 809.01$, $p < .001$, demonstrating a much better fit.

This large and statistically significant reduction in the chi-square statistic confirms that the specified factor structure explains the observed covariances far better than a model assuming no relationships among variables. Therefore, the results provide strong support for the adequacy of the proposed measurement model (Hair et al. 2019).

Values in Table 2 represent the contribution of each individual item within the factor model. Since the factor model was specified with independent factors, the values reflect the contribution of each item to its corresponding latent construct.

The standardized factor loadings obtained from the confirmatory factor analysis (CFA) are all statistically significant ($p < .001$), confirming that each observed item meaningfully contributes to its respective latent construct. The loadings presented in Table 3 ranged from 0.52 to 0.98, exceeding the commonly accepted minimum threshold of 0.50 (Hair et al. 2019).

Within the ESB construct, the loadings ranged between 0.57 and 0.82, indicating that all items consistently capture pro-environmental behavioral tendencies. The construct unneeded consumption demonstrated high loadings (0.68-0.98), suggesting a strong and homogeneous representation of impulsive or excessive buying behavior. Similarly, saving orientation showed factor loadings from 0.76 to 1.02, reflecting a stable and well-defined construct associated with cost-conscious purchasing behavior. Lastly, product reusability displayed loadings between 0.74 and 0.95, confirming that items measuring reuse and recycling practices contribute strongly to this latent factor. The results confirm the convergent validity of all four constructs, as each indicator loads significantly and substantially on its intended latent variable, indicating that the measurement model demonstrates strong indicator reliability and adequately represents the theoretical structure of ESB.

To further assess the convergent validity of the constructs, the Average Variance Extracted (AVE) was

Table 2. R-Squared

Item	R^2
I buy cleaning products that do not harm the environment.	0.386
I buy clothes made from natural materials.	0.295
I encourage my family and friends not to buy products that harm the environment.	0.440
I replace technological devices like phones even when unnecessary.	0.291
I buy new clothes even when I do not need them.	0.523
I buy products without prior thought or when they are unnecessary.	0.588
I buy new products even when I already have similar ones.	0.737
I buy food and drinks even when they are not necessary.	0.414
In my household, we buy energy-efficient appliances.	0.539
In my household, we buy electronic devices that consume less energy.	0.901
In my household, we are mindful of electricity consumption.	0.518
I reuse product packaging like glass or cardboard instead of throwing it away.	0.335
I borrow or rent products instead of purchasing them.	0.371
I reuse paper for taking notes or other purposes.	0.457

Table 3. Factor loadings

Factor	Indicator	Estimate	Std. Error	p	95% Confidence Interval	
					Lower	**Upper**
ESB	I buy cleaning products that do not harm the environment.	0.678	0.079	0.000	0.524	0.833
	I buy clothes made from natural materials.	0.578	0.078	1.117×10^{-13}	0.426	0.731
	I encourage my family and friends not to buy products that harm the environment.	0.815	0.089	0.000	0.640	0.991
Unneeded consumption	I replace technological devices like phones even when unnecessary.	0.676	0.067	0.000	0.545	0.806
	I buy new clothes even when I do not need them.	0.978	0.057	0.000	0.866	1.090
	I buy products without prior thought or when they are unnecessary.	0.889	0.050	0.000	0.791	0.987
	I buy new products even when I already have similar ones.	1.006	0.047	0.000	0.914	1.099
	I buy food and drinks even when they are not necessary.	0.765	0.061	0.000	0.645	0.885
Saving orientation	In my household, we buy energy-efficient appliances.	0.791	0.057	0.000	0.680	0.903
	In my household, we buy electronic devices that consume less energy.	1.023	0.050	0.000	0.925	1.121
	In my household, we are mindful of electricity consumption.	0.841	0.059	0.000	0.725	0.956
Product reusability	I reuse product packaging like glass or cardboard instead of throwing it away.	0.739	0.087	0.000	0.569	0.910
	I borrow or rent products instead of purchasing them.	0.811	0.090	0.000	0.635	0.986
	I reuse paper for taking notes or other purposes.	0.955	0.100	0.000	0.760	1.151

calculated for each latent variable (Table 4). According to Fornell and Larcker (1981), AVE values above 0.50 indicate that a construct explains more than half of the variance in its observed indicators, thus confirming adequate convergent validity. In this study, unneeded consumption achieved an AVE of 0.505, meeting the recommended threshold, while ESB obtained a slightly lower value of 0.381. Although this indicates that ESB items share a moderate rather than strong level of common variance, all factor loadings were significant and most exceeded 0.50, suggesting acceptable convergent validity for exploratory research (Hair et al. 2019). The relatively lower AVE for ESB therefore points to the need for refining or rewording certain items in future studies to better capture the construct's underlying dimension.

Internal reliability was further examined using McDonald's omega (ω), as shown in Table 4, and Composite Reliability (CR) coefficients for each construct (Table 4). Following Hair et al. (2019), reliability values above 0.70 are considered satisfactory for established constructs, while values between 0.60 and 0.70 are acceptable for exploratory research (Fornell and Larcker 1981). The results show that all constructs achieved satisfactory composite reliability (CR = 0.74–0.94), confirming strong internal consistency. While unneeded consumption and saving orientation demonstrated high reliability (ω > 0.80), product reusability and ESB displayed slightly lower coefficients (ω = 0.64-0.84), indicating some conceptual heterogeneity among items. Despite these moderate values, all constructs exhibit acceptable reliability for exploratory purposes, particularly given the theoretical novelty and multidimensional nature of the model. Accordingly, all constructs were retained for subsequent structural analysis, with a recommendation that future studies refine or expand certain scales to enhance internal consistency.

Table 4. Results for AVE and McDonald's omega coefficient

Construct	AVE	Coefficient ω
ESB	0.381	0.644
Unneeded consumption	0.505	0.832
Saving orientation	0.645	0.843
Product reusability	0.392	0.656

3.3. Hypothesis testing and results

After confirming the reliability and validity of the measurement model, the next step involved testing the hypothesized relationships between the constructs. The aim of this analysis was to examine whether unneeded consumption, saving orientation, and product reusability (as independent variables) have a statistically significant effect on ESB, which serves as the dependent variable in the model. A linear regression model was employed to assess the strength and direction of these relationships. Prior to the regression analysis, the overall significance of the model was evaluated using an ANOVA test, which determines whether the combination of independent variables explains a statistically significant portion of variance in the dependent variable.

The results of the ANOVA test confirmed that the overall regression model is statistically significant, F (3, 330) = 34.43, $p < .001$. The coefficient of determination (R^2 = 0.238) shows that approximately 23.8% of the variance in environmentally sustainable behavior can be explained by these three predictors (Table 5).

After confirming that the overall regression model is statistically significant, the next step involved testing the individual hypotheses proposed in the conceptual framework. The study has three hypotheses and the results of the regression analysis are shown in Table 6:

H1: Unneeded consumption negatively affects ESB.
H2: Saving orientation positively affects ESB.
H3: Product reusability positively affects ESB.

Unneeded consumption has no statistically significant effect on ESB (β = –0.030, t = –0.611, p = 0.542). Therefore, Hypothesis H1, which proposed that unneeded consumption negatively affects environmentally sustainable behavior, is not supported.

In contrast, both saving orientation (β = 0.290, t = 5.510, p < 0.001) and product reusability (β = 0.283, t = 5.268, p < 0.001) have statistically significant and positive effects on ESB, confirming that higher levels of saving orientation and product reusability tendencies are associated with stronger environmentally sustainable behavior. Thus, Hypothesis H2 and Hypothesis H3 are supported.

The results of the hypothesis testing provide partial support for the proposed conceptual model. Among the three examined predictors, saving orientation and product reusability emerged as significant positive determinants of ESB, confirming that consumers who are more financially cautious and who engage in reusing or repurposing products are more likely to exhibit environmentally responsible behavior.

Table 5. ANOVA model summary

R	R Square	Std. Error of the Estimate	Change Statistics R Square Change	F Change	df1	df2	Sig. F Change
0.488	0.238	0.75463	0.238	34.431	3	330	0.000

Table 6. Regression analysis with ESB as dependent variable

	Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.	Zero-order	Partial	VIF
(Constant)	1.208	0.227		5.326	0.000			
Unneeded consumption	-0.028	0.045	-0.030	-0.611	0.542	-0.139	-0.034	1.063
Saving orientation	0.259	0.047	0.290	5.510	0.000	0.410	0.290	1.203
Product reusability	0.236	0.045	0.283	5.268	0.000	0.408	0.279	1.247

5. DISCUSSION

The study explored how distinct consumption orientations, unneeded consumption, saving orientation, and product reusability, shape ESB among Croatian Generation Z consumers. The findings provide insights into the complex dynamics between sustainability awareness and actual consumption patterns within a post-transition, EU-member context.

The rejection of H1, indicating that unneeded consumption has no significant effect on ESB, reflects the coexistence of sustainable and unsustainable behaviors, representing a pattern widely discussed in the literature, where consumers' pro-environmental attitudes often fail to translate into consistent sustainable actions (Longoni, Gollwitzer, and Oettingen 2014; Ham et al. 2021). Similar findings have been reported in international studies showing that young consumers often engage in eco-friendly behaviors, such as recycling or energy saving, while simultaneously over-consuming or engaging in impulsive purchases (Ah Fook and McNeill 2020; Ziesemer, Hüttel, and Balderjahn 2021). In Croatia, this paradox may be further intensified by economic and social factors: limited purchasing power, the perception of sustainable products as expensive, and the strong influence of social media trends that promote impulsive buying. Generation Z's digital lifestyle, characterized by constant exposure to influencer marketing, short-form videos, and "fast fashion" culture, creates a consumption environment that simultaneously encourages sustainability signaling and impulsive purchases. This tension illustrates why environmental attitudes do not always translate into consistent behavioral outcomes.

In contrast, the acceptance of H2 and H3 confirms that saving orientation and product reusability are significant positive predictors of ESB. These results align with prior research emphasizing the dual nature of saving behavior: it satisfies both economic rationality and moral responsibility (Bulut, Kökalan Çımrin, and Doğan 2017; Chiu, Kuo, and Liao 2020; Kara and Min 2024). In the Croatian context, where economic uncertainty and inflation shape consumer priorities, sustainable practices are often adopted when they also lead to tangible financial benefits, such as lower energy costs or savings through product reuse. This pattern reinforces findings from Lopes et al. (2024), who note that Gen Z's green behavior is frequently driven more by pragmatic motives than by purely altruistic ones.

The strong association between product reusability and ESB suggests that Croatian Gen Z consumers are receptive to sustainability actions that are convenient, familiar, and cost-effective which are behaviors that require little additional effort or financial sacrifice. These findings are consistent with Muranko et al. (2021) and Pšurný et al. (2024), who highlight that reusability practices, such as repurposing or borrowing, are perceived as accessible entry points to sustainable living. The social dimension of these behaviors also resonates with VBN theory, as reusability often fosters moral satisfaction and social recognition within peer networks.

Overall, this study positions Croatian Generation Z within the broader European discourse as pragmatic - a cohort that values sustainability but approaches it through economic rationality rather than strict environmental activism. Their behavior mirrors trends observed in other emerging EU economies, where sustainability is interpreted through affordability and practicality (Cyfert et al. 2024).

From a theoretical perspective, the results confirm that economic motivations and perceived behavioral control, core elements of the integrated TPB-VBN framework, are essential for explaining sustainable behavior in this demographic. This supports the argument that Gen Z's sustainability is less a moral obligation and more a function of perceived self-efficacy and cost-benefit evaluation.

The study's limitations must also be acknowledged. First, although the CFA confirmed satisfactory validity and reliability, the product reusability and ESB constructs exhibited moderate internal consistency. This may reflect the multidimensional nature of these behaviors. Second, the snowball sampling limits generalizability, and self-reported data may be affected by social desirability bias. Finally, while economic and attitudinal determinants were examined, digital behavior, social media engagement, and peer influence were not directly measured but are likely critical mediating factors.

Future research should therefore extend beyond demographic or psychographic profiling and adopt mixed-method approaches to explore how online ecosystems, digital communication, and algorithmic exposure influence sustainable consumption. Moreover, cross-cultural comparisons with other post-transition EU countries could reveal whether the pragmatic orientation observed among Croatian Gen Z consumers represents a broader regional pattern.

6. CONCLUSION

This study provides empirical evidence on the determinants of ESB among Generation Z consumers in Croatia. By integrating TPB and VBN framework, the analysis confirms that sustainability-related behaviors are best understood as an interplay between economic pragmatism and moral intention.

The results reveal that unneeded consumption does not significantly influence ESB, reinforcing the persistence of the attitude–behavior gap and the coexistence of sustainable and unsustainable practices. In contrast, saving orientation and product reusability emerged as robust predictors of ESB, demonstrating that young consumers are more likely to adopt sustainable actions when such behaviors align with economic efficiency or personal convenience.

Practical and social implications. These findings have several implications for policymakers, educators, and businesses. Policymakers should design interventions that highlight financial incentives for sustainable choices, such as subsidies for energy-efficient products, product repair programs, or deposit-refund systems that reward reusability. Educational institutions can strengthen sustainability curricula by linking environmental responsibility to personal economic benefits and digital literacy, helping young people critically evaluate marketing stimuli in online environments. For businesses, emphasizing cost savings, product longevity, and reusability in marketing communications may prove more effective than relying solely on environmental appeals.

Directions for future research. Further studies should expand the model by incorporating digital consumption patterns, such as exposure to influencer marketing, greenwashing perception, or social media-driven purchasing, to better capture the digital-behavioral dimension of Gen Z's sustainability. Longitudinal and comparative studies across different EU contexts would also help determine whether the findings reflect transitional economic conditions or generational preferences more broadly.

In sum, the research enriches the understanding of sustainable consumption among Croatian Generation Z consumers by showing that sustainable behavior is less about idealistic commitment and more about feasible, economically rational action. Bridging the gap between ecological awareness and daily consumption thus requires aligning sustainability with personal benefit, convenience, and social validation as an approach that can make sustainability both realistic and achievable for the generations to come.

References

Aceleanu, M. I., Serban, A. C., and Burghelea, C. 2015. "Greening" the youth employment—a chance for sustainable development. Sustainability 7 (3): 2623-2643.

Ah Fook, L. and McNeill, L. 2020. Click to buy: The impact of retail credit on over-consumption in the online environment. Sustainability 12 (18): 7322.

Ajzen, I. 1991. The theory of planned behavior. Organizational behavior and human decision processes 50 (2): 179-211.

Andruszkiewicz, K., Grzybowska-Brzezińska, M., Grzywińska-Rąpca, M., and Wiśniewski, P. D. 2023. Attitudes and Pro-Environmental Behavior of Representatives of Generation Z from the Example of Poland and Germany. Sustainability 15 (20): 15068.

Bloodhart, B. and Swim, J. K. 2020. Sustainability and consumption: what's gender got to do with it? Journal of Social issues 76 (1): 101-113.

Bogueva, D. and Marinova, D. 2022. Australian Generation Z and the nexus between climate change and alternative proteins. Animals 12 (19): 2512.

Booi-Chen, T. and Teck-Chai, L. A. U. 2009. Examining sustainable consumption patterns of young consumers: is there a cause for concern?. Journal of International Social Research 2 (9): 465-472.

Bulut, Z. A., Kökalan Çımrin, F., and Doğan, O. 2017. Gender, generation and sustainable consumption: Exploring the behaviour of consumers from Izmir, Turkey. International journal of consumer studies 41 (6): 597-604.

Campbell, D. T. 1963. Social attitudes and other acquired behavioral dispositions. https://psycnet.apa.org/record/1964-06919-003. Accessed 4 May 2024.

Cao, Y., Lu, H., and Zhu, C. 2022. Consumer preference for end-of-life scenarios and recycled products in circular economy. Sustainability 14 (19): 12129.

Carrero, I., Valor, C., and Redondo, R. 2020. Do all dimensions of sustainable consumption lead to psychological well-being? Empirical evidence from young consumers. Journal of Agricultural and Environmental Ethics 33: 145-170.

Chen, Y. S., Yan, X., and Liew, C. B. A. 2023. University Social Responsibility in China: The Mediating Role of Green Psychological Capital. International journal of environmental research and public health 20 (4): 3634.

Chiu, M. C., Kuo, T. C., and Liao, H. T. 2020. Design for sustainable behavior strategies: Impact of persuasive technology on energy usage. Journal of Cleaner Production 248: 119214.

Cyfert, S., Górka, J., Piórkowska, K., Dyduch, W., Glabiszewski, W., and Batko, R. 2024. Shaping sustainable development of tomorrow: generation Z competencies, green consumption values and the role of knowledge acquisition sources. Central European Management Journal.

https://doi.org/10.1108/CEMJ-07-2024-0213 Accessed 20 October 2025.

Dąbrowski, L. S., Środa-Murawska, S., Smoliński, P., and Biegańska, J. 2022. Rural–urban divide: Generation Z and pro-environmental behaviour. Sustainability 14 (23): 16111.

Delmas, M. A. and Burbano, V. C. 2011. The drivers of greenwashing. California management review 54 (1): 64-87.

Djafarova, E. and Foots, S. 2022. Exploring ethical consumption of generation Z: Theory of planned behaviour. Young Consumers 23 (3): 413–431.

Doğan, O., Bulut, Z. A., and Kökalan Çımrın, F. 2015. A scale development study to measure individuals' sustainable consumption behavior. Ataturk University Journal of Economics and Administrative Sciences 29: 659–678.

European Commission 2024. Achievements of the von der Leyen commission, The European Green Deal. https://commission.europa.eu/documents_en. Accessed 30 July 2024.

Ewe, S. Y. and Tjiptono, F. 2023. Green behavior among Gen Z consumers in an emerging market: eco-friendly versus non-eco-friendly products. Young Consumers 24 (2): 234-252.

Fischer, D., Böhme, T., and Geiger, S. M. 2017. Measuring young consumers' sustainable consumption behavior: Development and validation of the YCSCB scale. Young consumers 18 (3): 312-326.

Fornell, C. and Larcker, D. F. 1981. Evaluating structural equation models with unobservable variables and measurement error. Journal of marketing research 18 (1): 39-50.

Francis, T. and Hoefel, F. 2018. True Gen': Generation Z and its implications for companies. McKinsey & Company. http://www.drthomaswu.com/uicmpaccsmac/Gen%20Z.pdf. Accessed May 5 2024.

Gadenne, D., Sharma, B., Kerr, D., and Smith, T. 2011. The influence of consumers' environmental beliefs and attitudes on energy saving behaviours. Energy policy 39 (12): 7684-7694.

Gajović, A., Bjelica, D., Pavlović, D., and Vukmirović, D. 2023. Educating youth on project sustainability: project engagement and recognition of the green deal. Applied Ecology and Environmental Research 2023 21 (4): 2969–2989.

http://dx.doi.org/10.15666/aeer/2104_29692989. Accessed April 4 2024.

Gazzola, P., Pavione, E., Pezzetti, R., and Grechi, D. 2020. Trends in the fashion industry. The perception of sustainability and circular economy: A gender/generation quantitative approach. Sustainability 12 (7): 2809.

Gupta, V. 2021. Investigating the mediating role of green intention between green attitude-behaviour gap. Marketing in 2021, 33. https://www.researchgate.net/. Accessed 10 June 2024.

Hair, J. F., Black, W. C., Babin, B. J., and Anderson, R. E. 2009. Multivariate data analysis (7th ed.). Prentice-Hall.

Ham, C. D., Chung, U. C., Kim, W. J., Lee, S. Y., and Oh, S. H. 2022. Greener than others? Exploring generational differences in green purchase intent. International Journal of Market Research 64 (3): 376-396.

Hajian, M. and Kashani, S. J. 2021. Evolution of the concept of sustainability. From Brundtland Report to sustainable development goals. In Sustainable resource management (1-24). Elsevier.

Harland, P., Staats, H. and Wilke, H. A. 1999. Explaining proenvironmental intention and behavior by personal norms and the Theory of Planned Behavior 1. Journal of applied social psychology 29 (12): 2505-2528.

Hinton, P. R., McMurray, I., and Brownlow, C. 2014. SPSS explained. Routledge.

Hu, L. T. and Bentler, P. M. 1999. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. Structural equation modeling: a multidisciplinary journal 6 (1): 1-55.

Kara, A. and Min, M. K. 2024. Gen Z consumers' sustainable consumption behaviors: influencers and moderators. International Journal of Sustainability in Higher Education 25 (1): 124-142.

Klug, K. and Niemand, T. 2021. The lifestyle of sustainability: Testing a behavioral measure of precycling. Journal of Cleaner Production 297: 126699.

Knez, S., Štrbac, S., and Podbregar, I. 2022. Climate change in the Western Balkans and EU Green Deal: status, mitigation and challenges. Energy, Sustainability and Society 12 (1): 1-14.

Krstinić Nižić, M. and Butković, I. 2023. Can Generation Z implement sustainable development in tourism? In 7th International Scientific Conference ToSEE–Tourism in Southern and Eastern Europe 2023 Engagement & Empowerment: A Path Toward Sustainable Tourism (231-248). University of Rijeka, Faculty of Tourism and Hospitality Management.

Lavuri, R., Jusuf, E., and Gunardi, A. 2021. Green sustainability: Factors fostering and behavioural difference between millennial and Gen Z: Mediating role of green purchase intention. Ekonomia i Środowisko: 8-38.

Liang, J., Li, J., and Lei, Q. 2022. Exploring the influence of environmental values on green consumption behavior of apparel: A chain multiple mediation model among Chinese Generation Z. Sustainability 14 (19): 12850.

Lisboa, A., Vitorino, L., and Antunes, R. 2022. Gen Zers' intention to purchase products with sustainable packaging: An alternative perspective to the attitude-behaviour gap. Journal of Marketing Management 38 (9-10): 967-992.

Longoni, C., Gollwitzer, P. M., and Oettingen, G. 2014. A green paradox: Validating green choices has ironic

effects on behavior, cognition, and perception. Journal of Experimental Social Psychology 50: 158-165.

Loo, W. H., Yeow, P. H., and Yee Yen, Y. 2023. Antecedents of the responsible acquisition of computers behaviour: Integrating the theory of planned behaviour with the value-belief-norm theory and the habits variable. Plos One 18 (6): e0286022.

Lopes, J. M., Gomes, S., Suchek, N., and Nogueira, S. 2024. The hidden reasons behind generation Z's green choices. Discover Sustainability 5 (1): 1-17.

Moore, J. E., Mascarenhas, A., Bain, J., and Straus, S. E. 2017. Developing a comprehensive definition of sustainability. Implementation Science 12: 1-8.

Muralidharan, S. and Xue, F. 2016. Personal networks as a precursor to a green future: A study of "green" consumer socialization among young millennials from India and China. Young Consumers 17 (3): 226-242.

Muranko, Ż., Tassell, C., Zeeuw van der Laan, A., and Aurisicchio, M. 2021. Characterisation and environmental value proposition of reuse models for fast-moving consumer goods: Reusable packaging and products. Sustainability 13 (5): 2609.

Narayanan, S. 2022. Does Generation Z value and reward corporate social responsibility practices? Journal of Marketing Management 38 (9-10): 903-937.

Nikolić, T. M., Paunović, I., Milovanović, M., Lozović, N., and Đurović, M. 2022. Examining Generation Z's attitudes, behavior and awareness regarding eco-products: A Bayesian approach to confirmatory factor analysis. Sustainability 14 (5): 2727.

Ninan, N., Roy, J. C., and Cheriyan, N. K. 2020. Influence of social media marketing on the purchase intention of Gen Z. International Journal of Advanced Science and Technolog 29 (1): 1692-1702.

Nguyen, T. N., Lobo, A., and Nguyen, B. K. 2018. Young consumers' green purchase behaviour in an emerging market. Journal of Strategic Marketing 26 (7): 583-600.

Olsson, P., Galaz, V., and Boonstra, W. J. 2014. Sustainability transformations: a resilience perspective. Ecology and society 19 (4).

Park, H. J. and Lin, L. M. 2020. Exploring attitude–behavior gap in sustainable consumption: Comparison of recycled and upcycled fashion products. Journal of business research 117: 623-628.

Perić, N., Mamula, N. T., and Delić, T. 2020. Analysis of attitudes of GenZ toward media and consumption: The region of Balkans. Marketing 51 (3): 210-218.

Pšurný, M., Mokrý, S., Langr, A., and Stavkova, J. 2024. A reusable product from the point of view of a young generation: How companies can increase their competitiveness. Journal of Competitiveness 16 (4): 128-148.

Rausch, T. M., Baier, D., and Wening, S. 2021. Does sustainability really matter to consumers? Assessing the importance of online shop and apparel product attributes. Journal of Retailing and Consumer Services 63: 102681.

Reisch, L., Eberle, U., and Lorek, S. 2013. Sustainable food consumption: an overview of contemporary issues and policies. Sustainability: Science, Practice and Policy 9 (2): 7-25.

Robichaud, Z. and Yu, H. 2021. Do young consumers care about ethical consumption? Modelling Gen Z's purchase intention towards fair trade coffee. British Food Journal 124 (9): 2740–2760.

Sheoran, M. and Kumar, D. 2022. Benchmarking the barriers of sustainable consumer behaviour. Social Responsibility Journal 18 (1): 19-42.

Shrestha, B., Tiwari, S. R., Bajracharya, S. B., Keitsch, M. M., and Rijal, H. B. 2021. Review on the importance of gender perspective in household energy-saving behavior and energy transition for sustainability. Energies 14 (22): 7571.

Silveira, P. D., Sandes, F. S., Xara-Brasil, D., and Menezes, K. 2024. Brands' Green Activism: An Empirical Comparison between Posts of Digital Influencers and Brands. Sustainability 16 (16): 6863.

Stern, P. C. 2000. Toward a coherent theory of environmentally significant behaviour. Journal of Social Issues 56 (3): 407-424.

Šebek, V., Sarajlić, H., and Jurković, N. 2023. Towards Sustainable Consumption: Attitudes, Barriers, and Practices. Marketing in multiverse 2023 : from real to virtual : conference proceedings / 28th CROMAR Congress: 373-392.

Tan, C. S., Ooi, H. Y., and Goh, Y. N. 2017. A moral extension of the theory of planned behavior to predict consumers' purchase intention for energy-efficient household appliances in Malaysia. Energy Policy 107: 459-471.

Tangari, A. H. and Smith, R. J. 2012. How the temporal framing of energy savings influences consumer product evaluations and choice. Psychology & Marketing 29 (4): 198-208.

Testa, F., Iraldo, F., Vaccari, A., and Ferrari, E. 2015. Why ecolabels can be effective marketing tools: Evidence from a study on Italian consumers. Business Strategy and the Environment 24 (4): 252-265.

Tewari, A., Mathur, S., Srivastava, S., and Gangwar, D. 2022. Examining the role of receptivity to green communication, altruism and openness to change on young consumers' intention to purchase green apparel: A multi-analytical approach. Journal of Retailing and Consumer Services 66: 102938.

Theocharis, D. and Tsekouropoulos, G. 2025. Sustainable consumption and branding for Gen Z: How brand dimensions influence consumer behavior and adoption of newly launched technological products. Sustainability 17 (9): 4124.

UN 2015. Resolution adopted by the General Assembly on Transforming our world: The 2030 agenda for sustainable development (A/RES/70/1). United Nations, October 2015. https://www.eea.europa.eu/policy-documents/resolution-adopted-by-the-general Accessed April 4 2024.

Wang, S., Liao, Y. K., Wu, W. Y., and Le, K. B. H. 2021. The role of corporate social responsibility perceptions in brand equity, brand credibility, brand reputation, and purchase intentions. Sustainability 13 (21): 11975.

Weigel, R. H. 1983. Environmental attitudes and the prediction of behavior. Environmental psychology: Directions and perspectives: 257-287.

Xiong, K. 2020. Research on Influencing Factors of Impulsive Buying in Online Shopping Environment Bases on Perspective of a Payment Method. In 2020 International Conference on E-Commerce and Internet Technology (ECIT) (109-112). IEEE.

Yusak, N. A. M., Mohd, Z., and Yusran, N. F. N. 2022. An empirical study of online impulsive buying behavior. Environment-Behaviour Proceedings Journal 7 (SI8): 27-32.

Ziesemer, F., Hüttel, A. and Balderjahn, I. 2021. Young people as drivers or inhibitors of the sustainability movement: The case of anti-consumption. Journal of Consumer Policy 44 (3): 427-453.

South East European Journal of Economics and Business
Volume 20 (2) 2025, 134-148
DOI: 10.2478/jeb-2025-0023

LONG-RUN AND SHORT-RUN RELATIONSHIP BETWEEN AGRICULTURAL VALUE ADDED AND ECONOMIC GROWTH: EMPIRICAL EVIDENCE FROM SERBIA

Milka Grbić, Vladan Ivanović, Jasna Atanasijević

Abstract

The aim of this paper is to empirically examine the short-run and long-run relationships between agricultural value added and real GDP growth in Serbia from 1995 to 2023, using the ARDL approach. The results of the empirical analysis based on the ARDL bounds testing procedure indicate the existence of cointegration between the examined variables. The findings reveal that, in the long run, there is a statistically significant and positive relationship between agricultural value added and economic growth, while the short-run relationship is also positive but of lower intensity. The negative and statistically significant error correction coefficient in the ECM model confirms that a substantial portion of short-run deviations in real GDP growth is corrected within one year, indicating the existence of a stable long-run equilibrium among the analyzed variables. These empirical results suggest that designing and implementing policies that stimulate agricultural production could make a significant contribution to achieving long-term sustainable economic growth in Serbia.

Key words: *Agricultural value added, economic growth, ARDL approach, coitegration, ECM, Serbia*

JEL Classification: *Q10, O47, C32, C52*

1. Introduction

Agriculture is a primary economic activity with wide-ranging importance to a country's economy. As a source of food, industrial raw materials, and employment in rural areas, agriculture not only satisfies the basic needs of the population but also plays a crucial role in promoting economic growth (Dowrick and Gemmell 1991).

In recent decades, the global economy has undergone significant structural changes, reflected, among other things, in the declining relative share of value added from the agricultural sector in gross domestic product (GDP). According to World Bank data, during the 1960s, agriculture accounted for more than 10% of global GDP on average, whereas by the 2020s this share had declined to less than 4% (World Bank 2025).

Milka Grbić, PhD
Associate Professor
University of Kragujevac – Faculty of Economics, Kragujevac
Serbia
Email: mgrbic@kg.ac.rs
ORCID: 0000-0001-9839-1166

Vladan Ivanović, PhD (Corresponding author)
Full Professor
University of Kragujevac – Faculty of Economics, Kragujevac
Liceja Kneževine Srbije 3, 34 000 Kragujevac
Serbia
Email: vivanovic@kg.ac.rs
ORCID: 0000-0001-9205-8645

Jasna Atanasijević, PhD
Associate Professor
University of Novi Sad – Faculty of Sciences, Department of Mathematics and Informatics
Novi Sad, Serbia
Email: jasna.atanasijevic@dmi.uns.ac.rs
ORCID: 0000-0002-5527-9841

In the case of Serbia, the agricultural sector accounted for 3.8% of GDP in 2023 (World Bank 2025), which is higher than in most European countries and indicates that the sector still plays a relatively significant role in the national economy.

The available literature shows that the number of empirical studies examining the relationship between agricultural value added and GDP growth remains limited, especially in transition economies. In the case of Serbia, several previous studies (Novaković et al. 2024; Mitrović, Mitrović and Cogoljević 2017; Atanasijević and Danon 2014) highlight the importance of agriculture in the structure of GDP. However, a quantitative analysis of the relationship between agricultural value added and GDP growth has not yet been conducted. In this context, this study seeks to address the following key research question: Is the growth of agricultural value added associated with GDP growth in Serbia, and how stable is this relationship? To address this question, this study is to empirically examine the short-run and long-run relationships between agricultural value added and real GDP growth in Serbia using time-series econometric analysis.

This research makes a significant contribution to the academic literature. Primarily, it focuses on analyzing the relationship between agricultural value added and economic growth, thereby enriching the existing literature on growth structures in countries where agriculture plays an important role. Furthermore, given that previous studies on the impact of agriculture on economic growth have yielded inconclusive and highly context-dependent results, this paper contributes to a better understanding of this relationship within the specific context of Serbia. Considering that Serbia is still undergoing structural transformation and aligning its economy with the standards of developed market economies, analyzing the contribution of agriculture to economic growth is of particular importance. It provides deeper insight into the transitional challenges and developmental potential of the agricultural sector.

In addition to its academic contribution, this research also has clear practical implications. By establishing the long-run and short-run relationships between agricultural value added and economic growth, the study provides a foundation for formulating economic policies aimed at enhancing the agricultural sector and fostering sustainable growth. The findings may serve as a basis for developing recommendations related to rural development, increasing agricultural productivity, and promoting more efficient resource utilization, which are issues of particular importance for developing and transitional economies such as Serbia.

The paper is structured into five sections. Following the introduction, Section 2 provides a review of previous research. Section 3 describes the data and the methodological framework, while Section 4 presents and interprets the research findings. Finally, Section 5 contains the key conclusions, policy implications, and directions for future research.

2. Literature review

The study of the relationship between the sectoral structure of GDP and economic growth represents a significant segment of contemporary theoretical discussions and empirical research. Traditionally, agriculture is perceived as the primary sector that stimulates economic growth, particularly in the early stages of national economic development (Johnston and Mellor 1961). In this context, Mackie (1964) emphasizes that in low-income countries with slow growth rates, the underdevelopment of the agricultural sector can constitute a major obstacle to overall economic development. Conversely, in rapidly growing economies, the role of agriculture becomes more important, as this sector may play a key role in generating the initial momentum for sustainable economic progress. A similar position is taken by Nyiwul and Koirala (2022), who underscore that the primary sector is of fundamental importance in growth and sustainable development in developing countries.

Some authors point out that the contribution of agriculture to overall economic growth gradually declines as countries advance in their development. In developing countries, such as those in the Sub-Saharan African region, agriculture plays a significant role in poverty reduction and in fostering economic growth (Christiaensen, Demery, and Kuhl 2011). In contrast, in developed economies, the relative contribution of agriculture to GDP decreases, with the industrial and service sectors assuming a dominant role (Gollin 2010). This trend is consistent with the theory of structural transformation, which posits that, as economies develop, production and employment gradually shift from the primary to the secondary and eventually to the tertiary sector, as a result of productivity gains and technological progress (Kuznets 1973). Similarly, Gollin (2023) examines the key role of agricultural productivity growth in the process of structural transformation, emphasizing that improving efficiency in this sector represents a fundamental prerequisite for long-term economic growth, particularly in low-income countries. Empirical confirmation of the differentiated roles of the agricultural sector across various stages of economic development is provided

by a study conducted by Los and Gardebroek (2015), based on a sample of 55 African countries over the period from 1961 to 2010. By applying panel cointegration techniques and the Granger causality test, their study shows that food production growth plays a key developmental role in low-income countries, while in upper-middle-income countries, the decisive factor is the pace of labor force transition from agriculture to more productive sectors.

Timmer, deVries, and de Vries (2014) emphasize that developing countries undergo specific patterns of structural change that differ from the earlier experiences of developed economies. In this process, although the share of agriculture in GDP and total employment declines, the agricultural sector continues to play a crucial role in securing income and employment, particularly in rural areas. Deininger, Jin, and Ma (2022) further emphasize that in low- and middle-income countries, the pace and form of agricultural transformation vary significantly, depending on policy, land structure, and the dynamics of labor shifting to more productive sectors. In addition, Wang, Zhang, and Guo (2024) show that in large modern economies, such as China, agricultural transformation involves farm modernization, technological innovations, and the reorganization of production chains, confirming that the process is not limited to traditional patterns but reflects contemporary development trends. In this context, Liu et al. (2024) highlight that the digital economy serves as a key contemporary driver of agricultural transformation, shaping the sector by enhancing productivity, improving market integration, and facilitating the transition toward high-quality development.

One of the earliest empirical studies examining the relationship between agricultural value added per worker and GDP per capita was conducted by Gardner (2003), using data from 85 countries. Building on his findings, Tiffin and Irz (2006) applied the Granger causality test to the same sample of countries and demonstrated that agriculture acts as a driver of economic growth in developing countries, whereas this relationship is less pronounced in developed economies. The causal relationship between agricultural value added per worker and GDP *per capita* was also examined using data from 14 of the oldest European Union member states (EU-15, excluding Luxembourg). The results indicate that the direction of causality varies across countries: in some, agriculture drives economic growth, while in others, a reverse or a bidirectional relationship is observed (Apostolidou et al. 2014). Despite the absence of unambiguous findings, the main conclusion highlights the role of agriculture as a potential stabilizing factor during times of economic crisis. This underscores the need for greater recognition of agriculture within economic policy frameworks, despite its declining share in the European Union's GDP. Similar conclusions are confirmed by Beckman and Countryman (2021), who analyze the role of agriculture in different regions around the world during the COVID-19 pandemic and indicate that this sector had a stabilizing effect on overall macroeconomic performance, mitigating the negative impacts of the crisis on GDP and employment. A study conducted on a sample of nine developing and transition countries from Sub-Saharan Africa, Asia, and Latin America confirms the existence of a long-run relationship between agriculture and economic growth, with the direction of causality also varying across countries (Awokuse and Xie 2015).

Similar findings are confirmed by a study conducted by Mbotiji, Oumar, and Egwu (2023) on a sample of Central African countries covering the period from 1990 to 2020, in which fixed effects panel models, random effects panel models, and the generalized least squares (GLS) method were applied. The results indicate that agricultural value added has a positive and statistically significant impact on economic growth in the observed region. A study conducted by Maiga (2024), based on a sample of five African countries (Tanzania, Ghana, Kenya, Morocco, and South Africa), using a multiple linear regression model, revealed that agricultural productivity contributes significantly to economic growth, although the effect was relatively weaker in Morocco and South Africa.

In the context of transition economies, Lerman (2001) emphasizes that differences in the approach to reforms in Eastern European countries and the Commonwealth of Independent States, particularly regarding private land ownership and the restructuring of the agricultural sector, have led to significant disparities in economic outcomes. According to his findings, Eastern European countries achieved greater progress in terms of GDP growth and agricultural productivity. However, Radlińska (2025) notes that the agricultural sectors of most Central and Eastern European countries still differ in many respects from those of other European Union member states.

Additional insights into the relationship between agriculture and economic growth are provided by country-level analyses, which allow for the identification of specific patterns and dynamics of this relationship while accounting for the context of each individual country. Using the Johansen cointegration approach and the Granger causality test, it has been established that agriculture makes a significant

contribution to long-term economic growth in Tunisia, whereas its short-term effect is considerably weaker (Chebbi 2010). By applying the ARDL model to Algeria for the period from 1991 to 2022, it has been documented that both agricultural value added and agricultural employment contribute to increased overall output (Mostefai 2024). In the case of Italy, it has been shown that improved efficiency and sustainability of agricultural production, achieved through the implementation of modern technologies, significantly contribute to economic growth (Finco et al. 2021). According to a study by Petre and Ion (2019), investments in agriculture in Romania, particularly following the country's accession to the European Union in 2007, have significantly contributed to GDP growth in rural areas. Additionally, Kumar (2025), examining the economic significance of agriculture in the state of Bihar, India, over the period 2000–2024, highlighted that agriculture, particularly through crop cultivation and livestock production, continues to play a key role in economic growth, with a special importance for rural areas.

Although numerous studies confirm the positive impact of agriculture on economic growth and poverty reduction (Thirtle, Lin, and Piesse 2003), certain findings suggest that these conclusions may not be universally applicable. Rupasingha (2009), analyzing agricultural processing enterprises at the county level in the United States, found no compelling empirical evidence for their significant contribution to income growth, employment, or poverty reduction. Similarly, some analyses indicate that agriculture may have a negligible or even negative effect on economic growth, while other studies fail to establish a clear causal relationship between the agricultural sector and GDP (Khan et al. 2022; Emam 2022; Ullah 2021; Tahamipour and Mahmoudi 2018; Matsuyama 1992).

Considering the findings of the aforementioned studies, it is evident that the contribution of agriculture to economic growth is not universally determined. Diversity among countries in terms of natural resources, cultural heritage, and historical context precludes the existence of a single definition of the role that agriculture should play in the economic growth process (Johnston and Mellor 1961). Further variability in empirical findings arises from differences in the choice of indicators used to measure agricultural sector development, the periods analyzed, and the methodologies applied, even when examining the same countries.

Therefore, the existing theoretical and empirical literature does not allow for a clear conclusion regarding the nature and importance of the relationship between agriculture and economic growth. This inconsistency in findings indicates that the issue remains open and requires further research that would take into account specific national conditions and development contexts.

3. Data and metodology

The empirical analysis in this paper is based on a set of macroeconomic variables selected in accordance with relevant studies that examine the relationship between agriculture and economic growth. The dependent variable is the annual growth rate of real GDP, as it is most commonly used as a primary indicator of overall economic performance and the dynamics of economic growth. The value added in agriculture (including forestry and fisheries), measured as a percentage of GDP, is used as the independent variable (Adebayo et al. 2024; Sertoglu, Ugural, and Bekun 2017). This variable shows the relative contribution of the agricultural sector to the overall economic activity and reflects its structural importance, i.e., how prominent agriculture is in the overall economy compared to other sectors.

To control for the impact of other potential determinants of economic growth, three additional variables are included in the analysis. First, capital investment, measured by the share of gross fixed capital formation in GDP, is introduced as a control variable, as investments in physical infrastructure, equipment, and technology represent one of the fundamental factors influencing the expansion of productive capacities and long-term economic development (FAO 2021). Second, trade openness (Los and Gardebroek 2015), measured as the ratio of the sum of exports and imports to GDP, allows for the control of the impact of foreign trade activities on economic growth. Finally, the inflation rate is included to control for nominal effects within the economy, and it is frequently used in the literature as an indicator of macroeconomic stability (Asom and Ijirshar 2016; Bassanini, Scarpetta, and Hemming 2001).

The time series data analysis on an annual basis covers the period from 1995 to 2023. The selection of this time frame is determined by data availability. Moreover, this period coincides with the beginning of the transition to a market-oriented economy, following the abandonment of the self-management socialist model. The research relies on secondary data obtained from the World Bank database (World Bank 2025), which represents a reliable source of internationally comparable and methodologically consistent statistical series, frequently used in empirical research.

Table 1. Summary of Variables Included in the Analysis

Explanation	Abbreviation	Transformation
Real GDP Growth Rate (annual %, proxy for Economic Growth)	EG	Original
Agricultural Value Added (as a percentage of GDP)	*ln*AVA	Natural Logarithm
Gross Fixed Capital Formation (as a percentage of GDP)	*ln*INV	Natural Logarithm
Trade Openness (export + import as a percentage of GDP)	*ln*TO	Natural Logarithm
Inflation, Consumer Prices (annual %)	INF	Original
Agricultural Value Added per Worker (used for robustness check)	lnAVAPW	Natural Logarithm

Note: ln denotes natural logarithm.

Due to the nature of the data, the model employs a combination of logarithmic and non-logarithmic variables. The GDP growth rate series is not log-transformed because it contains negative values. Since the inflation rate series is already expressed as a relative change, a logarithmic transformation is also not applied; instead, the variable is included in the model in its original form. The remaining variables have positive values and are log-transformed in order to mitigate heteroskedasticity. Table 1 provides an overview of variables used in the analysis, along with their corresponding abbreviations and information on the applied transformations. The table also includes an additional variable, agricultural value added per worker, expressed in constant 2015 prices, which is used for robustness testing. This indicator measures labor productivity in agriculture and is commonly used in the literature as an alternative measure of the importance of the agricultural sector, as it allows for a more accurate assessment of the sector's actual efficiency and performance (Gollin, Lagakos, and Waugh 2014; Apostolidou et al. 2014).

Based on the variables defined above, the following functional form of the baseline model is specified:

$$\mathrm{EG}_t = f(ln\mathrm{AVA}_t, ln\mathrm{INV}_t, ln\mathrm{TO}_t, \mathrm{INF}_t) \quad (1)$$

To examine cointegration, that is, the long-run equilibrium relationship between the dependent and independent variables in the model, the Autoregressive Distributed Lag (ARDL) bounds testing approach to cointegration analysis is applied. This method, which has been widely used in macroeconomic time series analysis, was developed by Pesaran and Shin (1998) and later extended by Pesaran, Shin, and Smith (2001). The choice of the ARDL bounds testing approach is based on its advantages over conventional cointegration techniques, such as the two-step residual-based procedure (Engle and Granger 1987) and the full maximum likelihood test (Johansen 1988; Johansen and Juselius 1990).

First and foremost, the ARDL bounds testing approach allows for the inclusion of variables with different orders of integration in the model. This means that it can be applied regardless of whether the time series is integrated of order zero, that is, stationary in levels, integrated of order one, that is, stationary after first differencing, or fractionally integrated (Pesaran, Shin, and Smith 2001, p. 290). This represents the most significant advantage of the bounds testing approach over other cointegration methods (Halil Arıç and Taştan 2018, p. 70). However, time series integrated of order two should not be included in the ARDL model, as such a level of integration renders the F-statistic invalid, along with all critical values, which are defined only for series integrated of order zero and/or one (Menegaki 2019, p. 2).

In economic analyses, where the endogeneity of regressors is a common issue, the ARDL model proves to be particularly useful, as it allows for obtaining unbiased and reliable parameter estimates. An additional advantage of the ARDL methodology lies in the fact that it requires the formulation of only a single regression equation (Bayer and Hanck 2013), unlike alternative approaches that involve the simultaneous estimation of a system of multiple equations.

Another important feature of this method is its ability to simultaneously estimate both long-run and short-run coefficients (Özen, Hodžić, and Yildirim 2022). Moreover, the ARDL approach allows individual variables to have different lag structures. The results obtained using this method remain consistent and robust even in the context of a limited sample size (Dewi et al. 2018).

Based on the functional form of the model presented in Equation (1), the ARDL model is specified to examine the long-run equilibrium relationship among the observed variables. Accordingly, the following equation is used to perform the bounds testing procedure:

$$\Delta EG_t = \alpha_0 + \sum_{i=1}^{m} \delta_i \Delta EG_{t-i} + \sum_{i=0}^{n} \gamma_i \Delta lnAVA_{t-i} + \sum_{i=0}^{p} \tau_i \Delta lnKAP_{t-i} + \sum_{i=0}^{q} \varphi_i \Delta lnTO_{t-i} + \sum_{i=0}^{r} \theta_i INF_{t-i} + \mu_1 EG_{t-1} + \mu_2 lnAVA_{t-1} + \mu_3 lnKAP_{t-1} + \mu_4 lnTO_{t-1} + \mu_5 INF_{t-1} + \varepsilon_t \quad (2)$$

where α_0 and ε_t are the intercept and random error terms, respectively, while Δ is the first difference operator. The short-run relationships are measured by δ, γ, τ and φ, while long-run relationships are by μs. The parameters *m*, *n*, *p*, *q* and *r* indicate the optimal lag length for the corresponding variables in the model.

Based on Equation (2), the existence of cointegration among the variables is tested using the F-test. The test is based on the null hypothesis H_0: $\mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5 = 0$, which implies that no cointegrating relationship exists among the variables. In contrast, the alternative hypothesis H_1: $\mu_1 \neq \mu_2 \neq \mu_3 \neq \mu_4 \neq \mu_5 \neq 0$ suggests the presence of cointegration. The calculated F-statistic is compared with the critical values provided by Pesaran, Shin, and Smith (2001), which include two sets of bounds: a lower bound (I(0)) and an upper bound (I(1)). If the F-statistic exceeds the upper bound, the null hypothesis is rejected at the chosen level of significance, indicating that a cointegrating relationship exists among the variables. Conversely, if the F-statistic falls below the lower bound, the null hypothesis cannot be rejected, suggesting the absence of cointegration. If the F-statistic lies between the lower and upper bounds, the test result is inconclusive, and no definitive conclusion regarding the existence of cointegration can be drawn.

If the ARDL model indicates the existence of a cointegrating relationship, the estimation of the long-run coefficients is conducted based on the following equation:

$$EG_t = \alpha_t + \mu_1 EG_{t-1} + \mu_2 AVA_{t-1} + \mu_3 INV_{t-1} + \mu_4 TO_{t-1} + \mu_5 INF_{t-1} + \varepsilon_t \quad (3)$$

Subsequently, in order to identify the short-run relationships among the variables, an error correction model (ECM) is specified based on the ARDL framework. In accordance with the ARDL model defined in Equation (2), the ECM can be expressed as follows:

$$\Delta EG_t = \alpha_0 + \sum_{i=1}^{m} \delta_i \Delta EG_{t-i} + \sum_{i=0}^{n} \gamma_i \Delta lnAVA_{t-i} + \sum_{i=0}^{p} \tau_i \Delta lnINV_{t-i} + \sum_{i=0}^{q} \varphi_i \Delta lnTO_{t-i} + \sum_{i=0}^{r} \theta_i INF_{t-i} + \lambda ECM_{t-1} + \varepsilon_t \quad (4)$$

where ECM_{t-1} is error correction term, that is, the component of the model that captures the short-run dynamics of the system and represents the speed of adjustment or the system's corrective response. ECM_{t-1} indicates the proportion of the deviation from equilibrium that is corrected, that is, the extent to which the deviation of the dependent variable in the previous period is adjusted in the current period. The coefficient associated with ECM_{t-1} should be negative and statistically significant, as this indicates an adjustment of the dependent variable toward its long-run equilibrium. If the estimated coefficient $\lambda = -1$, the adjustment in the current period is complete, whereas $\lambda = 0$ suggests no adjustment and implies that the assertion of a long-run relationship is invalid (Nkoro and Uko 2016, p. 85).

Following the estimation of the coefficients in the above equations, it is necessary to conduct diagnostic tests to identify potential issues such as serial correlation, heteroskedasticity, model misspecification, non-normality of residuals, and parameter instability.

To verify the robustness of the obtained results, an additional analysis is conducted in which the main independent variable, lnAVA, from the baseline model (Model 1) is replaced with an alternative indicator, lnAVAPW. All other elements of the model, including the control variables, lag selection, and diagnostic tests, remain identical. This parallel specification and testing of the alternative model (Model 2) make it possible to assess whether the results remain consistent when agricultural labor productivity is considered instead of the sector's relative contribution to GDP.

4. Results and discussion

As previously noted, the ARDL bounds testing approach permits the inclusion of variables with mixed orders of integration, provided that none of the variables are integrated of order two. Therefore, the first step in the analysis is to test the stationarity of the observed time series. The results of the Augmented Dickey-Fuller (ADF) test (Dickey and Fuller 1979) and

the Phillips-Perron (PP) test (Phillips and Perron 1988), presented in Table 2, indicate a mixed order of integration among the analyzed time series.

Table 2. Results of ADF and PP unit root tests

Levels	ADF test	PP test
EG	-4.698048*	-4.672857*
*ln*AVA	-1.695524	-1.695524
*ln*INV	-3896832**	-1.919353
*ln*TO	-7.570453*	-4.870333*
INF	-3.270402	-2.990406
lnAVAPW	-2.407061	-2.154494
1st differences	ADF test	PP test
Δ*ln*AVA	-4.466837*	-4.460573*
Δ*ln*INV	-3.929803**	-3.810837**
ΔINF	-6.672230*	-7.949988*
lnAVAPW	-4.524774*	-7.153027*

Note: Trend and intercept are included in the test equation for all variables; * and ** indicate significance at the 1% and 5% levels, respectively.

Source: Authors' own calculations

The growth rate of real GDP (EG) and trade openness (*ln*TO) are stationary at levels. Similarly, the capital investment series, according to the ADF test, exhibits stationarity at levels, although the PP test does not confirm this finding, indicating the need for further testing. On the other hand, the series representing the share of agricultural value added in GDP (lnAVA), the inflation rate (INF), and agricultural value added per worker (lnAVAPW) are not stationary at levels. However, when these series are transformed into first differences (ΔlnAVA, ΔlnINV, ΔINF, and ΔlnAVAPW), they become stationary, indicating that they are integrated of order one, I(1).

Considering the established orders of integration of the observed time series, it is possible to specify the ARDL model, given that none of the series are integrated of order two (I(2)), which would undermine the validity of the ARDL bounds testing approach.

To identify the optimal lag length for the further specification of the baseline and alternative ARDL (m, n, p, q, r) models, standard information criteria were applied for selecting the maximum lag length. Based on the values presented in Table 3 (Panel A and Panel B), it can be observed that all relevant criteria indicate that the optimal lag length is equal to 2 for both models.

After specifying the baseline ARDL model (Model 1), an F-test was applied to equation (2) to determine whether a cointegration relationship exists among the examined variables. According to the data presented in Table 4, Panel A, the F-statistic for the baseline model is 15.816. When this value is compared with the critical bounds of I(0) and I(1) at different significance levels, it is evident that the F-statistic exceeds the upper I(1) bound at all levels of significance. Accordingly, the null hypothesis (H_0: $\mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5 = 0$) is rejected, indicating the existence of a statistically significant long-run equilibrium relationship between the dependent and independent variables in the baseline model.

Table 3. Lag Selection for ARDL Models

Panel A: Model 1					
Lag	LR	FPE	AIC	SC	HQ
0	NA	0.512726	13.52120	13.76117	13.59256
1	120.8192	0.010760	9.619760	11.05958	10.04789
2	67.75888*	0.001229*	7.236682*	9.876350*	8.021594*
Panel B (Model 2)					
Lag	LR	FPE	AIC	SC	HQ
0	NA	0.002199	8.069594	8.309564	8.140950
1	101.1874	0.000118	5.102999	6.542818	5.531133
2	55.69383*	2.001150*	3.473987*	6.113654*	4.258898*

Notes: (1) Model 1 represents the baseline specification with lnAVA as the main independent variable, while Model 2 uses lnAVAPW as an alternative indicator. (2) The selected lag order, according to the criterion, is indicated by an asterisk (*). The LR test statistic, which is a sequentially modified likelihood ratio test, is performed at a significance level of 5%. FPE refers to the Final Prediction Error, while AIC stands for the Akaike Information Criterion. The abbreviation SC denotes the Schwarz Information Criterion, and HQ corresponds to the Hannan-Quinn Information Criterion.

Source: Authors' own calculations

Table 4. Bounds Test Results for the ARDL Models

Panel A: Model 1					
Estimated equity: EG=f(*ln*AVA, *ln*INV, *ln*TO, INF)					
Optimal lag: (1,1,1,0,2)					
Test Statistic	Value	k	Significant	I(0) Bound	I(1) Bound
F-statistic	15.816	4	10% 5% 2.5% 1%	2.45 2.86 3.25 3.74	3.52 4.01 4.49 5.06
Panel B: Model 2					
Estimated equity: EG=f(lnAVPW, lnINV, lnTO, INF)					
Optimal lag: (1,0,0,1,0)					
Test Statistic	Value	k	Significant	I(0) Bound	I(1) Bound
F-statistic	10.440	4	10% 5% 2.5% 1%	2.45 2.86 3.25 3.74	3.52 4.01 4.49 5.06

Source: Authors' own calculations

For the alternative model (Model 2), in which the primary independent variable lnAVA is replaced by the indicator lnAVAPW, the F-statistic amounts to 10.440 (Table 4, Panel B). This value also exceeds the upper I(1) bounds at all standard significance levels, confirming the presence of a long-run cointegration relationship in the alternative model as well. The result suggests that changing the main independent variable does not affect the fundamental conclusion regarding the long-run equilibrium among the examined variables.

Given the existence of a cointegration relationship among the variables in the examined models, the long-run coefficients were estimated using equation (3). The results for Model 1, presented in Table 5, Panel A, indicate that changes in the share of agricultural value added in GDP (lnAVA) are positively correlated with the growth rate of real GDP (EG). Specifically, in the long run, a 1% increase in lnAVA corresponds to an approximate 0.17 percentage point higher growth rate of real GDP, *ceteris paribus*. A similar result is confirmed in Model 2 (Table 5, Panel B), where a 1% increase in agricultural value added per worker (lnAVAPW) corresponds to a long-run increase in the real GDP growth rate of approximately 0.26 percentage points.

Estimates of the other long-run coefficients

Table 5. Estimated Long-run Coefficients in ARDL Models

Panel A: Model 1				
Dependent Variable: EG				
Regressor	Coefficient	Std. error	t-statistic	Probability
C	8.345	1.272	6.560	0.000
*ln*AVA	0.173	0.049	3.527	0.002
*ln*INV	0.171	0.024	6.840	0.000
*ln*TO	0.034	0.014	2.441	0.025
INF	-0.001	0.057	-0.031	0.975
Panel B: Model 2				
Dependent Variable: EG				
Regressor	Coefficient	Std. error	t-statistic	Probability
C	5.144	2.241	2.295	0.031
lnAVAPW	0.261	0.135	1.933	0.054
lnINV	0.617	0.201	3.069	0.005
lnTO	0.832	2.622	0.317	0.753
INF	0.036	0.033	1.090	0.296

Source: Authors' own calculations

indicate a positive and statistically significant relationship between the share of capital investments in GDP (lnINV) and the economic growth rate in both models. In Model 1, a positive and statistically significant relationship is also found between trade openness (lnTO) and economic growth, whereas in Model 2 this relationship is not statistically significant. The relationship between inflation (INF) and economic growth in the long run is statistically insignificant in both models.

These results suggest the existence of statistically significant relationships between long-run changes in the independent variables and GDP growth, highlighting the absolute importance of agriculture for economic growth, as well as its relative significance compared to the other variables considered.

The short-run coefficients in the ECM specified in equation (4) were subsequently estimated. The results, presented in Table 6, represent the estimates of the short-run coefficients within the ARDL(1,1,1,0,2) model (Model 1). The findings indicate that a 1% increase in the share of agricultural value added in GDP (ΔlnAVA) is associated with an increase in the real GDP growth rate of approximately 0.09 percentage points, *ceteris paribus*. This result is statistically significant at the 10% level, indicating a positive, though less robust, short-run effect.

A 1% increase in the share of capital investments in GDP (ΔlnINV) corresponds to an increase in the real GDP growth rate of about 0.22 percentage points. This result is highly statistically significant, suggesting that investments play a key role in stimulating economic growth in the short run, *ceteris paribus*. An increase of 1% in trade openness (ΔlnTO) is associated with a 0.06 percentage point rise in the real GDP growth rate. The change in the inflation rate in the current period (ΔINF) is not statistically significant, whereas inflation from the previous period (ΔINF(-1)) is negatively associated with the real GDP growth rate at the 10% significance level, which may indicate a delayed negative impact of inflation on economic growth.

The error correction coefficient is negative (ECM(-1) = -0.66) and statistically significant at the 1% level. A negative and statistically significant ECM coefficient confirms that the system adjusts toward long-run equilibrium following short-run deviations. Specifically, approximately 66% of the deviation of the real GDP growth rate from its long-run equilibrium in the previous period is corrected in the current period. This implies that the system returns to equilibrium within approximately 1.5 years (1/0.66), given that the coefficient lies within the interval between 0 and -1.

As shown in Table 6, the high coefficient of determination (R-squared = 0.857) indicates that Model 1 explains 85.7% of the total variability in the real GDP growth rate, thereby confirming its adequacy.

The results presented in Table 7 refer to the estimation of the short-run coefficients within the ARDL(1,0,0,1,0) model (Model 2). The findings indicate patterns similar to those observed in Model 1. Specifically, a 1% increase in agricultural value added per worker (ΔlnAVAPW) is associated with an increase in the real GDP growth rate of approximately 0.07 percentage points, and this effect is statistically significant at the 10% level. Although the magnitude of the effect is slightly lower than in Model 1, the sign and significance of the coefficient confirm that the agricultural sector has a positive, yet moderate, short-run relationship with economic growth.

As in the previous model, an increase in capital investments (ΔlnINV) shows a positive and statistically significant relationship with the economic growth rate, again highlighting the key role of investments in

Table 6. ARDL(1,1,1,0,2) Error Correction Model Estimation Results (Model 1)

Dependent Variable: ΔEG				
Regressor	Coefficient	Std. error	t-statistic	Probability
Δ*ln*AVA	0.095	0.051	1.759	0.098
Δ*ln*INV	0.223	0.044	5.068	0.000
Δ*ln*TO	0.057	0.024	2.375	0.033
ΔINF	0.003	0.041	0.073	0.942
ΔINF(-1)	-0.065	0.033	-1.969	0.068
ECM(-1)	-0.66	0.065	-10.153	0.000
Model Statistics				
R-squared	0.857	Akaike criterion		5.053
Adj. R-squared	0.781	Schwarz criterion		5.533
F-statistic	11.348	Hannan-Quinn criterion		5.196
Prob(F-statistic)	0.000	Durbin-Watson statistic		1.682

Source: Authors' own calculations

Table 7. ARDL(1,0,0,0,1) Error Correction Model Estimation Results (Model 2)

Dependent Variable: ΔEG				
Regressor	Coefficient	Std. error	t-statistic	Probability
Δ*ln*AVA	0.067	0.038	1.763	0.091
Δ*ln*INV	0.841	0.285	2.955	0.007
Δ*ln*TO	0.069	0.037	1.865	0.077
ΔINF	-0.035	0.047	-0.745	0.464
ECM(-1)	-0.56	0.075	-7.466	0.000
Model Statistics				
R-squared	0.673	Akaike criterion		5.270
Adj. R-squared	0.500	Schwarz criterion		5.750
F-statistic	3.895	Hannan-Quinn criterion		5.413
Prob(F-statistic)	0.007	Durbin-Watson statistic		1.947

Source: Authors' own calculations

sustaining short-run economic activity. Trade openness (ΔlnTO) also exhibits a positive relationship with economic growth, but at the 10% significance level. The change in the inflation rate (ΔINF) remains statistically insignificant, consistent with the findings from Model 1.

The error correction coefficient (ECM(-1) = -0.56) is negative and statistically significant, confirming the existence of a stable long-run equilibrium among the examined variables in this model as well. The negative sign of the ECM coefficient implies that approximately 56% of the deviation from the long-run equilibrium is corrected within the current period, indicating that the system returns to equilibrium over roughly 1.8 years (1/0.56).

The coefficient of determination (R-squared = 0.673) shows that Model 2 explains approximately 67.3% of the variability in the real GDP growth rate, which is lower compared to Model 1 (R-squared = 0.857). This difference is understandable given that Model 2 uses agricultural value added per worker, which measures sectoral productivity rather than its relative contribution to the economy, and therefore naturally accounts for a smaller portion of the variation in overall economic growth.

After presenting the key results, diagnostic tests were conducted for both models to verify the main econometric assumptions, including the absence of autocorrelation, the normality of residuals, the absence of heteroskedasticity, and the correct functional form specification.

The results of the diagnostic tests for Model 1 are presented in Table 8, Panel A. The presence of serial correlation was examined using the Breusch-Godfrey

Tabela 8. Diagnostic Tests

Panel A: Model 1				
Test	Specification	Test statistic	d.f.	Probability
Serial correlation	Breusch-Godfrey LM Test	1.40	(2,15)	0.277
Normality	Jarque-Bera	1.988	2	0.369
Heteroscedasticity	Breusch-Pagan-Godfrey ARCH	1.163 0.117	2 1	0.375 0.734
Functional form	Ramsey RESET Test	3.596	(1,12)	0.076
Panel B: Model 2				
Test	Specification	Test statistic	d.f.	Probability
Serial correlation	Breusch-Godfrey LM Test	1.21	(2,19)	0.317
Normality	Jarque-Bera	0.639	2	0.726
Heteroscedasticity	Breusch-Pagan-Godfrey ARCH	1.41 0.385	2 1	0.254 0.540
Functional form	Ramsey RESET Test	2.715	(1,16)	0.118

Source: Authors' own calculations

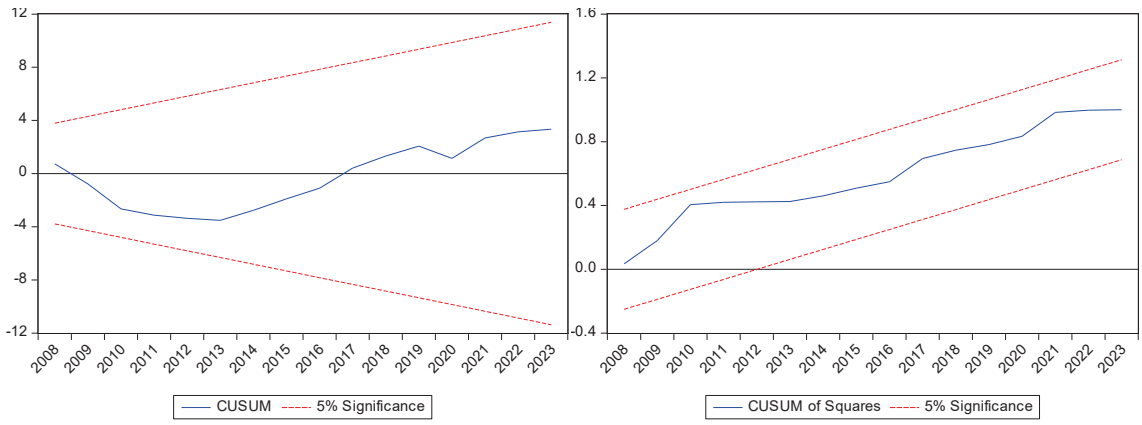
LM test. The test result, with a probability greater than 5%, indicates that serial correlation is not present in the model. The Jarque-Bera test was employed to assess the normality assumption of the residuals. A p-value greater than 5% confirms that the residuals are normally distributed. The Breusch-Pagan-Godfrey and Auto-Regressive Conditional Heteroskedasticity (ARCH) tests were applied to detect heteroskedasticity. Given that the p-values of both tests exceed 5%, it can be concluded that heteroskedasticity is not an issue in the model. The Ramsey RESET test was used to verify the correctness of the model specification. The test result, also with a probability above 5%, suggests that there are no specification errors in the model.

The diagnostic test results for Model 2 are presented in Table 8, Panel B. The results confirm that this model also satisfies the assumptions regarding autocorrelation, heteroskedasticity, and normality. The Ramsey RESET test, with a p-value of 0.118, indicates that the model's functional form is not problematic. Overall, the diagnostic results confirm that Model 2, as an alternative linear specification, provides robust support for the findings of Model 1, thereby increasing the reliability of the estimated effects.

The stability of the estimated parameters in Model 1 and Model 2 was examined using the Cumulative Sum (CUSUM) test and the Cumulative Sum of Squares (CUSUMSQ) test. The CUSUM and CUSUMSQ test plots for Model 1 are presented in Figure 1. The lower and upper dashed lines represent the 95% confidence bounds, while the solid lines denote the estimated parameters. Since the estimated parameters in both plots remain within the confidence bounds, it can be concluded that the parameters in Model 1 satisfy the stability condition at the 5% significance level over the observed period.

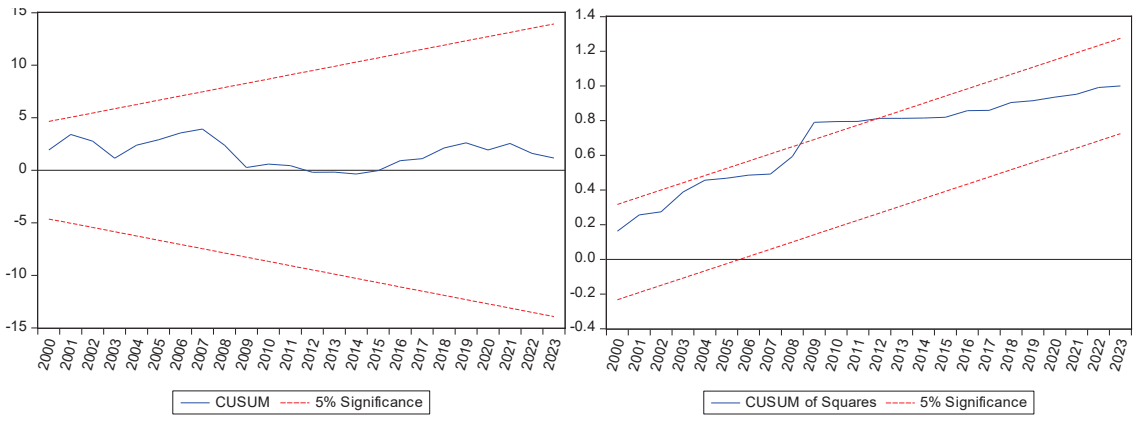
For Model 2, as shown in Figure 2, the parameter estimates in the CUSUM test remain within the confidence bounds. On the other hand, the CUSUM of Squares test shows a slight exceedance of the upper

Figure 1. Plots of CUSUM and CUSUM of Squares Tests (Model 1)



Source: Authors' own draft, 2025

Figure 2. Plots of CUSUM and CUSUM of Squares Tests (Model 2)



Source: Authors' own draft, 2025

critical bound around the middle of the sample, indicating a short period of parameter instability. Since this represents only a temporary fluctuation, Model 2 can be considered stable overall.

Considering that the short-run effect of agriculture is weaker and statistically less reliable, the findings suggest that agriculture primarily has a long-term significance for economic growth in Serbia. Although there are contextual differences, the results of this study are consistent with previous research (Mostefai 2024; Finco et al. 2021; Chebbi 2010) conducted for individual countries, which also confirm the long-term contribution of the agricultural sector to growth.

It is important to note, however, that the estimated short-run coefficients from the ECM model and the long-run coefficients derived from the ARDL model in this study indicate statistical associations between variables in both short-run and long-run dynamics, but do not imply causal relationships in a strict econometric sense. Establishing causality would require additional testing (e.g., the Granger causality test), which goes beyond the scope of this research.

5. Conclusion

This study aimed to examine the long-run and short-run relationships between agricultural value added and economic growth in Serbia. The growth rate of real GDP was used as the dependent variable, while gross agricultural value added, expressed as a percentage of GDP, served as the main explanatory variable. Control variables included capital investment (as a percentage of GDP), trade openness, and the inflation rate. The analysis of annual time-series data was conducted for the period 1995–2023 using the ARDL model. The results of the ARDL bounds test confirmed the existence of a long-run relationship among the variables. The analysis revealed that the association between the share of agricultural value added in GDP and the real GDP growth rate is positive and statistically significant, even as the agricultural sector's share gradually declines in overall GDP. Additionally, both capital investment and trade openness exhibit a positive and statistically significant long-run relationship with economic growth.

The short-run dynamics among the variables were examined using an ECM model based on the ARDL approach. The results indicate a positive and statistically significant relationship between the share of agricultural value added in GDP and economic growth in the short run. However, this finding is less robust, as significance is confirmed at the 10% level. In the short run, capital investment and trade openness also display positive and statistically significant relationships with economic growth. The negative and statistically significant error correction coefficient indicates that more than half of the short-term deviation in the real GDP growth rate is corrected within one year, confirming the existence of a stable long-run equilibrium among the observed variables.

To check the robustness of the results, an additional analysis was conducted in which agricultural value added per worker was used instead of the share of agricultural value added in GDP. The results of the alternative ARDL/ECM model showed similar signs and levels of statistical significance for the main coefficients, while the error correction coefficient remained negative and statistically significant, confirming the existence of a long-run relationship.

Comparison of the results from the baseline and alternative models indicates that changes in the measurement of agricultural activity do not significantly affect the main findings, further confirming the robustness of the results.

The findings have important implications for economic policy in Serbia. Given that agricultural value added is positively and statistically significantly associated with economic growth in both the short and long run, sectoral policies should be designed to promote improvements in the productivity and sustainability of the agricultural sector. Particular attention should be directed toward the efficient use of underutilized resources and the adoption of modern technologies in agriculture, supported by appropriate financial support mechanisms provided by the government. Addressing climate change and environmental degradation poses additional challenges that complicate strategic planning and require integrated approaches encompassing ecological, economic, and social dimensions of agricultural development. Furthermore, it is essential that agricultural sector policy be aligned with other sectoral policies in order to achieve synergistic effects. This is particularly important considering that there is currently no active agricultural development strategy, as the previous Strategy for Agriculture and Rural Development covered the period from 2014 to 2024.

This study has certain limitations that may serve as a basis for future research. First, the obtained results should be interpreted with caution, given that agricultural value added is expressed as a share of GDP, which raises the possibility of endogeneity and a denominator effect. In other words, changes in non-agricultural sectors can mechanically affect this share even when agricultural output remains unchanged. However, as noted earlier, the robustness of the findings was verified through an alternative model specification using

agricultural value added per worker. In this case, the results were consistent, confirming the stability of the main findings. Furthermore, although a long-term relationship between agricultural value added and economic growth has been confirmed, this study does not establish causality. The results indicate the presence of a correlation, but not the direction of causal influence.

One of the limitations relates to the potential for bias due to omitted variables, given that the number of available observations in the sample is relatively small. Therefore, it would be beneficial to consider additional variables, such as employment in agriculture, the share of the rural population in total population, agricultural exports, as well as subsidies and public investments in agriculture. A new study incorporating a broader set of variables and a longer time horizon would provide an opportunity for a more precise assessment of the impact of agricultural production on the dynamics of overall economic activity in Serbia.

Furthermore, the use of aggregate macroeconomic data does not allow for an insight into regional disparities and the specific characteristics of different subsectors within agriculture, which may obscure significant variations in the contribution of various parts of the agricultural sector to economic growth. For this reason, one of the future research directions could be a micro-level analysis, aimed at examining the effects of individual agricultural subsectors or types of production on economic growth. In addition, a comparative analysis of Serbia with countries that share a similar economic structure could reveal further specificities and offer guidance for a more effective design of development policies in the agricultural sector.

Acknowledgments

This research has been financially supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia (Contract No: 451-03-137/2025-03/200099).

References

Adebayo, T. S., Alola, A. A., Ullah, S., and Abbas, S. 2024. The growth impacts of agriculture value-added, energy utilization, and environmental degradation in Pakistan: Causality in continuous wavelet transform approach. Natural Resources Forum 48 (2): 321-660.

Apostolidou, I., Kontogeorgos, A., Michailidis, A., and Loizou, E. 2014. The Role of Agriculture in Economic Growth: A Comparison of Mediterranean and Northern Views in Europe. International Journal of Economic Sciences and Applied Research 7 (3): 81-102.

Asom, S. T. and Ijirshar, V. U. 2016. Impact of Agriculture Value Added on the Growth of Nigerian Economy. Nigerian Journal of Management Sciences: A Multi-disciplinary Edition 5 (1): 238-245

Atanasijević, J. and Danon, M. (2014). Financing agricultural development in Serbia: Opportunities and challenges. Enterprise Economics 62 (1-2): 67-81.

Awokuse, T.O., and Xie, R. 2015. Does Agriculture Really Matter for Economic Growth in Developing Countries? Canadian Journal of Agricultural Economics 63 (1): 77-99.

Bassanini, A., Scarpetta, S., and Hemming, P. 2001. Economic Growth: The Role of Policies and Institutions, Panel Data Evidence from OECD Countries. OECD Economics Department, Working Paper 283, OECD Publishing. https://www.oecd.org/en/publications/economic-growth-the-role-of-policies-and-institutions_722675213381.html (accessed May 10, 2025).

Bayer, C. and Hanck. C. 2013. Combining non-cointegration tests. Journal of Time Series Analysis 34 (1): 83–95.

Beckman, J. and Countryman, A. M. 2021. The Importance of Agriculture in the Economy: Impacts from COVID-19. American Journal of Agricultural Economics 103 (5): 1595-1611. doi:10.1111/ajae.12212

Chebbi, E. H. 2010. Agriculture and economic growth in Tunisia. China Agricultural Economic Review 2 (1): 63-78.

Christiaensen, L., Demery, L., and Kuhl, J. 2011. The (evolving) role of agriculture in poverty reduction-An empirical perspective. Journal of Development Economics 96 (2): 239-254.

Deininger, K., Jin, S., and Ma, M. 2022. Structural Transformation of the Agricultural Sector in Low- and Middle-Income Economies. Annual Review of Resource Economics 14: 221-241.

Dewi, S., Abd. Majid, M. S., Aliasuddin, A., and Hj. Kassim, S. 2018. Dynamics of Financial Development, Economic Growth and Poverty Alleviation: The Indonesian Experience. The South East European Journal of Economics and Business *13* (1): 17-30.

Dickey, D. A. and Fuller, W. A. 1979. Distribution of the Estimators for Autoregressive Time Series with a Unit Root. Journal of the American Statistical Association 74 (366): 427–431.

Dowrick, S. and Gemmell, N. 1991. Industrial catching up and economic growth: A comparative study across the world's capitalist economics. Economic Journal 101 (405): 263–76.

Emam, A. 2022. Present and future: Does agriculture affect economic growth and the environment in the Kingdom of Saudi Arabia? Agricultural Economics 68 (10): 380-392.

Engle, R. and Granger, C. 1987. Cointegration and Error-Correction: Representation, Estimation and Testing. Econometrica 55 (2): 251-278.

FAO. 2021. Gross domestic product and agriculture value added 1970–2019: Global and regional trends. FAOSTAT Analytical Briefs Series No. 23. Rome. https://openknowledge.fao.org/items/64e6dae8-5721-47e1-be2e-df482808e8d0 (accessed Jun 2, 2025).

Finco, A., Bucci, G., Belletti, M., and Bentivoglio, D. 2021. The Economic Results of Investing in Precision Agriculture in Durum Wheat Production: A Case Study in Central Italy. Agronomy 11 (8): 1520.

Gardner, B. 2003. Causes of Rural Economic Development. Working Papers 28559, University of Maryland, Department of Agricultural and Resource Economics. https://ideas.repec.org/p/ags/umdrwp/28559.html (accessed May 8, 2025).

Gollin, D. 2023. Agricultural productivity and structural transformation: evidence and questions for African development. Oxford Development Studies 51 (4): 375–396.

Gollin, D., Lagakos, D., and Waugh, M. E. 2014. The agricultural productivity gap. The Quarterly Journal of Economics 129 (2): 939–993.

Gollin, D. 2010. Agriculture, Productivity and Economic Growth. Handbook of Agricultural Economics 4: 3825-3866.

Halil Arıç K. and Taştan S. 2018. Are China and India Decoupling from the United States? Panoeconomicus 65 (1): 65-78.

Johansen, S. 1988. Statistical Analysis of Cointegration Vectors. Journal of Economic Dynamics and Control 12 (2-3): 231-254.

Johansen, S. and Juselius, K. 1990. Maximum Likelihood Estimation and Inference on Cointegration with Applications to the Demand for Money. Oxford Bulletin of Economics and Statistics 52 (2): 169-210.

Johnston, B. F. and Mellor J. W. 1961. The Role of Agriculture in Economic Development. The American Economic Review 51 (4): 566-593. https://www.jstor.org/stable/1812786

Khan, R., Zhuang, W., Najumddin, O., Butt, R. S., Ahmad, I., and Al-Faryan, M. A. S. 2022. The impact of agricultural intensification on carbon dioxide emissions and energy consumption: A comparative study of developing and developed nations. Frontiers in Environmental Science 10: 1036300.

Kumar, J. 2025. Agricultural Value Addition and Economic Linkages in Bihar (2000-2024): An Empirical Analysis of Growth Dynamics. Journal of Economic Development, Innovation and Policy 1 (1): 19-39.

Kuznets, S. 1973. Modern Economic Growth: Findings and Reflections. American Economic Review 63 (3): 247–258.

Lerman, Z. 2001. Agriculture in transition economies: from common heritage to divergence Agricultural Economics 26 (2): 95-114.

Liu, J., Feng, X., Liu, J., and Yamaka, W. (2024) Digital Economy and Industrial Structure Transformation: Mechanisms for High-Quality Development in China's Agriculture and Rural Areas. Agriculture 14 (10): 1769.

Los, E. J. and Gardebroek, C. 2015. Unravelling the links between agriculture and economic growth: a panel time series approach for post-WW II Africa Evert J. Los and Cornelis Gardebroek. Unpubl. Artic. Wageningen University, The Netherlands Hollandseweg. https://edepot.wur.nl/351447 (accessed May 8, 2025).

Mackie, A. B. 1964. The Role of Agriculture in Economic Growth and Development. Illinois Agricultural Economics 4 (3): 1-10.

Maiga, Y. 2024. The Impact of Agricultural Productivity on Economic Growth in Africa. Journal of Agricultural Studies 12 (2): 25-57.

Matsuyama, K. 1992. Agricultural productivity, comparative advantage, and economic growth. Journal of Economic Theory 58 (2): 317–334.

Mbotiji, F., Oumar, S. B., and Egwu, B. M. J. 2023. Agricultural Value Added and Economic Development in the CEMAC Zone. Law and Economy 2 (9): 1-9.

Menegaki, A. N. 2019. The ARDL Method in the Energy-Growth Nexus Field; Best Implementation Strategies. Economies 7 (4): 105.

Mitrović, S., Mitrović, A., and Cogoljević, M. 2017. Contribution of Agriculture to the Development of Serbia. Economics of Agriculture 64 (2): 805–819.

Mostefai, Y. 2024. Effect of agriculture on economic growth in Algeria during the period 1991–2022. Journal of Innovations and Sustainability 8 (2): 11.

Nkoro, E. and Uko, A. K. 2016. Autoregressive Distributed Lag (ARDL) cointegration technique: application and interpretation. Journal of Statistical and Econometric Methods 5 (4): 63-91.

Novaković, T., Tomaš Simin, M., Novaković, D., and Mutavdžić, B. 2024. Analysis of the Gross Added Value of Agricultural Production in The Republic of Serbia. Ekonomika Poljoprivrede 71 (4): 1383–1399.

Nyiwul, L. and Koirala, N. P. 2022. Role of foreign direct investments in agriculture, forestry and fishing in developing countries. Future Business Journal 8 (1): 50.

Özen, E., Hodžić, S., and Yildirim, A. 2022. THE LINKAGE BETWEEN FISCAL POLICY AND NON-PERFORMING HOUSEHOLD LOANS IN TURKEY. The South East European

Journal of Economics and Business 17 (2): 113-124. DOI: 10.2478/jeb-2022-0018

Pesaran, M. and Shin, Y. 1998. An Autoregressive Distributed-Lag Modelling Approach to Cointegration Analysis. In S. Strøm (Ed.), Econometrics and Economic Theory in the 20th Century: The Ragnar Frisch Centennial Symposium (Econometric Society Monographs, (pp. 371-413). Cambridge: Cambridge University Press.

Pesaran, M. H., Shin, Y., and Smith, R. 2001. Bounds testing approaches to the analysis of level relationships. Journal of Applied Econometrics 16 (3): 289-326.

Petre, I. L. and Ion, R. A. 2019. The impacts of the investments in agriculture on economic growth in rural communities in Romania. Economics of Agriculture 66 (4): 955–963.

Phillips, P. C. and P. Perron, 1988. Testing for a unit root in time series regression. Biometrika 75 (2): 335-346.

Radlińska, K. 2025. Changes in the Structure of Agriculture in Central and Eastern Europe in the Light of the European Green Deal. Sustainability 17 (1): 104.

Rupasingha, A. 2009. Value-Added Agricultural Enterprises and Local Economic Performance. Review of Agricultural Economics 31 (3): 511-534.

Sertoglu, K., Ugural, S., and Bekun, F. V. 2017. The Contribution of Agricultural Sector on Economic Growth of Nigeria. International Journal of Economics and Financial Issues 7 (1): 547–552.

Tahamipour, M. and Mahmoudi, M. 2018. The Role of Agricultural Sector Productivity in Economic Growth: The Case of Iran's Economic Development Plan. Research in Applied Economics 10 (1): 9-16.

Thirtle, C., Lin, L., and Piesse, J. 2003. The impact of research-led agricultural productivity growth on poverty reduction in Africa, Asia and Latin America. World Development 31 (2): 1959–1975.

Tiffin, R. and Irz, X., 2006. Is agriculture the engine of growth? Agricultural Economics 35 (1): 79-89.

Timmer, M., de Vries, G. J., and de Vries, K. 2015. Patterns of structural change in developing countries. In Routledge handbook of industry and development, edited by J. Weiss and M. Tribe, 65-83, Routledge, London.

Ullah, S., Ahmad, W., Majeed, M. T., and Sohail, S. 2021. Asymmetric effects of premature deagriculturalization on economic growth and CO2 emissions: fresh evidence from Pakistan. Environmental Science and Pollution Research 28 (47): 66772–66786.

Wang, M., Zhang, X., and Guo, Z. 2024. The Impact of Farm Structure on Agricultural Growth in China. Land 13 (9): 1494.

World Bank. 2025. World Development Indicators. https://databank.worldbank.org/source/world-development-indicators (accessed Jun 3, 2025)

South East European Journal of Economics and Business
Volume 20 (2) 2025, 149-164
DOI: 10.2478/jeb-2025-0024

THE DEBT-GROWTH RELATIONSHIP IN THE WESTERN BALKANS, DEVELOPING EUROPE, AND THE EUROZONE ECONOMIES: TESTING FOR THE EXISTENCE OF A TIPPING POINT

Hajdar Korbi, Avdullah Hoti

Abstract

This paper examines the impact of public debt on economic growth in European regions, focusing on two objectives: first, to determine whether a threshold exists in the debt-growth relationship beyond which debt impedes growth, and second, to assess whether this threshold varies across regions. Using a threshold regression model, the analysis confirms such thresholds and identifies distinct levels: 22.2 percent for the Western Balkans, 37.4 percent for selected emerging European economies, and 82.6 percent for the Eurozone. These findings show that the debt-growth threshold depends on factors like economic structure and debt management capacity, suggesting a uniform debt management approach is ineffective. Instead, tailored strategies are needed to address regions' unique economic contexts. By identifying specific thresholds, this research provides valuable insights for policymakers, guiding fiscal strategies that balance stability and growth while considering regional dynamics. The paper contributes to the discourse on debt sustainability and supports informed decision-making for resilience.

Keywords: *public debt, economic growth, threshold, Western Balkans, Europe*

JEL Classification codes: *H63, H68, F34, O47*

1. Introduction

The relationship between public debt and economic growth has long drawn substantial academic and policy attention, yet empirical findings remain inconclusive. Despite this uncertainty, governments continue to rely heavily on debt to finance public spending, and debt-to-GDP (Gross Domestic Product) ratios have risen steadily across many economies, particularly in recent years. In this context, the need for a deeper understanding of the debt-growth nexus is not only of academic interest but also a pressing priority for policymakers seeking to balance fiscal sustainability with growth imperatives in an increasingly volatile global environment

A fundamental principle in debt management is the emphasis on borrowing for productive investments (Zanna et al. 2019). Essentially, if a country can

Hajdar Korbi (Corresponding author)
Doctoral Candidate, Faculty of Economics,
University of Prishtina, Kosovo
International Monetary Fund *
700 19th Street NW
Washington, DC 20431, USA
E-mail: hajdarkorbi@gmail.com
ORCID: 0009-0001-3410-3222

Avdullah Hoti
Professor of Economics
Department of Economics, Faculty of Economy,
University of Prishtina
Street Agim Ramadani nn, 10000 Prishtina, Kosovo
E-mail: Avdullah.Hoti@uni-pr.edu
ORCID: 0000-0002-5312-0300

* The views expressed in this paper are those of the author and do not necessarily represent the views of the International Monetary Fund.

generate growth through debt-financed investments, it can reduce the likelihood of a debt crisis. It is, therefore, crucial to examine the impact of debt-financed government spending on economic growth. The European sovereign debt crisis highlighted the importance of this issue, demonstrating how excessive borrowing combined with structural vulnerabilities can amplify economic and political pressures.

This paper examines the debt-growth nexus using a threshold regression model to capture potential non-linearities in the impact of public debt on economic performance. The analysis focuses primarily on the Western Balkans, a region with limited fiscal space, structural constraints, and scarce empirical evidence regarding debt thresholds. By constructing a dataset tailored to the specific conditions of these economies, the paper provides new insights into a region often overlooked in the literature. To assess the robustness of the findings, the sample is expanded to include European Union (EU) member states classified as Emerging and Developing Europe (EDE). These countries share similar development characteristics with the Western Balkans but operate within the institutional framework of the EU, allowing for a comparative perspective. A third group—Eurozone members that adopted the euro before 2007—is included as a benchmark to illustrate how debt-growth relationships may differ in more institutionally advanced environments.

Overall, the contribution of this paper lies in its regional comparative approach and its application of threshold techniques to previously underexamined economies. The remainder of the paper proceeds as follows: Section 2 reviews debt dynamics over time; Section 3 surveys the literature on debt and growth; Section 4 presents the data and discusses the methodology; Section 5 reports the results; and Section 6 concludes.

2. Debt dynamics

Despite a noticeable decline in government debt over the past two years, looking further back, the situation reveals an upward trend in government liabilities (Table 1). This upward trend is largely the result of two factors: first, in response to more frequent crises, governments have increased spending, aiming to alleviate the impact of these events, and second, the persistently low-interest rate during 2009-2018, has made debt financing more attractive (Hofmann et al. 2021) and a more feasible option compared to increasing taxes or reducing spending.

Table 1. Government debt in percent of GDP in Advanced Economies and EMDEs

Year	Advanced Economies	Emerging Market and Developing Economies
2006	73.38	36.97
2008	77.74	33.40
2010	97.38	37.40
2012	105.62	36.72
2014	103.70	39.86
2016	105.78	49.11
2018	102.95	52.57
2020	122.95	64.64
2022	112.28	64.17

Source: IMF World Economic Outlook, October 2023

Overall, the stock of government debt as percent to GDP rose from 73.38 percent in 2006 to a staggering 122.95 percent in 2020 and then dropped to 112.28 percent in 2022. The trajectory in Emerging Market and Developing Economies (EMDE), however, presents a slightly different picture. While they also exhibit pronounced increases during crises, with debt to GDP ratio increasing from 37 percent in 2006 to 64 percent in 2022, unlike advanced economies, EMDEs have consistently accumulated debt even in non-crisis periods, aiming to boost growth through increased spending (Kose, Ohnsorge, and Sugawara 2020).

The debt trends in our three focus regions, as presented in Table 2 below, offer an insightful perspective on how these regions compare with broader global trends. While experiencing an uptick in debt levels, each of these regions exhibit unique patterns regarding the magnitude of the debt increase.

Overall, Table 2 underscores the varied fiscal strategies and economic resilience exhibited by different regions in response to global economic challenges.

Table 2. Government debt in percent of GDP in selected regions

Year	Western Balkans	Selected EDE	Eurozone
2006	35.26	41.68	69.09
2008	31.89	40.60	70.62
2010	38.98	49.92	86.88
2012	47.81	51.85	93.96
2014	56.18	52.07	96.47
2016	56.57	53.22	93.50
2018	48.84	47.49	89.12
2020	54.82	56.43	100.30
2022	49.29	51.02	94.14

Source: IMF World Economic Outlook, October 2023

3. Literature review

The theoretical perspectives on the relationship between public debt and economic growth have evolved considerably. The Keynesian framework viewed debt as a short-run stabilizing tool that supports demand and employment, whereas Neoclassical models emphasized long-term costs, arguing that persistent borrowing raises interest rates, crowds out investment, and constrains potential output (Modigliani 1961; Diamond 1965; Barro 1979; Feldstein 1982). Building on this, the Ricardian equivalence hypothesis proposed that government borrowing may be neutral for aggregate demand because rational agents anticipate future tax liabilities and adjust their savings, accordingly, leaving consumption and investment unchanged (Barro 1974). Later, endogenous growth theories reconciled these views by recognizing that while fiscal expansion can stimulate short-term activity, excessive debt may hinder capital formation and productivity unless directed toward growth-enhancing investment (Romer 1986; Barro 1990).

As data became more widely available, research began to shed greater light on the debt–growth relationship. A growing body of evidence suggests that the impact of debt on growth is not one-directional. Early contributions by Barro (1991) and Fischer (1993) highlighted how fiscal imbalances and inflation—often associated with high public debt—tend to slow long-term growth. Subsequent cross-country analyses deepened this understanding. Pattillo, Poirson, and Ricci (2002, 2004) identified an inverted-U relationship between external debt and growth, suggesting that debt may initially stimulate economic performance but becomes detrimental beyond certain thresholds. Similar nonlinear or threshold effects were later reported by Reinhart and Rogoff (2010), Baum, Checherita-Westphal, and Rother (2012), and Caner, Grennes, and Koehler-Geib (2010), each finding that excessive public debt levels are associated with diminishing or negative returns to growth. Collectively, these studies underscore that the relationship between debt and economic performance is conditional and nonlinear, varying across countries, debt composition, and institutional settings.

A pivotal contribution to this discourse is the work of Reinhart and Rogoff (2010), which stands as a cornerstone in understanding the public debt-growth dynamics. Their comprehensive analysis of historical data, spanning 200 years and encompassing 44 countries, finds that once gross government debt surpasses roughly 90 percent of GDP, it generally exerts a significant negative effect on economic growth. However, Herndon, Ash, and Pollin (2013) later revealed data and coding errors, showing that this rule lacked robustness and that the relationship is context dependent. This prompted more sophisticated empirical strategies. Building on Hansen's framework, Kumar and Woo (2010) modeled the nonlinear relationship between public debt and growth, showing that moderate debt can foster investment while excessive debt hinders growth through crowding-out and fiscal stress. Baum, Checherita-Westphal, and Rother (2012) similarly found an inverted U-shaped debt–growth relationship in euro area economies. Extending this work, Mencinger, Aristovnik, and Verbič (2014) and Égert (2015) highlighted that debt thresholds vary across countries depending on institutional quality, fiscal credibility, and external conditions.

Recent research has advanced the empirical and methodological frontier by introducing greater flexibility and realism into models of debt–growth dynamics. Karadam (2018) identified asymmetry in this relationship, showing that low to moderate debt supports growth while excessive debt is detrimental, with thresholds varying by country and model specification. Building on this, Kitutila (2024) employed a Panel Smooth Transition Regression (PSTR) approach for Sub-Saharan Africa, revealing gradual rather than abrupt regime shifts, while Chen, Stengos, and Zhang (2024) used panel kink regressions to capture nonlinearities and cross-country heterogeneity.

Beyond the direct debt–growth relationship, empirical studies consistently emphasize the importance of controlling for other macroeconomic factors that condition growth outcomes. Variables such as trade openness, inflation, and initial income levels are frequently included to isolate the specific impact of public debt. Baum, Checherita-Westphal, and Rother (2012) and Mendonça and Brito (2021) control for openness and capital formation to account for the role of external integration and investment, while Eberhardt and Presbitero (2015) highlight initial GDP per capita as a key determinant of cross-country heterogeneity in debt effects. These practices reflect the broader consensus that debt's influence on growth operates alongside structural and macroeconomic variables, reinforcing the need for a well-specified empirical framework.

In summary, the evolving literature demonstrates that the growth effects of debt are nonlinear, context-dependent, and mediated by institutional and macroeconomic conditions. These insights provide the theoretical and empirical foundation for employing a threshold framework in this paper, allowing the relationship between public debt and growth to vary across regimes and over time. By integrating structural (openness and inflation) and initial-condition

(income level) controls, the model aims to capture both the direct and conditional effects of debt on growth dynamics in diverse European and Western Balkan economies

4. Data and methodology

Building on the theoretical foundations and insights from the existing literature, this section outlines the empirical strategy employed to investigate the research questions. It provides a detailed account of the data sources, key variables, and the construction of the dataset, followed by an explanation of the model specification and its theoretical grounding.

The empirical analysis draws on several datasets. First, the dataset for the six Western Balkan countries is used, covering the period 2006-2022. As discussed in Section 2, these six countries make a specific grouping as per their similarities in terms of economic structure and level. Second, the analysis is expanded by adding data for the current four emerging economies that are members of the EU. Finally, the analysis is further expanded to include Eurozone economies that have joined the monetary union prior to 2007. A complete list of countries used in this analysis is attached to Annex 1.

On the data, per capita GDP and trade indicators are sourced from the World Bank's World Development Indicators (WDI), while all remaining variables are drawn from the IMF's *World Economic Outlook* (October 2023 edition). Table 2 provides a summary of the variables employed in the analysis, including their definitions and respective data sources. More detailed descriptions and broader definitions are presented in Annex 2.

Regarding the model specification and its theoretical grounding, it builds on two principal theoretical channels through which public debt is expected to influence economic growth. In the neoclassical tradition, Diamond (1965) and Barro (1979) show that moderate borrowing can stimulate aggregate demand and investment, but beyond a certain level it crowds out private capital, reduces savings, and requires distortionary taxation that depresses long-run growth. Endogenous growth theory (Romer 1986; Barro 1990) complements this view by emphasizing that debt-financed expenditure can enhance human and physical capital formation, but excessive borrowing increases macroeconomic risk, raises risk premia, and generates policy uncertainty that reduces incentives for private investment. These theoretical mechanisms all imply *nonlinear* effects of debt on growth: positive or neutral at low levels, and negative beyond a certain indebtedness threshold.

This theoretical duality motivates an empirical framework that allows the debt–growth relationship to vary across regimes defined by a data-driven threshold. Threshold models are particularly appropriate in this context because they operationalize the idea—present in both neoclassical and endogenous growth frameworks (Diamond 1965; Barro 1979; Romer 1986)—that the marginal effect of debt changes qualitatively once borrowing exceeds a fiscally sustainable or growth-compatible range. In this sense, the threshold model is not merely a statistical device but a direct empirical representation of well-established theoretical mechanisms, and one that has been widely applied in recent empirical work on nonlinear debt–growth dynamics (Caner and Hansen 2004; Baum, Checherita-Westphal, and Rother 2012).

Guided by this theoretical foundation, the baseline empirical analysis adopts a pooled least squares version of the static panel threshold regression framework, developed by Hansen (1996, 2000). The model is constructed with Y_{it} capturing real GDP growth and D_{it} measuring the contemporaneous public debt-to-GDP ratio for each country and year. To isolate the effect of public debt, the model includes the standard growth-theory control variables C_{it}: initial GDP per capita (to capture convergence), trade openness (to capture the benefits of international integration), and inflation (to proxy macroeconomic stability).

The model is expressed separately for regimes below and above the debt threshold δ:

Table 3. Data Definitions and Sources

Variable	**Definition (as per source)**	**Source**
GDP growth	Annual % change in constant-price GDP (expenditure-based).	IMF, WEO database, Oct 2023
Debt	Gross general government debt; includes all liabilities requiring future repayment (GFSM 2001).	
Inflation	Year-on-year % change in average consumer prices.	
Trade openness	Sum of exports and imports of goods and services (% of GDP).	World Bank, World Development Indicators
GDP per capita	GDP (constant 2015 USD) divided by midyear population.	

Low-debt regime ($D_{it} \leq \delta$)

$$Y_{it} = \beta_{0,1} + \beta_{1,1} D_{it} + \beta_{2,1} C_{it} + \varepsilon_{it} \quad (1)$$

High-debt regime ($D_{it} > \delta$)

$$Y_{it} = \beta_{0,2} + \beta_{1,2} D_{it} + \beta_{2,2} C_{it} + \varepsilon_{it} \quad (2)$$

Combined threshold specification

$$Y_{it} = \beta_{0,1} 1\{D_{it} \leq \delta\} + \beta_{0,2} 1\{D_{it} > \delta\} + \beta_{1,1} D_{it} 1\{D_{it} \leq \delta\} + \beta_{1,2} D_{it} 1\{D_{it} > \delta\} + \beta_{2,1} C_{it} 1\{D_{it} \leq \delta\} + \beta_{2,2} C_{it} 1\{D_{it} > \delta\} + \varepsilon_{it}. \quad (3)$$

Here, $\beta_{1,1}$ and $\beta_{1,2}$ measure the marginal effect of debt in the low- and high-debt regimes, respectively. The coefficients $\beta_{2,1}$ and $\beta_{2,2}$ allow the impact of control variables to differ across regimes, thereby reflecting the possibility that openness, stabilization, or convergence channels operate differently at different debt levels.

The selection of control variables follows established empirical growth frameworks. Initial GDP per capita reflects conditional convergence (Barro 1991) and is measured using its 2005 value to mitigate endogeneity (Mencinger, Aristovnik, and Verbič 2014; Caner, Grennes, and Koehler-Geib 2010). Trade openness is widely recognized to enhance growth through technology diffusion, scale expansion, and export diversification (Pattillo, Poirson, and Ricci 2002; Hurić-Bjelan and Hadžiahmetović 2020). Inflation proxies macroeconomic instability, with theoretical and empirical evidence showing that high inflation distorts investment decisions, increases interest rate volatility, and amplifies debt-servicing burdens (Fischer 1993; Égert 2015). Together, these controls ground the empirical model firmly in mainstream growth theory.

Econometrically, the specification corresponds to the static panel threshold regression model developed by Hansen (1996, 2000). This approach enables the marginal effect of public debt on economic growth to vary endogenously across regimes separated by a data-driven threshold value δ of the debt-to-GDP ratio. In contrast to ad hoc piecewise regressions or spline approaches, Hansen's methodology allows the threshold, the regime-specific coefficients, and their statistical significance to be estimated jointly and consistently. This regime-dependent structure captures the nonlinearities emphasized in both neoclassical and endogenous growth theory, where the effects of debt on growth differ qualitatively at low versus high levels of indebtedness. Moreover, the model accommodates potential structural shifts in fiscal capacity, institutional quality, and macroeconomic constraints that arise as countries accumulate debt, thereby providing a theoretically coherent and empirically rigorous way of modeling nonlinear fiscal–growth interactions.

Subsequent empirical applications in the debt–growth literature—such as Caner and Hansen (2004), Baum, Checherita-Westphal, and Rother (2012), and Mencinger, Aristovnik, and Verbič (2014)—have demonstrated the usefulness of the threshold approach for identifying nonlinearities and regime-dependent fiscal dynamics. These studies consistently report that debt tends to have small or statistically insignificant effects on growth below a country-specific threshold, whereas growth becomes significantly weaker once the threshold is exceeded. Related empirical contributions employing variants of Hansen's technique (Égert 2015; Karadam 2018; Chudik et al. 2015) likewise document threshold-type nonlinearities, often finding that the marginal effect of debt becomes increasingly negative as debt ratios rise. This accumulated evidence lends strong empirical support to the adoption of a threshold model in the present analysis and provides benchmark findings to which the current results can be compared.

Recent global analyses and meta-studies further reinforce the appropriateness of this specification. The World Bank's *Global Waves of Debt* report (Kose et al. 2020) presents comprehensive evidence that high and rising debt levels in emerging and developing economies are associated with weaker subsequent growth, heightened vulnerability to shocks, and greater macroeconomic instability—precisely the types of regime shifts captured by threshold models. Similarly, the IMF–World Bank Debt Sustainability Framework (DSF) operationalizes country-specific debt thresholds that vary with institutional strength, policy credibility, and macroeconomic fundamentals, closely mirroring the logic of Hansen-type threshold regressions. Complementary meta-analytic evidence and recent empirical work (Heimberger 2021; Augustine and Rafi 2023) confirm that the debt–growth relationship is inherently nonlinear and context-dependent, with no universal threshold applying across countries. Together, these contributions substantiate the theoretical and empirical justification for estimating a Hansen-style threshold model with standard growth controls, allowing for the heterogeneity and nonlinearities emphasized throughout the fiscal sustainability and development economics literature.

While the baseline threshold specification is static, both theory and empirical research highlight that the growth effects of public debt may materialize with a temporal lag. In neoclassical models, debt-financed stimulus raises demand immediately, but the negative effects—crowding out, higher taxation, and reduced capital accumulation—emerge gradually (Barro 1979; Diamond 1965). Endogenous growth models similarly

predict lagged effects via human capital accumulation and investment dynamics (Romer 1986). Empirical studies report analogous patterns: Pattillo, Poirson, and Ricci (2002), Baum, Checherita-Westphal, and Rother (2012), and Chudik et al. (2015) find that debt burdens affect growth with delay, particularly through debt servicing and risk premia channels.

To account for such dynamics, the baseline two-regime threshold model is augmented by including a one-period lag of the debt-to-GDP ratio, $D_{it\text{-}1}$, as follows:

$$Y_{it} = \beta_{0,1} 1\{D_{it} \leq \delta\} + \beta_{0,2} 1\{D_{it} > \delta\} + \beta_{1,1} D_{it} 1\{D_{it} \leq \delta\} + \beta_{1,2} D_{it} 1\{D_{it} > \delta\} + \theta_1 D_{it\text{-}1} 1\{D_{it} \leq \delta\} + \theta_2 D_{it\text{-}1} 1\{D_{it} > \delta\} + \beta_{2,1} C_{it} 1\{D_{it} \leq \delta\} + \beta_{2,2} C_{it} 1\{D_{it} > \delta\} + \varepsilon_{it}. \quad (4)$$

The parameters θ_1 and θ_2 capture the delayed effects of debt in the low- and high-debt regimes, respectively. To evaluate whether these lagged effects differ significantly between regimes, a Wald test of the null hypothesis $H_0 : \theta_1 = \theta_2 = 0$ is conducted following Baum, Checherita-Westphal, and Rother (2012).

This specification enables the model to capture both nonlinear (threshold-based) and dynamic (time-dependent) channels through which public debt affects growth, thereby reflecting the short-run stimulus and longer-run debt-overhang mechanisms emphasized in the theoretical and empirical literature.

5. Empirical results

This section outlines the empirical implementation of the threshold regression framework. It begins by describing the composition and characteristics of the regional samples used in the analysis, followed by the formal testing procedure for the existence of a debt threshold. Once the presence of a threshold is established, the section presents the estimated threshold values and regime-specific coefficients for each regional group. The final subsection introduces a dynamic robustness check that incorporates lagged debt to examine whether the growth effects of debt materialize with delay.

Regarding the composition and characteristics of the regional samples used in the analysis, the Western Balkan countries form the core sample, reflecting their relatively limited fiscal space, shallow financial markets, and heightened vulnerability to external shocks. These features imply a lower debt-carrying capacity and make it plausible that even moderate increases in public debt may trigger growth-reducing effects in the region.

To assess whether these patterns are specific to the Western Balkans or also present in economies with similar developmental legacies but stronger institutional anchors, the sample is expanded to include four EU member states that were classified as emerging and developing economies at the time this dataset was initially compiled. These countries—Bulgaria, Hungary, Poland, and Romania—share structural and historical similarities with the Western Balkans but differ in one key respect: they have benefited from many years of EU membership, which provides enhanced policy credibility, access to EU structural funds, and more advanced fiscal and regulatory frameworks. Their inclusion allows us to examine whether EU-related institutional improvements meaningfully shift the debt–growth threshold, while maintaining comparability with the Western Balkan sample.

The third group comprises Eurozone economies that joined the monetary union prior to 2007. Restricting the Eurozone sample to countries that were already members before the beginning of the estimation window (2006–2022) ensures that all economies in this group operated under a stable common monetary and institutional environment throughout the full sample period. These advanced economies typically possess deeper financial markets, broader fiscal capacity, and stronger institutional quality, which collectively enable them to sustain substantially higher public debt ratios without immediate adverse effects on growth.

Taken together, the three samples represent a deliberate gradient of institutional and economic development—from transition economies with constrained fiscal space, to emerging EU members with strengthened policy frameworks, and finally to advanced Eurozone economies. This structure enhances the interpretability of the empirical findings, allowing the analysis to identify not only whether debt thresholds exist, but also how institutional capacity and economic structure shape the point at which public debt becomes growth-reducing.

Having described the sample composition and its relevance for the empirical analysis, the next step is to establish whether a statistically significant debt threshold exists. To empirically validate the applicability of the threshold regression model outlined in Equation (3), an initial test is conducted to ascertain the presence of a threshold in the debt-to-growth relationship. This test determines whether the slope coefficients and intercepts are identical across the two regimes, as presumed by the null hypothesis:

$$H_0: \beta_{0,1} = \beta_{0,2};\ \beta_{1,1} = \beta_{1,2};\quad \beta_{2,1} = \beta_{2,2.}$$

This null hypothesis implies that if the public debt-to-GDP ratio does not exert a differential impact on economic growth at varying levels, then the coefficients in both the low-debt and high-debt regimes should be statistically indistinguishable.

Using the heteroskedasticity-consistent Lagrange Multiplier test to detect the existence of the threshold in the data, the null hypothesis is rejected, thus confirming the presence of a threshold effect. Such findings open the way for a threshold regression model as per Equation (3), including the estimation of the unknown threshold value δ. Given the complexities involved in estimating threshold models, including the potential biases arising from small samples and the likelihood that the ratio test statistic may not adhere to the standard asymptotic distribution, bootstrap p-values for testing the null hypothesis are utilized. Bootstrap methods, as demonstrated by Hansen (1996), are effective in replicating the asymptotic distribution of the test statistic, thus providing more reliable inference in the context of threshold models.

The null hypothesis for all three groups of countries is rejected, indicating the presence of a threshold in the relationship between public debt and GDP growth. However, notable differences exist between the groups. In the Western Balkan countries, a critical threshold of 22.20 percent for the debt-to-GDP ratio is identified, above which increasing public debt negatively impacts GDP growth. The thresholds for the selected EDE countries and Eurozone economies are found to be much higher, at 37.4 and 82.8 percent respectively. These differences underscore the diverse economic structures, policies, and the quality of government spending and the overall institutional efficiency, highlighting the need for tailored contextual approaches to debt management and growth.

The coefficient for the debt-to-GDP ratio is statistically significant across all groups presented in the following three tables, indicating its importance in influencing GDP growth. Except for the lower debt regime in the Western Balkans, inflation is positively associated with growth. Trade openness demonstrates a positive relationship with GDP growth across all groups, suggesting the importance of international trade in driving economic expansion. The initial per capita GDP coefficient is consistently negative and significant, highlighting the role of starting economic conditions in shaping growth trajectories. These findings emphasize the multifaceted nature of the debt-growth relationship and underscore the importance of considering various economic factors when formulating policy interventions. The following subsections offer more details.

a) Western Balkan

Findings for Western Balkan countries in Table 4 indicate a nonlinear relationship between public debt and GDP growth, marked by a critical juncture at a 22.20 percent debt-to-GDP ratio. When the public debt is below or equal to this threshold, an increase in the public debt-to-GDP ratio positively impacts on GDP growth, and negatively if debt levels exceed this threshold. Regarding control variables, the results show that higher inflation rates adversely affect GDP growth under the low debt regime, while under the higher debt regime its impact on growth turns positive. Although a slightly higher average inflation

Table 4. Regression results for the Western Balkan countries

Lower debt regime with debt-to-GDP ≤ 22.20 percent

GDP Growth	Coef.	St. err.	t-value	p-value	[95% Conf. Interval]	
Debt (percent to GDP)	0.1076	0.00771	13.96	0.000	0.0925	0.1227
Inflation	-0.1466	0.01115	-13.14	0.000	-0.1684	-0.1247
Trade openness	0.0350	0.00417	8.40	0.000	0.0268	0.0432
Initial GDP per capita	-0.0001	0.00001	-0.59	0.557	0.0002	0.0001

Higher debt regime with debt-to-GDP > 22.20 percent

GDP Growth	Coef.	St. err.	t-value	p-value	[95% Conf. Interval]	
Debt (percent to GDP)	-0.0110	0.00173	-6.34	0.000	-0.0144	-0.0076
Inflation	0.1735	0.00817	21.24	0.000	0.1575	0.1895
Trade openness	0.0306	0.00157	19.50	0.000	0.0276	0.0337
Initial GDP per capita	-0.0004	0.00004	-10.35	0.000	0.0005	0.0003

under the lower debt regime might partially explain its negative contribution to growth in the Western Balkans, further investigations in this relationship is needed. A more comprehensive analysis is essential to fully elucidate the dynamics of this transition in the inflation-growth relationship. Trade openness exhibits a significant positive impact on growth under both regimes, while the initial GDP per capita has a rather low coefficient in both regimes, albeit with different signs and not significant under the low debt regime.

The identified threshold of 22.20 percent for the Western Balkan countries is notably lower compared to other similar studies and datasets assessed in this paper. This could be attributed to a multitude of factors distinctive to the Western Balkan region, such as profound and delayed economic transformations and a legacy of inherited debt, among others. These findings underscore the unique economic dynamics at play within the Western Balkans, offering valuable insights for both policymakers and economists when considering the implications of public debt on growth.

b) Selected Emerging and Developing European countries

The analysis of the selected EDE countries reveals nuanced insights into the debt-growth nexus (Table 5). Unlike in the case of the Western Balkans only, where a 22.4 percent threshold was identified, the expanded dataset suggests a higher threshold of 37.4 percent, which is statistically significant as evidenced by bootstrap p-values. All control variables seem to have positive impact on GDP growth in both scenarios.

These findings suggest that initial economic conditions, represented by per capita GDP, impact the relationship between public debt and growth. Also, the debt thresholds differences between the datasets could reflect broader economic conditions, the scale of economic activities, and the fact that the additional emerging and developing countries included in the analysis are part of the European Union.

c) Eurozone

In line with the above findings for the Western Balkans and the EDE countries, the analysis of Eurozone economies confirms the nonlinear dynamic relationship between public debt and economic growth (Table 6). Though, the threshold of 82.6 percent is notably higher, beyond which the relationship becomes negative, aligning with the hypothesized detrimental impact of high debt levels on economic performance. In the higher debt regime, inflation has a surprisingly high positive coefficient, while trade openness retains its positive influence on GDP growth. In both the lower and higher public debt regimes, we observe a negative coefficient for Initial GDP per capita. This may suggest that economies with higher initial levels of GDP per capita experience slower rates of economic growth, which aligns with the economic principle known as 'convergence theory'.

These findings highlight the unique economic dynamics within the Eurozone and underscore the importance of understanding the underlying factors for specific thresholds and debt-growth dynamics in different regions when formulating effective debt management and growth strategies.

Table 5. Regression results for selected Emerging and Developing European countries

Lower debt regime with debt-to-GDP ≤ 37.4 percent

GDP Growth	Coef.	St. err.	t-value	p-value	[95% Conf. Interval]	
Debt (percent to GDP)	0.0160	0.00474	3.380	0.001	0.007	0.025
Inflation	0.2951	0.00939	31.410	0.000	0.277	0.313
Trade openness	0.0221	0.00158	14.020	0.000	0.019	0.025
Initial GDP per capita	0.0001	0.00005	2.070	0.039	0.000	0.000

Higher debt regime with debt-to-GDP > 37.40 percent

GDP Growth	Coef.	St. err.	t-value	p-value	[95% Conf. Interval]	
Debt (percent to GDP)	-0.04544	0.00185	-24.580	0.000	-0.049	-0.042
Inflation	0.07915	0.00703	11.250	0.000	0.065	0.093
Trade openness	0.00133	0.00107	1.250	0.212	-0.001	0.003
Initial GDP per capita	0.00003	0.00001	3.310	0.001	0.000	0.000

Table 6. Summary of regression results for the Eurozone countries

Lower debt regime with debt-to-GDP ≤ 82.6 percent

GDP Growth	Coef.	St. err.	t-value	p-value	[95% Conf. Interval]	
Debt (percent to GDP)	0.0068	0.000862	7.92	0.0004	0.0051	0.0085
Inflation	0.1789	0.005480	32.64	0.0000	0.1681	0.1896
Trade openness	0.0442	0.000298	148.45	0.0000	0.0436	0.0448
Initial GDP per capita	-0.0001	0.000001	-103.80	0.0000	-0.0001	-0.0001

Higher debt regime with debt-to-GDP > 82.6 percent

GDP Growth	Coef.	St. err.	t-value	p-value	[95% Conf. Interval]	
Debt (percent to GDP)	-0.01862	0.0005	-41.1	0.0000	-0.01951	-0.01774
Inflation	0.44003	0.0054	81.78	0.0000	0.42974	0.45085
Trade openness	0.02149	0.0003	64.59	0.0000	0.02084	0.02214
Initial GDP per capita	-0.00005	1.9000	-23.80	0.0000	-0.00005	-0.00041

d) Lagged effects of debt

To examine whether the effect of public debt on growth unfolds with delay, the baseline threshold model was augmented with a one-period lag of the debt-to-GDP ratio for the Western Balkan region. This dynamic extension captures the possibility that debt-financed spending may influence growth gradually, while excessive debt may exert immediate contractionary effects.

In the low-debt regime, the contemporary debt coefficient is negative but statistically weak, whereas the lagged debt term is positive. This pattern suggests that moderate borrowing does not stimulate growth immediately but yields delayed gains—consistent with the gradual payoff of public investment.

In the high-debt regime, current debt exerts a strong and highly significant negative effect, confirming short-run debt-overhang pressures. The lagged debt coefficient, however, is again positive and significant, indicating that past borrowing may partially offset the immediate drag, possibly reflecting consolidation efforts or the eventual productivity of earlier investment.

The combined model, which incorporates both regimes and a regime interaction term, reinforces these dynamics: current debt remains strongly negative, lagged debt remains strongly positive, and the regime interaction is mildly negative, suggesting that delayed benefits weaken as debt surpasses the threshold.

The Wald test for equality of lagged effects across regimes ($\theta_1 = \theta_2$) fails to reject the null hypothesis, indicating that the delayed adjustment mechanism operates similarly regardless of regime. Overall, the dynamic model supports the baseline findings: debt has immediate contractionary effects at higher levels, while lagged debt contributes positively, aligning with theoretical expectations of short-run overhang and medium-run adjustment (Baum, Checherita-Westphal, and Rother 2012; Chudik et al. 2015).

Table 7. Dynamic threshold regressions with lagged debt effects (Fixed Effects, cluster-robust SEs)

Variable	Low-debt regime	High-debt regime	Combined model
Debt (current)	–0.229	–0.450	–0.472
Debt (lagged)	0.383	+0.396	+0.397
Regime. interaction (D_regime)	—	—	–0.170 (0.10)
Inflation	–0.247	–0.035	–0.082
Trade openness	0.029	+0.034	+0.039
R^2 (within)	0.23	0.58	0.57
N	17	79	96
Wald test (θ_1=θ_2)	—	—	F(1,5)=0.05, p=0.83

As seen in the previous sections, the analysis reveals marked variation in debt thresholds across the three groups. For the Western Balkans, the results suggest a notably low debt threshold, indicating that even relatively modest debt levels may begin to constrain growth. This likely reflects the region's still-developing institutional frameworks, limited revenue mobilization capacity, shallow financial markets, and a legacy of delayed transitions. These structural weaknesses can magnify the adverse effects of public debt, as governments face elevated borrowing costs, reduced fiscal space, and heightened investor caution.

In this context, policymakers in the Western Balkans should prioritize strengthening the foundations of fiscal and economic governance—including public debt management institutions, budgetary credibility, and macroeconomic coordination. These reforms are essential for enhancing the region's debt-carrying capacity over time and enabling more effective countercyclical fiscal policy as institutional maturity improves.

That said, these findings should be interpreted with appropriate caution. This analysis offers a single empirical contribution to a complex and evolving issue. The estimated thresholds are influenced by limitations inherent in the dataset, including sample size constraints, data quality issues, and a relatively short time horizon. Accordingly, the results should not be treated as definitive policy benchmarks, but rather as indicative reference points that warrant further examination. Continued research—especially country-specific studies employing alternative methodologies and longer time frames—is essential to advance the understanding of debt-growth dynamics and to inform more nuanced, context-specific guidance for prudent public debt accumulation in the region.

The higher threshold observed among EU EDE countries likely reflects the institutional and credibility benefits associated with EU membership, including access to structural funds, stronger policy frameworks, and enhanced investor confidence. Meanwhile, the much higher threshold found in the Eurozone is consistent with the characteristics of advanced economies, such as broader fiscal space, deeper financial markets, and access to the European Central Bank's monetary instruments. These factors collectively enable them to sustain higher public debt levels without immediate growth repercussions.

6. Conclusion

This paper offers a detailed examination of the impact of public debt on economic growth across diverse European economies, with a focus on the Western Balkans, a region often underrepresented in economic literature. Findings not only confirm the non-linear relationship between public debt and economic growth but also identify region-specific debt thresholds that diverge notably from previous studies. In the Western Balkan countries, the critical debt-to-GDP threshold stands at 22.4 percent, a relatively low threshold which may reflect the regions' economic vulnerabilities and structural inefficiencies.

For selected emerging European economies, the threshold is established at a higher level, 37.40 percent. While for the Eurozone countries it is established at a much higher level of 82.6 percent, suggesting that these economies are characterized by stronger economic foundations and robust debt management frameworks, which can sustain higher debt levels without adverse growth impacts.

Nonetheless, the implications of these findings are clear: there is no one-size-fits-all debt threshold for economic growth. Consequently, each region must tailor its fiscal policies to align with its economic conditions, institutional frameworks, and growth aspirations. For the lower-income nations of Europe, the Eurozone's adept handling of higher debt levels provides a benchmark and a set of strategic lessons for balancing debt accumulation with economic sustainability and growth.

This research, while shedding light on the critical relationship between public debt and economic growth across various European regions, is not without limitations. Economic growth is affected by multiple factors, one of which may be public debt. While the estimation model incorporates a number of control variables that impact growth, there are other factors that are not part of this analysis. Additionally, the paper's focus on GDP growth as the sole indicator of economic performance may overlook other important factors, such as employment rates, income inequality, and social welfare. Thus, future studies could expand upon this research by incorporating additional macroeconomic variables that reflect the diverse economic conditions and structural idiosyncrasies of each region. Further research might also consider the qualitative aspects of public debt, such as the composition of

creditors, debt maturity profiles, and currency denomination, which can significantly influence the debt's impact on economic growth.

In conclusion, this paper enhances our understanding of the intricate balance between debt and growth. It confirms that while public debt can fuel economic expansion within certain bounds, surpassing these bounds may hinder economic vitality. The challenge for policymakers is to discern these region-specific thresholds and to craft fiscal strategies that straddle the delicate line between beneficial and detrimental debt levels. As such, this analysis not only informs current fiscal policy debates, but also adds a nuanced perspective to the broader discourse on economic growth and debt sustainability in different European regions. The higher thresholds observed in the more developed regions of Europe suggest that strengthening economic foundations and debt management strategies enable countries sustain higher debt levels without adverse effects on growth.

References

Augustine, B., and O. P. C. Muhammed Rafi. 2023. Public Debt–Economic Growth Nexus in Emerging and Developing Economies: Exploring Nonlinearity. Finance Research Letters 52: 103540.

Barro, R. J. 1974. Are Government Bonds Net Wealth? Journal of Political Economy 82 (6): 1095–1117.

Barro, R. J. 1979. On the Determination of the Public Debt. Journal of Political Economy 87 (5, part 1): 940–71.

Barro, R. J. 1990. Government Spending in a Simple Model of Endogenous Growth. Journal of Political Economy 98 (S5): 103–25.

Barro, R. J. 1991. Economic Growth in a Cross Section of Countries. The Quarterly Journal of Economics 106 (2): 407–43.

Baum, A., C. Checherita-Westphal, and P. Rother. 2012. Debt and Growth: New Evidence for the Euro Area. ECB Working Paper No. 1450. Frankfurt am Main: European Central Bank.

Caner, M. and B. E. Hansen. 2004. Instrumental Variable Estimation of a Threshold Model. Econometric Theory 20 (5): 813–43.

Caner, M., T. Grennes, and F. Koehler-Geib. 2010. Finding the Tipping Point—When Sovereign Debt Turns Bad. Policy Research Working Paper 5391. Washington, DC: World Bank.

Chen, C., T. Stengos, and J. Zhang. 2024. Public Debt and Economic Growth: A Panel Kink Regression Latent Group Structures Approach. Econometrics 12 (1): 7.

Chudik, A., K. Mohaddes, M. H. Pesaran, and M. Raissi. 2015. Is There a Debt-Threshold Effect on Output Growth? IMF Working Paper WP/15/197. Washington, DC: International Monetary Fund.

Diamond, P. A. 1965. National Debt in a Neoclassical Growth Model. American Economic Review 55 (5): 1126–50.

Eberhardt, M. and A. F. Presbitero. 2015. Public Debt and Growth: Heterogeneity and Non-linearity. Journal of International Economics 97 (1): 45–58.

Égert, B. 2015. Public Debt, Economic Growth and Nonlinear Effects: Myth or Reality? Journal of Macroeconomics 43: 226–38.

Feldstein, M. 1982. Government Deficits and Aggregate Demand. Journal of Monetary Economics 9 (1): 1–20.

Fischer, S. 1993. The Role of Macroeconomic Factors in Growth. Journal of Monetary Economics 32 (3): 485–512.

Hansen, B. E. 1996. Inference When a Nuisance Parameter Is Not Identified under the Null Hypothesis. Econometrica 64 (2): 413–30.

Hansen, B. E. 2000. Sample Splitting and Threshold Estimation. Econometrica 68 (3): 575–603.

Heimberger, P. 2023. Do Higher Public Debt Levels Reduce Economic Growth? A Meta-analysis. Journal of Economic Surveys 37 (2): 285–322.

Herndon, T., M. Ash, and R. Pollin. 2013. Does High Public Debt Consistently Stifle Economic Growth? A Critique of Reinhart and Rogoff. PERI Working Paper No. 322. Amherst, MA: Political Economy Research Institute, University of Massachusetts Amherst.

Hofmann, B., M. J. Lombardi, B. Mojon, and A. Orphanides. 2021. Fiscal and Monetary Policy Interactions in a Low Interest Rate World. BIS Working Paper No. 954. Basel: Bank for International Settlements.

Hurić-Bjelan, J. and A. Hadžiahmetović. 2020. External Debt in Bosnia and Herzegovina—An Empirical Analysis. South East European Journal of Economics and Business 15 (2): 70–82.

Karadam, D. Y. 2018. An Investigation of Nonlinear Effects of Debt on Growth. Journal of Economic Asymmetries 18: 1–13.

Kitutila, Y. W. 2024. Estimation of the Public Debt Threshold Effects on Economic Growth in Sub-Saharan African Countries. African Development Review 36 (3): 377–90.

Kose, M. A., F. Ohnsorge, and N. Sugawara. 2020. Benefits and Costs of Debt: The Dose Makes the Poison. Policy Research Working Paper 9166. Washington, DC: World Bank.

Kose, M. A., P. Nagle, F. Ohnsorge, and N. Sugawara. 2020. Global Waves of Debt: Causes and Consequences. Washington, DC: World Bank.

Kumar, M. S. and J. Woo. 2010. Public Debt and Growth. IMF Working Paper No. 10/174. Washington, DC: International Monetary Fund.

Mencinger, J., A. Aristovnik, and M. Verbič. 2014. The Impact of Growing Public Debt on Economic Growth in the

European Union. Amfiteatru Economic Journal 16 (35): 403–14.

Mendonça, H. F. de and Y. Brito. 2021. The Link between Public Debt and Investment: An Empirical Assessment from Emerging Markets. Applied Economics 53 (50): 5864–76.

Modigliani, F. 1961. Long-run Implications of Alternative Fiscal Policies and the Burden of the National Debt. The Economic Journal 71 (284): 730–55.

Pattillo, C., H. Poirson, and L. Ricci. 2002. External Debt and Growth. IMF Working Paper WP/02/69. Washington, DC: International Monetary Fund.

Pattillo, C., H. Poirson, and L. Ricci. 2004. What Are the Channels Through Which External Debt Affects Growth? IMF Working Paper WP/04/15. Washington, DC: International Monetary Fund.

Reinhart, C. M. and K. S. Rogoff. 2010. Growth in a Time of Debt. American Economic Review 100 (2): 573–78.

Romer, P. M. 1986. Increasing Returns and Long-run Growth. Journal of Political Economy 94 (5): 1002–37.

Zanna, L.-F., E. F. Buffie, R. Portillo, A. Berg, and C. Pattillo. 2019. Borrowing for Growth: Big Pushes and Debt Sustainability in Low-Income Countries. The World Bank Economic Review 33 (3): 661–89.

Annex 1: List of countries and their grouping used in the analyses

Western Balkan	Emerging and Developing Europe (selected countries)	Eurozone (countries that joined Eurozone before 2007)
Albania	Albania	Austria
Bosnia and Herzegovina	Bosnia and Herzegovina	Belgium
Kosova	Bulgaria	Finland
Montenegro	Hungary	France
North Macedonia	Montenegro	Germany
Serbia	North Macedonia	Greece
	Poland	Ireland
	Romania	Italy
	Serbia	Luxembourg
		Netherlands
		Portugal
		Spain

Annex 2: Data source and definition

Variables	As defined by the source	Source
GDP growth	Annual percentages of constant price GDP are year-on-year changes; the base year is country-specific. Expenditure-based GDP is total final expenditures at purchasers' prices (including the f.o.b. value of exports of goods and services), less the f.o.b. value of imports of goods and services. [SNA 1993]	International Monetary Fund, World Economic Outlook Database, October 2023
Debt	Gross debt consists of all liabilities that require payment or payments of interest and/or principal by the debtor to the creditor at a date or dates in the future. This includes debt liabilities in the form of SDRs, currency and deposits, debt securities, loans, insurance, pensions and standardized guarantee schemes, and other accounts payable. Thus, all liabilities in the GFSM 2001 system are debt, except for equity and investment fund shares and financial derivatives and employee stock options. Debt can be valued at current market, nominal, or face values (GFSM 2001, paragraph 7.110).	
Inflation	Annual percentages of average consumer prices are year-on-year changes.	
Exports of goods and services	Exports of goods and services represent the value of all goods and other market services provided to the rest of the world. They include the value of merchandise, freight, insurance, transport, travel, royalties, license fees, and other services, such as communication, construction, financial, information, business, personal, and government services. They exclude compensation of employees and investment income (formerly called factor services) and transfer payments.	World Bank World Development Indicators
Imports of goods and services	Imports of goods and services represent the value of all goods and other market services received from the rest of the world. They include the value of merchandise, freight, insurance, transport, travel, royalties, license fees, and other services, such as communication, construction, financial, information, business, personal, and government services. They exclude compensation of employees and investment income (formerly called factor services) and transfer payments.	
GDP per capita	GDP per capita is gross domestic product divided by midyear population. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in constant 2015 U.S. dollars.	

Annex 3: Descriptive statistics

Table 3.1. Summary of data for Western Balkan countries

Variable	Obs.	Mean	Std. Dev.	Min	Max
Countries	102	3.5	1.716	1	6
Years	102	2014	4.923	2006	2022
GDP Growth	102	3.104	3.644	-15.31	13.04
Debt (percent to GDP)	102	43.796	20.956	5.57	107.35
Inflation	102	3.149	3.594	-2.42	14.21
Trade openness	102	94.756	19.858	59.83	170.82
Initial GDP per capita	102	3532.967	948.819	2284.59	5013.2

Figure 3.1. Debt (percent to GDP) over years for Western Balkan countries

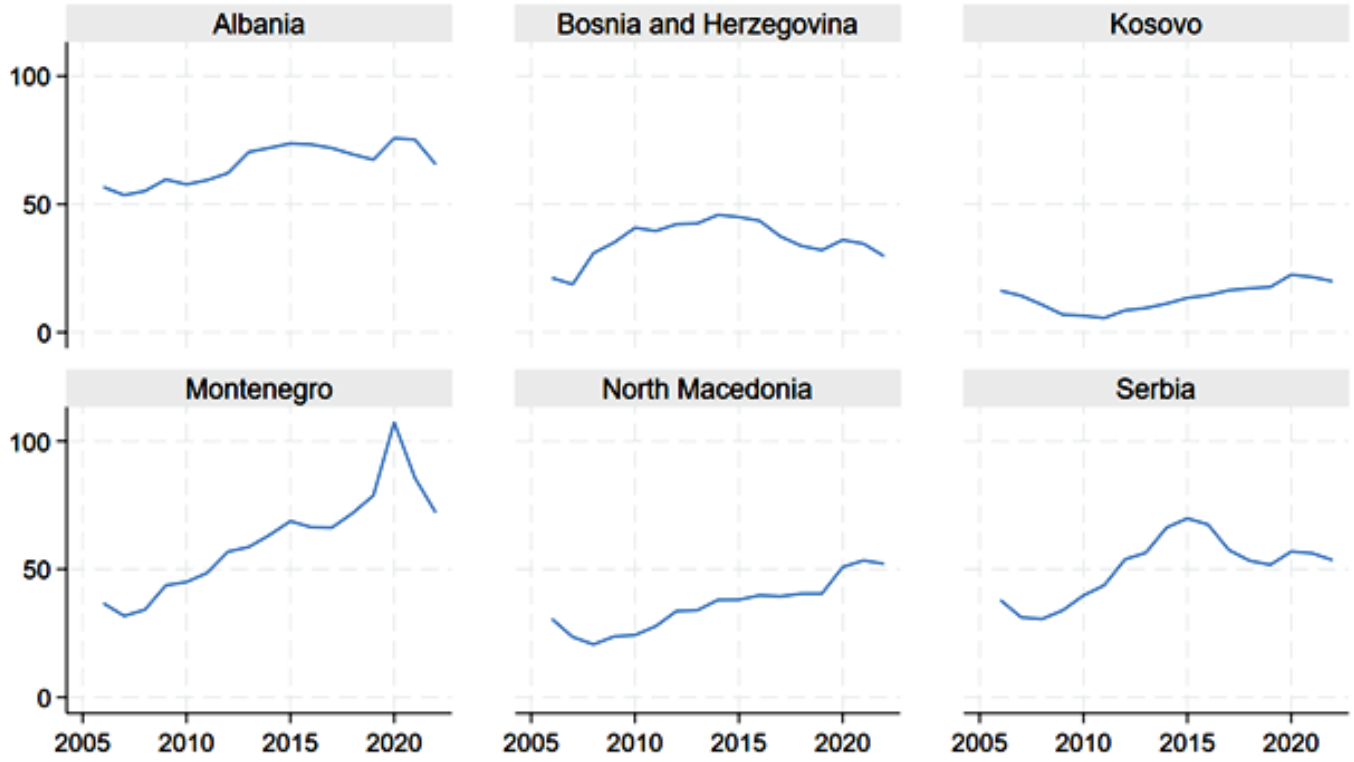


Table 3.2. Summary of data for the selected Emerging and Developing Europe

Variable	Obs.	Mean	Std. Dev.	Min	Max
Countries	153	5.778	2.907	1	10
Years	153	2014	4.915	2006	2022
GDP Growth	153	2.909	3.571	-15.31	13.04
Debt (percent to GDP)	153	47.589	19.43	12.43	107.35
Inflation	153	3.442	3.614	-1.6	14.55
Trade openness	153	104.563	28.338	58.47	186.72
Initial GDP per capita	153	5589.759	2625.351	2675.51	11278.62

Figure 3.2. Debt (percent to GDP) over years for the selected Emerging and Developing Europe

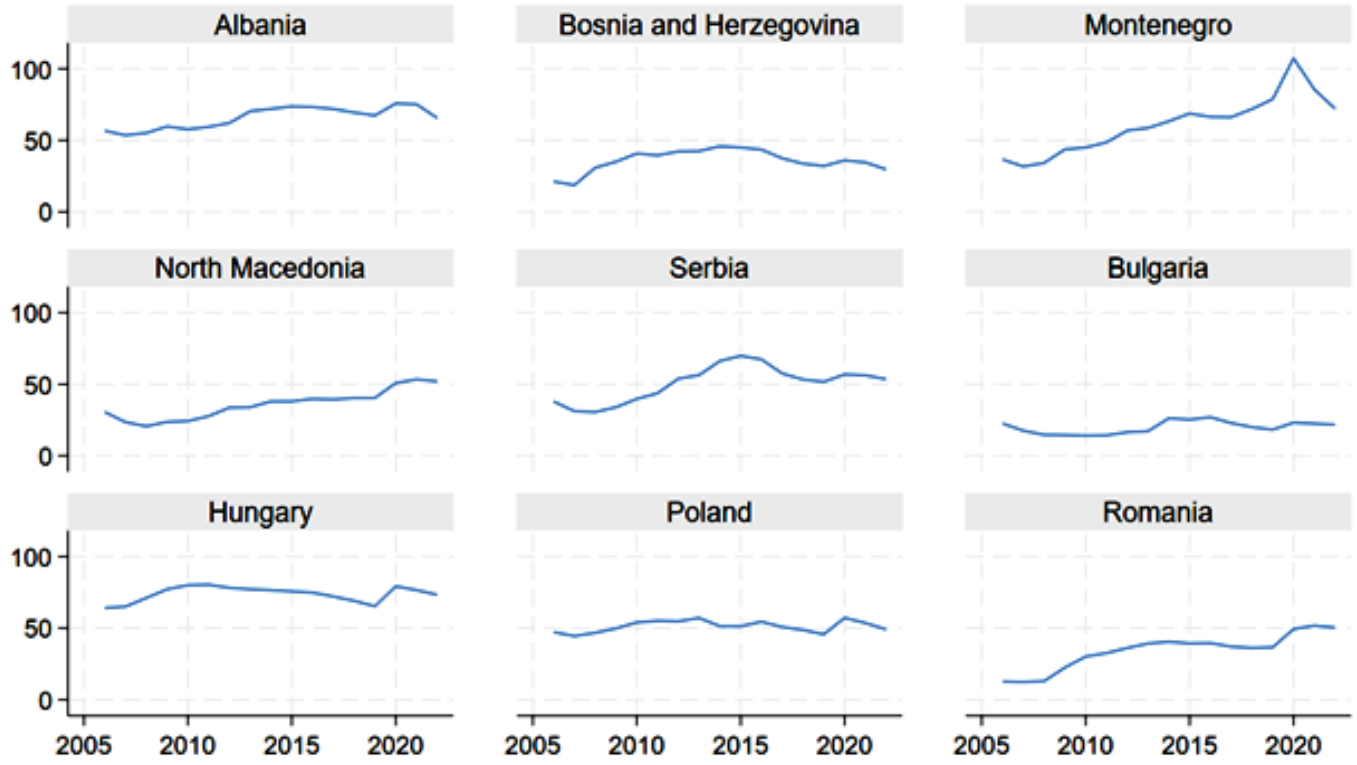
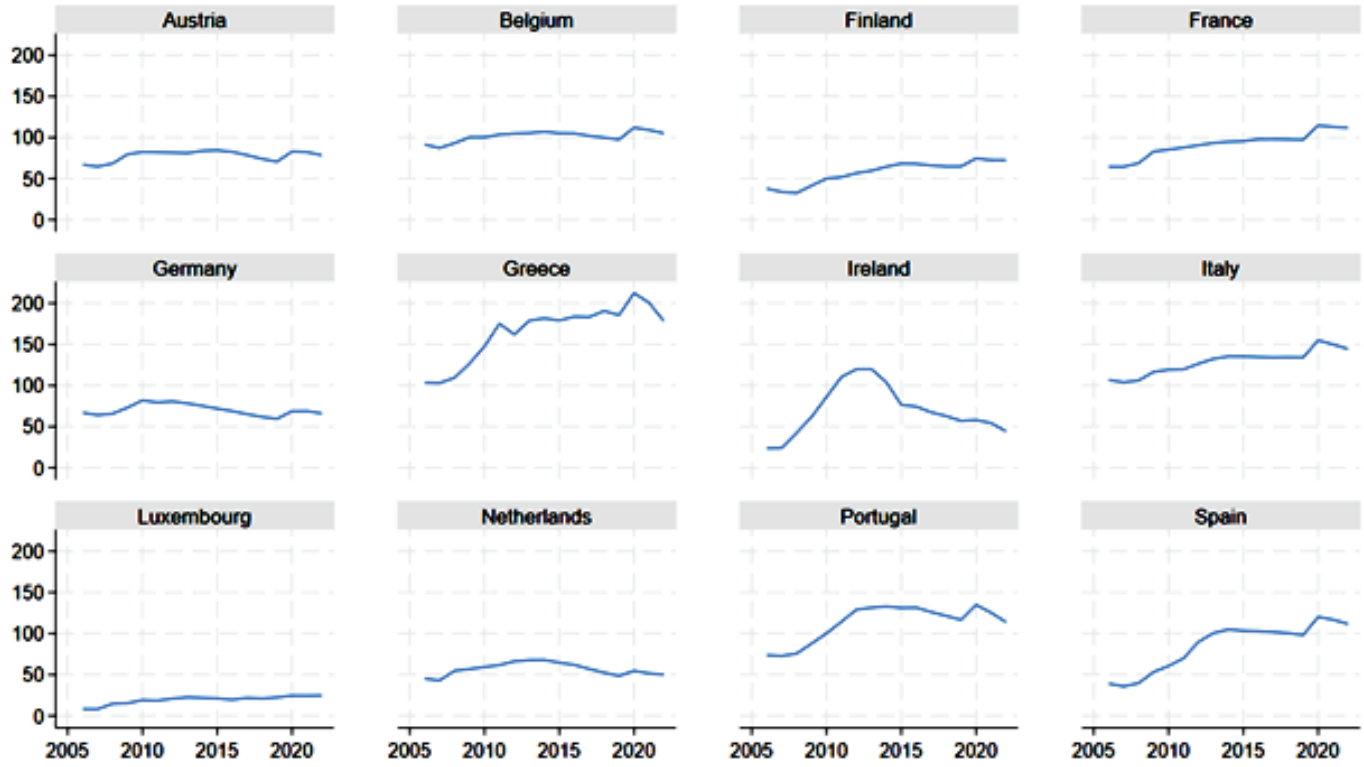


Table 3.3. Summary of data for the Eurozone

Variable	Obs.	Mean	Std. Dev.	Min	Max
Countries	204	16.5	3.461	11	22
Years	204	2014	4.911	2006	2022
GDP Growth	204	1.422	3.991	-11.17	24.48
Debt (percent to GDP)	204	86.415	40.647	8.1	212.43
Inflation	204	1.931	2.103	-1.68	11.63
Trade openness	204	119.456	80.333	45.42	393.14
Initial GDP per capita	204	40561.682	20228.12	19224.029	101222.05

Figure 3.3. Debt (percent to GDP) over years for the Eurozone



South East European Journal of Economics and Business
Volume 20 (2) 2025, 165-180
DOI: 10.2478/jeb-2025-0025

DRIVERS OF FOREIGN DIRECT INVESTMENT IN DEVELOPING COUNTRIES: EVIDENCE FROM NORTH MACEDONIA USING A GRAVITY MODEL APPROACH

Filip Selamovski

Abstract

This paper aims to evaluate the foreign direct investment in North Macedonia, a small developing economy. Findings indicate that after the dissolution of Yugoslavia, North Macedonia's policy of economic openness was generally successful and the country attracted substantial amounts of FDI by using its Technological industrial development zones and leveraging proximity to EU markets. By applying the gravity model to a panel of data, spanning 35 countries and a period of 14 years (2010-2023), this paper argues that economic dimensions of the host and source countries, geographic proximity, relative economic distance, economic integration, historical and cultural proximity, bilateral investment treaties and double taxation avoidance agreements have a positive impact on FDI. However, this paper does not find conclusive evidence that inflation rates, political corruption and innovation influence the FDI stock. In light of the need to avoid high concentration in just a few economic segments and high dependence on several source countries, the paper points out the need to simultaneously attract and diversify sources of foreign capital in order to enhance resilience to exogenous shocks. Diversified FDI stock is pivotal for achieving long-term macroeconomic stability and maintaining higher growth rates.

Keywords: *foreign direct investment, North Macedonia, gravity model, factor endowments, economic integration, relative economic distance, diversification.*

JEL classification: F210, F230, F150, C330, C510.

1. Introduction

Following Yugoslavia's dissolution, North Macedonia pursued market-based reforms, but faced major economic hardships in the 1990s. Although it was the only republic to secede peacefully, the Yugoslav wars brought severe trade disruptions. The country lost access to its key markets for industrial production, which combined with a decrease in demand led to a significant fall in GDP. The post-war period was characterized by serious macroeconomic problems, including high unemployment, rampant inflation and capital scarcity (World Bank 2018).

Macedonian attempts at economic recovery were hampered by sanctions from Greece due to a naming

Filip Selamovski, MSc
Lecturer
Higher School of Economics and Business,
Plekhanov Russian University of Economics
115054, Moscow, Stremyanny lane 36
Russia
E-mail: Selamovski.F@rea.ru
ORCID: 0000-0001-7484-6592

dispute and Greek allegations that the Macedonian Constitution makes territorial claims and promotes irredentist vision. As a result of the refusal to alter its position on the matter, Greece imposed a complete trade embargo in February 1994, which lasted 18 months. The embargo isolated the country economically, given that North Macedonia was cut off from its nearest port, Thessaloniki, and landlocked by the UN embargo against the Federal Republic of Yugoslavia, its main trading partner, in the north, causing about $2 billion in damages (Petreski 2023).

Realizing the severity of the economic situation, as well as its limited resources and domestic savings, North Macedonia pursued a policy of economic openness and closer cooperation (integration) with the European Union (EU) in order to secure the capital needed to accelerate economic growth. Domestic efforts, as well as deepening economic ties with the EU stabilized the economy by providing access to financial aid and attracting a significant amount of foreign direct investment (FDI). As a result of the policy of openness, FDI has acquired a pivotal role in the Macedonian economy, which makes this study quite relevant.

Having this in mind, the objective of this paper is to evaluate existing FDI trends and patterns in North Macedonia, as well as to gain insight into the factors that shaped these trends in order to identify policy implications not just for the country of interest, but for other developing countries as well.

This paper will contribute to the empirical literature on FDI determinants in developing countries. Evidence suggests that the FDI stock in North Macedonia is determined by the economic size of the host and source countries, geographic distance, relative economic distance, host country FDI attraction policy as well as historical aspects. The use of relative economic distance which measures the interdependency of economic growth trajectory is a meaningful contribution to the analysis of FDI stock in North Macedonia given that previous studies have not used this concept. This paper does not find unequivocal evidence that inflation, political corruption and innovation environment affect FDI.

The paper is structured as follows: the following section proceeds with a presentation of previous studies on FDI determinants in North Macedonia and other countries. The third section presents the methodology and the hypotheses to be tested. The subsequent section presents the results of the descriptive analysis and provides interpretation of the econometric model. The last section summarizes the results and argues policy implications for North Macedonia and other developing countries.

2. Literature review

Research on FDI patterns and determinants in North Macedonia has been relatively modest and mainly focused on their impact on the national economy and the policy of attracting FDI through Technological industrial development zones (TIDZ), which offer incentive packages to foreign investors. Previous studies present differing results on FDI's role in the Macedonian economy. For instance, Jankuloska (2016) in her study on the effects of the Technological industrial development zones provides a brief overview of inward FDI flows and highlights the positive impact of FDI into TIDZ on the economic structure, foreign trade and unemployment rates. However, some studies underline the unambiguity of these effects by arguing that FDI into TIDZ did not yield the expected spill-over effects in terms of transfer of knowledge and technology and substantially increased North Macedonia's trade deficit (Kikerkova 2017; Bartlett et al. 2019). Similarly, by applying a cost-benefit analysis Garvalieva et al. (2016) argue that although North Macedonia successfully attracted greenfield FDI through TIDZ, the benefits from knowledge transfer face challenges due to concentration of R&D, marketing, and sales activities within parent companies or regional centers, limiting knowledge spillovers as an attraction factor for FDI in Macedonia. A study by Osmani and Ahmeti (2020) provides insight into FDI in North Macedonia since gaining independence and highlights its significance as a factor of economic growth considering market size and domestic savings limitations.

To some extent foreign investment is also examined by international organizations. The World Trade Organization (WTO) includes trends and patterns in FDI in its reports for the trade policy review. The latest country report (2019) acknowledges that North Macedonia managed to successfully attract a fair amount of FDI by maintaining an open regime and pursuing accelerated integration with EU countries. Another 2018 World Bank (WB) study also highlights the country's success in attracting FDI through incentives. Moreover, the WB highlights the gradual transition from FDI in services to technology-intensive industries, leveraging closeness to major assembly facilities across Central and Western Europe and Turkey, along with preferential tariff-free entry to EU markets.

Some research on Macedonian FDI is incorporated as a part of a broader analysis of Balkan countries or transition economies. Notably, a study by Dauti (2015) investigates the determinants of FDI stock in transition economies, with special reference to North Macedonia. By using LSDV estimates for the gravity

model, Dauti provides empirical evidence that market size, distance and institutional factors including corruption perception and regulatory quality determine inward FDI stock. Another study by Kuzmanoska Mirkovikj et al. (2024) using CLRM approach argues that regulatory quality and macroeconomic stability have a significant positive impact on FDI in the country and further policy improvements in institutional quality can enhance FDI and overall economic growth.

Despite the evident scarcity of research on FDI in North Macedonia, numerous studies have addressed the issue of evaluating determinants in other transition and developing economies. A study by Dauti (2020) on the institutional determinants in transition economies provides evidence that FDI flows are influenced by gravity factors as well as institutional factors such as WTO membership, transition progress and others. Deichmann et al. (2022) in their study on FDI propensity and geo-cultural interaction in former Yugoslavia based on analysis of FDI location choice across the successor states argue that host governments seeking FDI might potentially increase the likelihood by targeting geographically-proximate partners that are culturally similar. Estrin and Uvalic (2013) apply the OLS methodology to an augmented gravity model for European transition economies with focus on Western Balkans and find evidence that gravity factors, EU membership and wages influence FDI. Johnson in his 2006 study on FDI inflows to Eastern European transition economic uses pooled OLS, fixed and random effect model and provides evidence that gravity factors, corruption perception, market seeking and progress in transition are important determinants of FDI.

A study by Dorakh (2020) on FDI across EU countries uses the OLS and PPML estimators and finds that gravity factors (economic size and geographical proximity) have positive impact on FDI. Moreover, by using EU membership and historical ties (colony) proxies Dorakh provides evidence about their significance as determinants of FDI. Analyzing Portuguese (unilateral) inward FDI, Leitão (2023) uses the same methodology and draws similar conclusions. The author also provides evidence that cultural proximity due to historical ties enhances FDI. Kox and Rojas-Romagosa (2020) use an augmented gravity model with FDI stocks as the dependent variables and dummies for cultural proximity, bilateral investment treaties, preferential trade agreements and provide evidence that besides the standard gravity factors, these factors are also key determinants of FDI stocks. A 2024 study by Tu investigating the relationship between innovation and FDI attraction across 66 developing countries by using the Global Innovation Index provides evidence that innovation is also a determinant of FDI albeit it has smaller effect vis-à-vis other variables (market size, labor resources and financial development). The author also analyzes the effects of inflation rates however he finds an insignificant negative relationship.

3. Methodology

Several research methodologies were used to evaluate foreign direct investment in North Macedonia. Aiming to assess inward FDI trends this research adopts a combined quantitative and qualitative approach to the analysis of inward FDI flows and stock for the period 2010-2023.

The first part of the study focuses on empirical data on inward FDI stock and their distribution across different geographic entities and economic sectors. The method of compound annual growth rate (CAGR), descriptive and comparative analysis were used in order to assess current patterns.

The second part employs the gravity model to get deeper insight into the drivers of FDI stock. The model builds on panel data collected by the National Bank of the Republic of North Macedonia, United Nations Conference on Trade and Development (UNCTAD) and other relevant organizations (Appendix 1), and it spans a period of 14 years (2010-2023). The dataset includes 35 countries (Appendix 2) from different geographic regions which account for approximately 99% of the inward FDI stock. Building on studies by Leitão (2023), Kox and Roja-Romagosa (2019) and other similar research, the augmented gravity equation for the FDI stock in North Macedonia is specified as:

$$ln\ FDI_{h,i,t} = \beta_0 + \beta_1\ ln\ Y_{h,t} + \beta_2\ ln\ Y_{i,t} + \beta_3\ ln\ DIST_t + \beta_4\ ln\ RED_t + \beta_5\ ln\ CPI_t + \beta_6\ ln\ PCI_t + \beta_7\ ln\ GII_t + \beta_8\ EU_t + \beta_9\ HIST_t + \beta_{10}\ BIT_t + \beta_{11}\ DTAA_t + e_t \quad (1)$$

The dependent variable ($ln\ FDI_h$) is defined as the unilateral FDI stock of source country *i* in North Macedonia (host). Despite a predominant focus on FDI flows within existing literature, the use of FDI stock has some advantages. Kox and Roja-Romagosa (2019, 2020) contend that FDI stock data exhibits reduced variability and hence enhances statistical robustness; Dauti (2015) emphasizes that employing FDI stock facilitates capturing time lag effects.

The dependent variable contains some zero and negative observations. To treat these observations a logarithmic transformation on the absolute value of FDI stock increased by 1, proposed by Yeyati et al. (2003), is used. According to other studies employing this transformation, the coefficients from the OLS

regression can still provide meaningful interpretation (Guerin and Mazocchi 2006).

Macedonian GDP per capita ($ln\ Y_h$), GDP per capita of source countries ($ln\ Y_i$), geographical distance ($ln\ DIST$), relative economic distance ($ln\ RED$), consumer price index ($ln\ CPI$), political corruption index ($ln\ PCI$), global innovation index ($ln\ GII$), EU membership of an investing country (*EU*), shared history (*HIST*), Bilateral Investment Treaty (*BIT*), Double Taxation Avoidance Agreement (*DTAA*) are the independent variables. GDP per capita of both the host and source countries, geographical distance, relative economic distance, consumer price index, political corruption index and global innovation index are expressed in natural logarithmic form. Geographical distance (*DIST*) is defined as the direct air distance between the capital of North Macedonia (Skopje) and the capitals of source countries. The random residual term is denoted as *e*.

In line with Frankel et al. (1995) the gravity model approach frequently uses the difference between logarithms of GDP per capita as a measure of economic distance ($ED = |ln\ Y_h - ln\ Y_i|$). The reasoning behind this is that differences in per capita output to a certain extent can be considered as a measure of differences in factor endowment and hence economic distance (Melitz 2007). However, taking into consideration Dunning's (1993) taxonomy of FDI motives and the fact that North Macedonia is a developing country with relatively lower costs of traditional factor endowments, it can be argued that economic distance indeed has a certain impact on FDI. Moreover, preliminary correlation analysis confirmed the presence of certain correlation (0.100) between ($ln\ FDI_h$) and *ED*, but it also confirmed the presence of a very strong correlation between $ln\ Y_i$ and *ED* (0.947), which could potentially cause multicollinearity issues. Thereby, *ED* was excluded replaced with relative economic distance (*RED*) which measures the proximity (interdependency) of economic growth trajectory.

The theoretical justification for the use of RED is derived from the growth of global connectivity and economic interdependence as a result of globalization and regional integration; North Macedonia is actively pursuing EU integration. Furthermore, there is empirical evidence that regional integration contributes to convergence and synchronization of economic growth paths (Lee 2012; Gomez et al. 2013), which in turn might lead to lower *ED*. Evaluation of the RED between North Macedonia and the investing countries is based on the approach proposed by Mazurek (2012) which measures the correlation coefficient of time series for the chosen period. Namely, this study employed the following formula:

$$RED_{f,t}(A,B) = \left|\frac{1 - r(f_A, f_B)}{2}\right| x\ 100 \quad (2)$$

where A and B are the countries of interest, f is the macroeconomic indicator of interest (GDP per capita), f_A and f_B are the time series, t is the time period (2010-2023) and r is the Pearson's correlation coefficient of the time series. Based on the formula, a conclusion can be drawn that stronger correlation implies higher relative economic proximity (interdependency) of growth trajectory.

The $ln\ CPI$ variable is considered in the model to account for inflation trends in the host country. In line with previous research this study employs the inflation rate of North Macedonia measured by the Consumer Price Index. It is expected that inflation negatively impacts FDI stocks in host country given that countries experiencing higher rates are often perceived as riskier by foreign investors and can lead to depreciation of the local currency and hence reduction in the value of assets. The studies of Mishra and Jena (2019) and Ascani et al. (2020) find negative relationship between FDI and inflation rates.

The $ln\ PCI$ variable is included to capture the effects of corruption on FDI. Most researchers use Transparency International's Corruption Perception Index however this study uses the Political Corruption Index, published by the Varieties of Democracy Institute (Stockholm, Sweden). In favor of the latter is the fact that it measures six distinct types of corruption that cover different areas and levels of the polity realm, distinguishing between public, executive, legislative and judicial corruption as well as the fact that is based on experts reports. On the contrary, the Transparency International Index does not distinguish individual types and is based on people's perceptions which might not reflect the actual corruption level. The index varies between 0 and 1 (0 indicates less corrupt and 1 more corrupt country). In this study the index is expressed as a percentage. It is expected that this variable negatively impacts FDI stocks in host country since a lower index value suggests a less corrupt environment.

The Global Innovation Index *(ln GII),* published by the World Intellectual Property Organization (WIPO), is considered in order to account for the effects of innovation on FDI. The GII measures a country's innovation performance by capturing both quantitative data and qualitative indicators across various dimensions of innovation inputs and outputs. In line with Tu's findings (2024) it is expected that this variable positively impacts FDI since countries with strong innovation environment often have advanced technologies and tend to grow faster due to higher productivity rates.

This in turn attracts FDI since multinational enterprises seek locations where they can access cutting-edge technology and investors prefer markets with high growth prospects as it usually increases returns on investment.

Other variables such as wages and their growth rates, unemployment rate, exchange rate of the local currency and the Fragile States Index published by the U.S. think tank Fund for Peace were considered, however the preliminary correlation analysis identified very strong correlation of the variables with $ln\ Y_h$. Since $ln\ Y_h$ is an integral part of the gravity model and strong correlation among the independent variables can cause multicollinearity issues these variables were excluded.

EU, HIST, BIT and *DTAA* are dummy variables included to capture specific fixed effects. The *EU* dummy aims to capture the effects of European integration on the Macedonian FDI stock. *EU* takes the value 1 if the investor is an EU member (27 countries) and the value 0 if the investor is not an EU member. Due to Brexit, the UK's value since 2020 is 0. Croatia's value after its official EU accession in 2013 is 1. The *HIST* dummy aims to capture the effects of historical aspects and cultural proximity. It takes the value 1 if North Macedonia was at some point part of the same country with the investing country and there is a certain degree of cultural and linguistic proximity, and the value 0 if it was not. Value 1 was assigned to Serbia, Croatia, Slovenia, Bosnia, Kosovo, Bulgaria, Greece and Turkey. Although North Macedonia, Greece and Turkey have some significant differences, the fact that they were part of the Ottoman Empire and the presence of strong cultural ties and sizable Macedonian diaspora can be considered sufficient evidence of shared history and overall social proximity. *BIT* and *DTAA* aim to capture the effects of international investment-related treaties on FDI stock. *BIT* takes the value 1 if the investing country and North Macedonia have a Bilateral Investment Treaty. Value 1 was assigned to Austria, Turkey, Germany, Netherlands, Slovenia, UK, Switzerland, Bulgaria, Hungary, Italy, Serbia, Belgium, China, Croatia, Albania, Luxembourg, Poland, Romania, Bosnia, Russia, Sweden and France (22 countries). *DTAA* take the value 1 if the investing country and North Macedonia have a Double Taxation Avoidance Agreement. Value 1 was assigned to Austria, Turkey, Germany, Netherlands, Slovenia, UK, Switzerland, Bulgaria, Hungary, Italy, Serbia, Estonia, China, Croatia, Albania, Luxembourg, Poland, Kosovo, Bosnia, Russia, Sweden, Norway, France (23 countries).

Supported by previous research, it is expected that all of the dummy variables will have a positive relationship with the dependent. The studies of Dorakh (2020) and Di Mauro (2000) find positive relationship between economic integration and FDI among European countries. Kox and Roja-Romagosa (2019, 2020) provide evidence that Bilateral Investment Treaties and Double Taxation Avoidance Agreements enhance FDI stocks. The rationale behind the positive relationship between FDI and historical aspects is that the presence of reliable historical ties is associated with lower transaction costs and easier market access (Leitão 2023).

In line with other studies on FDI employing the gravity model (Frankel et al. 2004; Alon et al. 2012; Estrin and Uvalic 2013; Leitão 2023), Equation (1) is estimated using a pooled OLS estimator with HAC standard errors. The use of pooled OLS is motivated by its simplicity and ability to combine information across countries and time periods. Moreover, given that the primary interest of this study lies in average relationships rather than specific entity-level variations, pooled OLS delivers parsimonious yet informative insights on key factors influencing the FDI stock in North Macedonia.

Overall, considering the arguments of the model, the following theoretical hypotheses to be tested have been formulated:

H1(a): Economic dimension of North Macedonia plays a crucial role in drawing FDI;
H1(b): Economic dimension of investing countries drives outward FDI;
H2: Geographical proximity is an important factor for investing countries;
H3: Relative economic distance in GDP per capita growth rates has positive impact on FDI;
H4: Inflation rates negatively affects FDI patterns;
H5: Political corruption hinders FDI;
H6: Innovation fosters FDI;
H7: Economic integration contributes to attracting FDI;
H8: Shared history and cultural proximity (including linguistic similarities) enhance FDI;
H9: Bilateral Investment Treaties help host countries attract FDI;
H10: Double Taxation Avoidance Agreements help host countries attract FDI.

4. Results and discussion

4.1. FDI inward stock in North Macedonia: volumes and distribution

Data displayed in Table 1 shows that North Macedonia has experienced a massive influx of FDI since 1994. Between 1994 and 2003 the inward FDI stock on average grew by 40.4% reaching $1.63 billion by 2003.

Table 1. North Macedonia's inward FDI 1994-2023

Indicators	1994	1998	2003	2008	2013	2018	2023	CAGR
GDP, in million USD	3,560	3,766	4,946	9,910	10,818	12,683	15,764	5.3%
FDI flow								
In million USD	24.0	150.0	117.8	586.9	334.7	725.3	625.1	11.9%
Share of GDP, %	0.7%	4.0%	2.4%	5.9%	3.1%	5.7%	4.0%	-
FDI stock								
In million USD	77	315	1,632	4,132	5,486	6,079	8,323	17.5%
Share of GDP, %	2.2%	8.4%	33.0%	41.7%	50.7%	47.9%	52.8%	-

Source: National Bank of North Macedonia, State Statistical Office

This reflects the post-Yugoslav economic policy of the country which was based on expedited liberalization of trade and capital markets, i.e. economic openness, in order to decrease capital deficiency and accelerate economic growth.

However, over the last two decades growth rates have slowed down significantly. Between 2004 and 2013 the average growth rates slowed to 10.7%. The average growth rates for the period 2014-2023 stood at 6.1% which is slightly lower than the global average – 7.4%. The slowdown is mostly attributable to the consequences of the European sovereign debt crisis which placed downward pressure on European investment patterns as well as various domestic institutional, economic, political constraints (Estrin and Uvalic 2016). A series of economic challenges such as the COVID-19 and the overall global slowdown as a result of the rising levels of geopolitical uncertainty also made their adjustments.

Nevertheless, the long-term trend remains positive. After a period of no positive changes, since 2017 FDI stock has been again on the rise and in 2023 inward surpassed $8.3 billion for the first time ever. Moreover, average growth rates have consistently surpassed GDP growth rates. As a result, FDI has become a significant part of the Macedonian economy. The substantial increase of annual inward FDI flows, as well as the total stock led to an increase of the FDI stock-GDP ratio. In 1994 the FDI stock accounted for just 2.2% of GDP and by 2023 reached 52.8%.

When compared to other Balkan and European countries, it can be concluded that North Macedonia's policy of economic openness has been quite successful in attracting foreign capital. Between 2010 and 2023 the FDI stock in North Macedonia increased by 94% which is significantly higher than the FDI stock increase in former Yugoslav republics Bosnia (59%) and Croatia (30%), which is an EU member. Moreover, comparing the FDI stock-GDP ratio, based on UNCTAD data, it can be noted that relative to its economic size North Macedonia has accumulated more foreign capital than Slovenia (34.3%), France (33.2%), Italy (20.8%), Germany (24.9%), Greece (25.3%), all of whom are EU members with better developed economies.

Table 2 displays the distribution of the FDI stock across key regions, regional blocs and source countries. In 2023 92% of the Macedonian FDI stock came from other European countries. America accounts for 5.8% and Asia's share stands at just 2.1%. Overall, this suggests that North Macedonia's FDI stock is poorly diversified and the country is extremely dependent on European investment. In terms of regional blocs, the European Union is by far the largest foreign investor in the country. By 2023 EU's FDI stock reached $5.6 billion which accounts for roughly 67% of the total FDI stock.

In terms of individual countries, with roughly 16% of the total FDI stock, Austria is by far the largest investor. Austrian FDI are mainly concentrated in electricity, finance, insurance and telecommunications. The most notable investments are EVN Macedonia – key provider of energy services (part of the EVN AG Group), A1 Macedonia– key provider of communications and digital solutions (subsidiary of A1 Telekom Austria Group); Sparkasse Bank Macedonia (part of Steiermärkische Sparkasse), Winner Life and Insurance Makedonija (subsidiaries of Vienna Insurance Group), Grawe (subsidiary of Grawe Group), WVP (subsidiary of WVP Group).

Other key investors are Greece, Turkey, Germany and the Netherlands. Combined these five countries account for 52% of the total FDI stock. It is noteworthy that in the last decade Turkish and German investments have surged. Turkish FDI stock in North Macedonia increased from just $64 million in 2010 to $790 million in 2023. For the same period, German FDI stock increased from $95 million to $720 million. Furthermore, the presence of American, British and Belgian companies has also been on the rise. American

Table 2. North Macedonia's FDI inward stock across key investing countries, regions and blocs, 2010-2023

	Volume, $ million			Share, %			Increase	
	2010	2016	2023	2010	2016	2023	Overall	CAGR
Key investing regions								
Europe	3,982.2	4,519.4	7,655.5	92.1%	92.1%	92.0%	1.92x	5.2%
Americas	297.4	316.1	479.4	6.9%	6.4%	5.8%	1.61x	3.7%
Asia	13.4	65.7	171.5	0.3%	1.3%	2.1%	12.82x	21.7%
Key investing regional blocs								
EU-27	3,403.0	3,242.6	5,558.6	78.7%	66.1%	66.8%	1.63	3.8%
EFTA	228.0	238.5	412.1	5.3%	4.9%	5.0%	1.81	4.7%
CEFTA	164.5	162.1	290.1	3.8%	3.3%	3.5%	1.76	4.5%
Key investing countries								
Austria	453.5	598.2	1,324.5	10.5%	12.2%	15.9%	2.92x	8.6%
Greece	572.6	488.5	829.8	13.2%	10.0%	10.0%	1.45x	2.9%
Turkey	64.13	261.2	790.4	1.5%	5.3%	9.5%	12.32x	21.3%
Germany	94.74	261.7	719.9	2.2%	5.3%	8.7%	7.60x	16.9%
Netherlands	730.9	446.2	659.3	16.9%	9.1%	7.9%	0.90x	-0.8%
Top 5 countries	1,915.9	2,055.9	4,324.0	44.3%	41.9%	51.9%	2.26x	6.5%

Source: National Bank of North Macedonia

Table 3. North Macedonia's inward FDI stock across key sectors, 2010-2023

Key investing countries	Volume, $ million			Share, %			Increase	
	2010	2016	2023	2010	2016	2023	Overall	CAGR
Financial intermediation	1,000.1	872.4	1,727.6	23.1%	17.8%	20.8%	1.73x	4.3%
Automotive industry	219.3	691.4	1,149.2	4.7%	13.7%	13.5%	5.24x	13.6%
Electricity	303.3	384.9	764.5	7.0%	7.8%	9.2%	2.52x	7.4%
Wholesale	292.5	479.2	679.9	6.8%	9.8%	8.2%	2.32x	6.7%
Construction	177.7	355.8	572.2	4.1%	7.2%	6.9%	3.22x	9.4%
Top 5	1,992.7	2,783.8	4,893.4	45.7%	56.4%	58.5%	2.46x	7.2%

Source: National Bank of North Macedonia

and British FDI stocks have quadrupled between 2010 and 2023. Belgian FDI stock increased from $1.6 million in 2010 to $128.5 million in 2023.

Table 3 displays the key sectors for Macedonian FDI. Data indicates a continuation of the trend identified by the World Bank about the shifting nature of FDI (World Bank 2018). In 2010 the stock was mostly concentrated in financial services (23.1%), non-precious metals & metal products (10.3%), food & beverage manufacturing (8.0%), electricity (7.0%) and wholesale (6.8%); these sectors were primarily focused on serving the local market and FDI was mostly in the form of mergers and acquisitions (M&A). In the following period, North Macedonia experienced a significant influx of greenfield FDI in relation to the automotive industry, whose FDI stock between 2010 and 2023 on average grew by 13.6% annually and as a result its share increased from 4.7% to 13.5%.

It stands to mention that most of the greenfield FDI in the last decade have been into the Technological and Industrial Development Zones (TIDZ) in North Macedonia (Kikerkova 2016). TIDZs are special economic zones that offer numerous fiscal benefits to foreign investors including partial return of investment costs in machines, equipment or construction, long-term lease on land (up to 99 years) at concessionary prices, as well as ten-year tax holiday for corporate and personal income tax, exemptions from customs duties and VAT on imported raw materials and equipment, etc. For instance, a company operating outside of TIDZ

would normally pay 10% corporate income tax, 18% VAT, 0-15% and 5-20% customs duties on imported raw materials and equipment respectively, while a company operating in TIDZ would be completely exempted from VAT and all customs duties applicable and will pay no corporate income tax for the first ten years (Invest North Macedonia website). Given that many of these incentives are zone-specific it comes as no surprise that these zones have been instrumental in drawing substantial manufacturing investments into the economy since being established in 2007, especially from multinationals seeking efficiency in the value chains and higher return on investment.

The zones were especially successful in attracting FDI into the automotive industry. The aforementioned FDI stock ($1,15 billion) in this sphere has been entirely into TIDZ. According to Invest North Macedonia, the government investment and export promotion agency, the list of companies that have their production facilities in TIDZ includes Johnson Matthey (UK), Gerrresheimer, Kessler, Franz Kiel, Marquardt, Kostal, Kromberg & Schubert, Draxelmaier (Germany), VDL Van Hool (Belgium), Adient, GenTherm, Amphenol, Lear Corporation, Aptiv, Kemer, Dura (USA), Joyson Safety Systems (China). Also, in 2024 Belgian Avesta Battery & Energy Engineering started the construction of a factory in TIDZ. All companies are important suppliers not just for the European but for the global automotive industry as well; most of their output is being exported to other European countries, which is consistent with a 2017 OECD study that classified Macedonian TIDZ as export processing zones.

In this regard, it must be noted that North Macedonia has a free trade area with the EU, the European Free Trade Association (Switzerland, Norway, Iceland, Liechtenstein), other CEFTA countries (Albania, Bosnia, Kosovo, Moldova, Montenegro, Serbia), Turkey and Ukraine, as well as a Partnership, trade and cooperation agreement with the UK (Invest North Macedonia website). Also, together with Albania and Serbia, the country is part of Open Balkan, an economic and political zone that aims to strengthen cooperation. Hence, for most of the foreign companies North Macedonia serves as an export platform and a part of their value chain. In this context, there are theoretical justifications to support the claim that Macedonia's EU integration increased the probability of attracting investors.

It should be mentioned that FDI, especially into TIDZ, significantly contributed to the transformation of the Macedonian industrial output and exports. According to data collected by the State Statistical Office, in 2000 the industrial output was mainly dominated by apparel, food, beverages, tobacco products and other non-metallic mineral products. These categories accounted for 60.7% of the industrial gross value added (GVA). Although food and apparel remain key industrial segments, accounting for a total of 19.1% in 2022, the shares of beverages, tobacco products and non-metallic minerals have declined significantly. This reconfiguration of the national industrial structure is mainly attributable to the FDI-based development of the automotive industry. As a result, in the last two decades the automotive industry contribution to the country's industrial GVA increased from 1.4% to 14.7%, which makes the automotive industry the largest industrial segment.

In terms of exports, the same situation can be observed. In 2018 TIDZ accounted for 36% of the value of exports (WTO 2019) and it is estimated that by 2023 their share exceeded 50%. Furthermore, two decades ago Macedonian exports were dominated by iron and steel (23.2%), articles of apparel (20.2%) and refined petroleum oils (8.0%). Nowadays, miscellaneous chemical products and electrical machinery lead with 23.4% and 20.4% respectively. The combined share of iron and steel, articles of apparel and refined petroleum oil declined from 51.4% in 2005 to 12.1% in 2024. It must be underlined that exports of miscellaneous chemical products, and by extension overall Macedonian exports, are highly dependent on a single product. In 2024 23.21% (almost a quarter) of Macedonian exports were reaction initiators, reaction accelerators and catalytic preparations (HS code 3815), which falls entirely on the British company Johnson Matthey, a world leader in the production of catalytic converters for the automotive industry and catalytic converters for environmental pollution control. Moreover, this product is almost entirely exported to Germany (97.1%), which poses a significant risk.

Overall, analysis shows that over the years North Macedonia has successfully integrated into European and global value chains, especially related to the automotive industry, by using its Technological industrial development zones and leveraging its proximity and duty-free access to European markets. Nevertheless, the current situation significantly exposes the country to exogenous shocks and changing patterns given the prevalence of export-oriented FDI in the total exports and the fact that economic crises can be transmitted through international trade. For instance, a decrease in demand from key export destinations might lead to a decrease in industrial output given that North Macedonia is simply a processing stop, and thus hinder economic growth. High exposure to exogenous shocks highlights the need to diversify FDI inflows in order to subsequently diversify its stock and mitigate possible negative outcomes.

4.2. Gravity model approach

In line with the gravity model (Equation (1)) formulated in this research, Table 4 displays the descriptive statistics of the variables. The GDP per capita variable of source countries ($ln\ Y_i$) exhibits higher maximum and average values than GDP per capita of the host country. This is somewhat expected, given that most of the FDI in North Macedonia come from more developed European economies with higher GDP per capita (Appendix 3). For instance, Switzerland's GDP per capita is almost 12x higher. Among the dummy variables, *HIST* exhibits the lowest average value while *DTAA* and *BIT* the highest. This indicates that North Macedonia has extensively used *DTAA* and *BIT* within its FDI attraction policy.

In order to evaluate the relationship degree between the variables, this research employed correlation analysis. Table 5 displays the results. Findings indicate positive correlation between $ln\ FDI$ and the economic dimensions of both the host country ($ln\ Y_h$) and source countries ($ln\ Y_i$), as well as the relative economic distance ($ln\ RED$), Political Corruption Index ($ln\ PCI$), *EU* membership of source countries, shared history (*HIST*), bilateral investment treaties (*BIT*) and double taxation avoidance agreements (*DTAA*). It must

Table 4. Variables descriptive statistics

Variables	Minimum	Maximum	Mean	St Dev	Observations
$ln\ FDI$	-4.61	7.19	3.90	1.87	490
$ln\ Y_h$	8.43	9.06	8.70	0.18	490
$ln\ Y_i$	8.00	12.22	10.17	0.93	490
$ln\ DIST$	4.61	9.65	7.19	1.18	490
$ln\ RED$	-1.05	4.06	1.93	1.53	490
$ln\ CPI$	4.60	4.74	4.63	0.04	490
$ln\ PCI$	3.99	4.32	4.22	0.08	490
$ln\ GII$	3.36	3.64	3.53	0.08	490
EU	0.00	1.00	0.56	0.50	490
$HIST$	0.00	1.00	0.23	0.42	490
BIT	0.00	1.00	0.60	0.49	490
$DTAA$	0.00	1.00	0.65	0.48	490

Source: author's calculations

Table 5. Correlation matrix

Variables	$ln\ FDI$	$ln\ Y_h$	$ln\ Y_i$	$ln\ DIST$	$ln\ RED$	$ln\ CPI$	$ln\ PCI$	$ln\ GII$	EU	$HIST$	BIT	$DTAA$
$ln\ FDI$	1.000											
$ln\ Y_h$	0.257	1.000										
$ln\ Y_i$	0.101	0.104	1.000									
$ln\ DIST$	-0.227	0.000	0.557	1.000								
$ln\ RED$	0.162	0.004	0.503	0.395	1.000							
$ln\ CPI$	0.120	0.571	0.083	0.000	0.003	1.000						
$ln\ PCI$	0.037	0.189	0.034	0.000	0.002	0.311	1.000					
$ln\ GII$	-0.106	-0.515	-0.059	0.000	-0.001	-0.630	0.125	1.000				
EU	0.237	-0.021	0.121	-0.132	-0.002	-0.017	-0.010	0.013	1.000			
$HIST$	0.215	0.000	-0.547	-0.607	-0.204	0.000	0.000	0.000	-0.069	1.000		
BIT	0.313	-0.002	-0.260	-0.404	-0.123	0.002	0.001	0.001	0.226	0.169	1.000	
$DTAA$	0.323	0.118	-0.214	-0.395	-0.098	0.035	0.016	-0.040	0.120	0.176	0.618	1.000

Source: author's calculations

be noted that the strongest positive correlation is observed between *ln FDI* and *DTAA* and the weakest between *ln FDI* and Political Corruption Index.

The only variables that exhibit negative correlation with *ln FDI* are geographical distance and Global Innovation index (*ln GII*). The negative correlation between FDI and geographical distance is consistent with previous theoretical and empirical studies arguing that greater geographical distance increases transaction and transportation costs and thereby hinders FDI. This is especially important for North Macedonia considering the export-oriented nature of recent FDI.

Since gravity models rely heavily on variables that either remain constant over time (like geographic distance) or vary discretely (such as dummy variables) and these characteristics minimize the likelihood of encountering unit-root problems, this study does not conduct a unit root test. Scholarly contributions support this perspective (Bergstrand 1985; Anderson and van Wincoop 2003).

Table 6 displays the econometric results for the gravity model using the pooled OLS estimator. Since the Breusch-Pagan test for heteroscedasticity and the Breusch-Godfrey test for autocorrelation in the errors detected presence of both heteroscedasticity and autocorrelation, the Newey-West estimator was used in order to derive heteroscedasticity-autocorrelation consistent (HAC) standard errors of the coefficients. The adjusted R^2 of the full model is 0,325 which is acceptable for this kind of studies and comparable to previous empirical research using the OLS estimator to analyze FDI determinants (Dorakh 2020; Leitão 2023).

In general, the model confirms that economic dimensions of both host and source countries have positive impact on Macedonian FDI stock given the positive signs of the coefficients and statistical significance of the variables ($ln\ Y_h$) and ($ln\ Y_i$) at 1% level. As expected, geographic distance negatively impacts FDI, indicating that proximity enhanced the FDI stock during the analyzed period, i.e. geographic distance hinders FDI which might explain North Macedonia's modest success in attracting and accumulating FDI stocks from other regions. The distance variable is significant at 10%. These findings are consistent with previous studies (for instance Estrin and Uvalic 2013).

Relative economic distance (*ln RED*) also influenced FDI; the variable has a positive sign and it is

Table 6. Gravity model: estimation summary

	Full model					Reduced model				
	Coefficients	t-stat	SE	p-value	VIF	Coefficients	t-stat	SE	p-value	VIF
ln Y_h	2.520***	4.100	0.615	0.000	1.661	2.202***	-4.882	0.494	0.000	1.049
ln Y_i	0.570***	4.427	0.129	0.000	2.094	0.565***	4.453	0.129	0.000	2.089
ln DIST	-0.207*	-1.834	0.113	0.067	2.321	-0.205**	4.370	0.113	0.000	2.320
ln RED	0.202***	2.743	0.074	0.006	1.448	0.203*	-1.814	0.074	0.070	1.448
ln CPI	-1.240	-0.456	2.719	0.649	2.408	-	-	-	-	-
ln PCI	-0.347	-0.431	0.806	0.667	1.393	-	-	-	-	-
ln GII	0.650	0.610	1.066	0.542	2.216	-	-	-	-	-
EU	0.568***	2.946	0.193	0.003	1.145	0.571***	2.958	0.193	0.003	1.144
HIST	1.241***	5.598	0.222	0.000	1.890	1.239***	5.609	0.221	0.000	1.890
BIT	0.720**	2.559	0.281	0.011	1.802	0.713**	2.534	0.281	0.012	1.799
DTAA	0.539*	1.906	0.283	0.057	1.745	0.550*	1.938	0.284	0.053	1.740
Const	-19.192	-1.398	13.732	0.163	-	-21.307***	-4.882	4.364	0.000	-
R^2	0.341					0.339				
Adj. R^2	0.325					0.328				
F-test	22.452 (0.000)					30.846 (0.000)				
Observations	490					490				
Breusch-Pagan	59.340 (0.000)					56.899 (0.000)				
Breusch-Godfrey	359.358 (0.000)					361.082 (0.000)				

Note: *** - 1% level; ** - 5% level; * - 10% level significance.

Source: author's calculations

significant at 1%. Moreover, this positivity suggests that higher RED would yield higher FDI stock. It stands to mention that higher RED between the host and investing country might indicate that:

a) Host country has lower GDP per capita growth rates than the investing country;
b) Host country has higher GDP per capita growth rates than the investing country,

with both cases likely reflecting differences in factor endowments, including their cost, as well as differences in factor intensity in the production of goods. By applying Dunning's taxonomy (Dunning, 1993) it can be argued that there are some theoretical justifications to support the claim that both cases can result in higher FDI stock. In the first case (a), the host could attract FDI by capitalizing on multinational enterprises seeking to take advantage of differences in the costs of traditional factor endowments. In the second case (b), the host country could attract FDI by capitalizing on multinationals seeking to profit from foreign markets, given that higher growth rates indicate better macroeconomic situation and thus potentially higher efficiency and profitability.

The coefficients of the variables for inflation rates (*ln CPI*), political corruption (*ln PCI*) have negative signs which suggests that indeed inflation rates and political corruption have negative impact on FDI stock. Nevertheless, they are statistically insignificant at all levels. The variable (*ln GII*) has a positive sign, indicating that improvement of the innovation environment indeed enhances FDI stock. However, the coefficient is also insignificant at all levels.

Regarding the dummy variables, findings indicate that all of them are statistically significant. *EU* and *HIST* are statistically significant at all levels, *BIT* at 5% and *DTAA* is significant at 10%. This suggests that these factors were helpful in accumulating FDI over the analyzed period. Among them, the highest enhancement effect has the *HIST* variable and the lowest *DTAA*. These findings are consistent with previous studies arguing that EU membership (Dorakh 2020), *BIT, DTAA* (Kox and Rojas-Romagosa 2020) and *HIST* (Leitão 2023) are significant determinants of FDI.

Given that *ln CPI, ln PCI* and *ln GII* are found to be statistically insignificant, a reduced model excluding these variables was estimated. There are indications that the second model is a slightly better option than the initial one; adjusted R^2 of the second model is 0.328 (against 0.325 of the initial model) and all of the variables are statistically significant at least at 10%. This would suggest that the model excluding the variables for inflation rate, political corruption and innovation fits the data slightly better. However, the study finds that both models are statistically significant at all levels. Additionally, in order to assess the reliability and interpretability of the models, a multicollinearity test was conducted by using the variance inflation factor (VIF). The results exclude the presence of high correlations between the independent variables, i.e. no multicollinearity was detected; all VIFs are less than 5. This suggests that the coefficients could provide adequate insight into the true relationship between the dependent and independent variables.

Based on the gravity model, this study finds sufficient evidence to accept hypotheses H1-H3 and H7-H10, i.e. economic dimensions of both the host and investing countries, geographical proximity, relative economic distance, EU integration and historical aspects, bilateral investment treaties and double taxation avoidance agreements have a positive impact on the FDI stock in North Macedonia. In terms of H4-H6, although there is some evidence that inflation rates, political corruption and innovation affect the FDI stock, these hypotheses cannot be unconditionally accepted suggesting that further research on this matter is needed. In this context, it stands to mention that the study is not without its limitations which are mostly related to the variables used and the estimation technique. Values of the coefficient of determination (R^2) indicate that some significant factors influencing the FDI stock have been omitted from the analysis. This lays the groundwork for a future research that would expand the gravity model to include more independent variables and employ different estimators (PPML, LSDV or others) which might provide a more definitive, and perhaps broader, perspective.

5. Conclusion and policy implications

Analysis of empirical data has revealed a slowdown in the growth rates of the foreign direct investment in North Macedonia over the last two decades. This trend reflects the global trend of modest growth in cross-border investment activity due to rising geopolitical uncertainty and numerous global economic challenges, as well as domestic factors hindering Macedonian FDI growth. Nevertheless, the long-term upward trend remains in place and FDI remains a vital part of the Macedonian economy. The case of North Macedonia confirms that small developing countries can attract and accumulate significant amounts of FDI relative to the size of their economies.

Distribution across countries and economic sectors reflects high dependency on European sources and investment related to the automotive industry. Despite the fact that North Macedonia's successful integration into European and global automotive

value chains had a positive impact on GDP and exports growth rates, this dependency diminishes its resilience to exogenous shocks, especially from ones coming from key European partners. In this context, the main policy implication is that North Macedonia should make efforts to diversify its inward FDI flows in order to achieve a more balanced and diversified stock. In line with the results of the gravity model, the diversification model should be based on attracting and accumulating export-oriented FDI in different technology-intensive industries from countries with suitable economic dimension and higher relative economic distance, given that North Macedonia has the potential to draw FDI by leveraging its comparative advantages in cost differentials for conventional factor endowments among multinational enterprises seeking such benefits. Although geographical distance indeed negatively impacts FDI, Asia (in particular China, Singapore, South Korea) and the Middle East (Saudi Arabia and United Arab Emirates) can be considered as prospective sources for FDI. In line with the OLI framework (Dunning 1979) and other studies on FDI localization determinants (for instance Franco et al. 2008) the Macedonian strategy for promoting its investment potential should leverage the fact that the country could be viewed as an export platform given its location advantages i.e. proximity and duty-free access to the EU market. In this way, North Macedonia could capitalize on foreign companies intending to enter or expand their presence on the European market, while exploiting the differences in factor endowments.

This paper indirectly identifies some important policy implications for other developing economies, especially for ones having limited market size and experiencing capital scarcity. Evidence from North Macedonia suggests that developing countries can increase the probability of attracting and accumulating FDI by pursuing deeper integration based on FTAs and investment-related treaties with better developed, geographically close economies, leveraging differences in factor endowments and creating suitable environment for export-oriented FDI using special economic zones. This will allow the countries to attract and accumulate FDI not just from multinational enterprises from those better developed, geographically close economies wishing to optimize their value chains but also from geographically more distant countries wishing to move production closer to larger target markets. However, the policy should not omit the need to maintain diversified FDI stock across industries and source countries in order to avoid increasing exposure to country-sector-specific exogenous shocks and to increase the general economic resilience.

References

Alon, I., Molodtsova, T., and Zhang, J. 2012. Economic Prospects for China's Outward FDI. Transnational Corporations Review 4 (2): 16-40.

Anderson, J.E. and Van Wincoop, E. 2003. Gravity with Gravitas: A Solution to the Border Puzzle. American Economic Review 93 (1): 170–192.

Ascani, A. Balland, P.A., and Morrison, A. 2020. Heterogeneous foreign direct investment and local innovation in Italian Provinces. Structural Change and Economic Dynamics 53: 388-401.

Bartlett, W., Krasniqi, B.A., and Ahmetbasic, J. 2019. Attracting FDI to the Western Balkans: special economic zones and smart specialization strategies. Croatian Economic Survey 21 (2): 5-35.

Bergstrand, J.H., 1985. The Gravity Equation in International Trade: Some Microeconomic Foundations and Empirical Evidence. The Review of Economics and Statistics 67 (3): 474-481.

Dauti, B. 2015. Determinants of foreign direct investment in transition economies, with special reference to Macedonia: evidence from gravity model. South East European Journal of Economics and Business 10 (2): 7-28.

Dauti, B. 2020. Institutional determinants of foreign direct investment flows in transition economies. Vision: The Journal of Business Perspective 17 (13/14): 71-86.

Deichmann, J.I., Grubaugh, S., and Scholten, P. 2022. FDI propensity and geo-cultural interaction in former Yugoslavia: pairwise analysis of origin and destination countries. Eurasian Economic Review 12 (2): 479-505.

Di Mauro, F. 2000. The Impact of Economic Integration on FDI and Exports: a Gravity Approach. Centre for European Policy Studies Working Document No. 156/2000.

Dorakh, A. 2020. A Gravity Model Analysis of FDI across EU Member States. Journal of Economic Integration 35 (3): 426-456.

Dunning, J. 1979. Toward an eclectic theory of international production: some empirical tests. Journal of International Business Studies 11 (1): 9–31.

Dunning, J. 1993. Multinational Enterprises and the Global Economy. Harlow: Addison-Wesley.

Estrin, S., and Uvalic, M. 2016. Foreign direct investment in the Western Balkans: What role has it played during transition? Comparative Economic Studies 58 (3): 455-483.

Franco, C., Rentocchini F., and Vittucci Marzetti, G. 2010. Why do firms invest abroad? An analysis of the motives underlying foreign direct investments. The IUP Journal of International Business Law 9 (1/2): 42-65.

Frankel, J., Stein, E., Wei, S. J. 1995. Trading Blocs and the Americas: The Natural, the Unnatural, and the Supernatural. Journal of Development Economics 47 (1): 61–95.

Frankel, M., Funke, K., Stadtmann, G. 2004. A panel analysis of bilateral FDI flows to emerging economies. Economic Systems 28 (3): 281-300.

Garvalieva, G., Nikolov, M., and Andonov, V. 2016. Benefits and Costs from FDI in TIDZ. Centre for Economic Analysis Working Paper 2016.

Gomez, D.M., Torgler, B., and Ortega, G.J. 2013. Measuring global economic interdependence: a hierarchical network approach. The World Economy 36 (12): 1632:1648.

Guerin, S.S. and Mazocchi, S. 2006. When FDI Flows from Rich to Poor Countries: Does democracy matter? Luiss Lab on European Economics Working Document no. 38, Rome.

Invest North Macedonia. 2025a. Technological Industrial Development Zones. https://investnorthmacedonia.gov.mk/tidz/ (accessed July 15, 2025).

Invest North Macedonia. 2025b. Free Trade Agreements. https://investnorthmacedonia.gov.mk/ftas/ (accessed July 15, 2025).

Jankuloska, V. 2016. Effects of the established Technological industrial development zones within the Republic of Macedonia. Paper presented at the International Conference Youth Dialogue – Capacity Building through International Customs Cooperation, Gabala, Azerbaijan, June.

Johnson, A. 2006. FDI inflows to the Transition Economies of Eastern Europe: Magnitude and Determinants. The Royal Institute of Technology, Centre for Excellence for Studies in Science in Innovation, Paper No, 59.

Kikerkova, I. 2017. Success or failure of the implemented strategy on attracting foreign capital in the form of FDI in the Republic of Macedonia. Ekonomska misao i praksa 26 (2): 939-954.

Kox, H.L.M and Rojas Romasgosa, H. 2020. How trade and investment agreements affect bilateral foreign direct investment: Results from a structural gravity model. The World Economy 43 (12): 3203-3242.

Kox, H.L.M. and Rojas Romasgosa, H. 2019. Gravity Estimations with FDI Bilateral Data: Potential FDI Effects of Deep Preferential Trade Agreements. Robert Schuman Centre for Advanced Studies Research Paper No. RSCAS 2019/70.

Kuzmanoska Mirkovikj, B., Gkasis, P., and Golitsis, P. 2024. Regulatory quality and foreign direct investment: a case analysis of North Macedonia. Theoretical Economics Letters 14 (5): 1883-1913.

Lee, J. 2012. Business cycle synchronization in Europe: evidence from a dynamic factor model. International Economic Journal 27 (3): 347-364.

Leitão, N.C. 2023. A Gravity Model Analysis of Portuguese Foreign Direct Investment. Economies 11 (9): 237.

Mazurek, J. 2012. The evaluation of an economic distance among countries: a novel approach. Prague Economic Papers 21 (3): 277-290.

Melitz, J. 2007. North, South and distance in the gravity model. European Economic Review 51 (4): 971-991.

Mishra, B.R. and Jena, P.K. 2019. Bilateral FDI flows in four major Asian economies: a gravity model analysis. Journal of Economic Studies 46 (1): 71-89.

National Bank of North Macedonia. 2025a. Direct investments stock in the Republic of North Macedonia, by country. https://nbstat.nbrm.mk/pxweb/mk/Eksterni%20statistiki/ (accessed May 03, 2025)

National Bank of North Macedonia. 2025b. Direct investments stock in the Republic of North Macedonia abroad, by economic activity. https://nbstat.nbrm.mk/pxweb/mk/Eksterni%20statistiki/ (accessed May 03, 2025).

Organization for Economic Co-operation and Development. 2017. Tracking special economic zones in the Western Balkans: objectives, features and challenges. Paris: Organization for Economic Cooperation and Development.

Osmani, R. and Ahmeti, L. 2021. FDI in North Macedonia. In Foreign Direct Investment in the Successor States of Yugoslavia, edited by J.I. Deichmann, 141-166. New York: Springer International Publishing.

Petreski, M. 2023. The Economic Transition of Macedonia. In Macedonia's Long Transition, edited by R. Hudson and I. Dodovski, 77-94. London: Palgrave Macmillan, Cham.

State Statistical Office of North Macedonia. 2025a. Foreign Trade by country, cumulative data https://makstat.stat.gov.mk/PXWeb/pxweb/mk/MakStat/MakStat__NadvoresnaTrgovija__KumulativniPod/125_zemji_kumulativ_ml.px/ (accessed May 03, 2025)

State Statistical Office of North Macedonia. 2025b. Foreign Trade by economic sectors, cumulative data. https://makstat.stat.gov.mk/PXWeb/pxweb/mk/MakStat/MakStat_NadvoresnaTrgovija_Kum ulativniPod/160_SMTK_godisni_ml.px/ (accessed May 03, 2025).

State Statistical Office of North Macedonia. 2025c. GDP components by sector. https://makstat.stat.gov.mk/PXWeb/pxweb/mk/MakStat/MakStat__BDP__BDPInvesGodisni__GodisniBDPsporedESS2010/375_NacSmA_Mk_09p2a_01ml.px/ (accessed May 03, 2025).

Tu, N. A. 2024. Innovation and foreign direct investment attraction in developing countries. Cogent Economics & Finance, 12 (1).

UNCTADstat. 2025a. Gross domestic product: Total and per capita, growth rates, annual. https://unctadstat.unctad.org/datacentre/dataviewer/US.GDPGR (accessed May 03, 2025).

UNCTADstat. 2025b. Foreign direct investment: Inward and outward flows and stock, annual. https://unctadstat.unctad.org/datacentre/dataviewer/US.FDIFlowsStock (accessed May 03, 2025).

World Bank. 2018. Seizing a brighter future for all: Former Yugoslav Republic of Macedonia, systematic country diagnosis. Washington, D.C: World Bank.

World Trade Organization. 2019. Trade policy review: Republic of North Macedonia. Geneva: World Trade Organization.

Yeyati, E., Panizza U., and Stein, E. 2003. The cyclical nature of North-South FDI flows, Inter-American Development Bank Working Paper No. 479, Washington, D.C.

APPENDIX 1: Description of variables and data sources.

Variables	Measurement units	Source
$ln\ FDI_{h,i,t}$	FDI stocks of source country i in host country at current year, in millions of US dollars, in logarithm	National Bank of North Macedonia
$ln\ Y_h$	GDP per capita of host country, US dollars, in logarithm	UNCTAD
$ln\ Y_i$	GDP per capita of investing country, US dollars, in logarithm	UNCTAD
$ln\ DIST$	Air distance in kilometers between capitals of host and source countries, in logarithm	www.geobytes.com
$ln\ RED$	Relative economic distance using Mazurek (2012) methodology, in logarithm	Author's calculations based on UNCTAD
$ln\ CPI$	Consumer price index, %, in logarithm	State Statistical Office of North Macedonia
$ln\ PCI$	Political corruption index, %, in logarithm	Varieties of Democracy (V-dem institute)
$ln\ GII$	Global Innovation Index	WIPO
EU	European Union membership of source country. Value 1 at year t if the country was an EU member, 0 otherwise	Own knowledge
$HIST$	Historical and cultural aspects. Value 1 if host country was a part of the same entity with source country or has strong historical and cultural ties, 0 otherwise	Own knowledge
BIT	Bilateral Investment Treaties. Value 1 at year t if the host country had a BIT in force with source country, 0 otherwise	UNCTAD Investment Policy Hub
$DTAA$	Double Taxation Avoidance Agreement. Value 1 at year t if the host country had a BIT in force with source countries, 0 otherwise	Public Revenue Office of North Macedonia

APPENDIX 2: Dataset of FDI stock in North Macedonia across countries: descriptive statistics.

№	Country	Mean	Minimum	Maximum	Standard deviation	Observations
1	Austria	772.40	453.49	1,324.51	265.04	14
2	Greece	609.44	488.5	829.83	98.88	14
3	Turkey	333.88	64.13	790.36	190.37	14
4	Germany	326.47	94.74	719.98	200.53	14
5	Netherlands	729.61	445.69	1,123.41	258.63	14
6	Slovenia	474.16	388.43	595.07	60.22	14
7	UK	454.76	51.39	932.51	318.96	14
8	Switzerland	213.30	99.29	331.06	69.59	14
9	Bulgaria	204.48	141.80	320.32	59.06	14
10	Hungary	297.49	188.20	460.62	104.54	14
11	USA	92.62	49.71	192.04	39.26	14
12	British Virgin Islands	116.19	59.09	174.48	39.28	14
13	Italy	125.68	77.75	174.89	36.97	14
14	Serbia	107.29	91.76	134.31	14.66	14
15	Belgium	71.82	1.56	128.51	44.30	14
16	Estonia	54.81	0.01	128.37	39.37	14
17	Cyprus	106.16	59.40	196.93	42.08	14
18	China	76.31	-3.82	177.04	73.65	14
19	Bahamas	37.09	0.00	105.39	48.10	14
20	Croatia	95.16	76.22	126.91	15.99	14
21	Albania	45.42	28.66	86.35	14.55	14
22	Luxembourg	53.36	19.70	102.31	29.51	14
23	Liechtenstein	49.35	23.63	68.77	15.64	14
24	Poland	16.19	0.53	47.22	14.02	14
25	Kosovo	10.67	0.00	41.03	11.98	14
26	Romania	11.85	0.78	35.45	11.10	14
27	Hong Kong	12.44	-0.42	33.36	11.46	14
28	Bosnia	17.08	4.50	29.54	7.89	14
29	Russia	24.63	5.89	41.57	10.10	14
30	Sweden	19.51	3.70	30.25	9.62	14
31	Australia	10.84	2.63	18.33	4.96	14
32	Norway	4.86	0.34	16.44	5.12	14
33	Portugal	4.56	1.04	11.99	3.70	14
34	France	72.30	4.60	189.09	71.21	14
35	Israel	7.94	1.91	11.57	2.70	14

Source: compiled by author based on data from the National Bank of North Macedonia

APPENDIX 3: GDP per capita of North Macedonia and investing countries: descriptive statistics.

№	Country	Mean	Minimum	Maximum	Standard deviation	Observations
	North Macedonia	6,109.9	4,585.0	8,606.0	1,193.4	14
1	Austria	49,650.1	43 908.0	56 042.0	3 307.8	14
2	Greece	20,990.4	17,885.0	26,645.0	2,756.0	14
3	Turkey	10,654.8	8,367.0	12,814.0	1,345.6	14
4	Germany	47,015.0	41,711.0	53,528.0	3,413.7	14
5	Netherlands	47,015.0	41,711.0	53,528.0	3,413.7	14
6	Slovenia	25,074.6	20,733.0	32,642.0	3,213.8	14
7	UK	43,363.9	39,448.0	49,224.0	2,935.6	14
8	Switzerland	87,200.9	76,523.0	100,831.0	6,093.8	14
9	Bulgaria	9,334.7	6,815.0	15,068.0	2,544.6	14
10	Hungary	15,554.6	12,729.0	21,954.0	2,722.2	14
11	USA	60,256.4	48,379.0	80,706.0	9,736.1	14
12	British Virgin Islands	38,656.7	35,705.0	41,589.0	1,845.0	14
13	Italy	34,631.1	30,465.0	38,672.0	2,453.8	14
14	Serbia	7,208.9	5,525.0	11,101.0	1,648.7	14
15	Belgium	46,873.1	40,890.0	55,049.0	3,840.8	14
16	Estonia	21,791.4	14,673.0	30,201.0	4,694.9	14
17	Cyprus	20,818.5	16,318.9	25,194.8	2,651.3	14
18	China	8,791.8	4,504.0	12,547.0	2,605.2	14
19	Bahamas	29,930.6	25,156.0	35,896.0	2,905.0	14
20	Croatia	15,184.9	12,072.0	21,661.0	2,508.8	14
21	Albania	5,086.2	3,928.0	8,172.0	1,218.5	14
22	Luxembourg	117,299.4	105,475.0	133,668.0	8,338.9	14
23	Liechtenstein	175,179.6	156,145.0	202,659.0	13,570.9	14
24	Poland	15,009.3	12,369.0	20,876.0	2,543.9	14
25	Kosovo	4,238.4	2,988.0	6,157.0	899.2	14
26	Romania	11,584.6	8,323.0	18,348.0	3,014.2	14
27	Hong Kong	43,132.6	32,195.0	51,166.0	6,025.2	14
28	Bosnia and Herzegovina	5,803.6	4,506.0	8,639.0	1,264.2	14
29	Russia	12,448.6	8,758.0	15,853.0	2,380.4	14
30	Sweden	55,565.9	51,196.0	61,173.0	3,675.8	14
31	Australia	61,347.0	52,010.0	69,651.0	6,402.3	14
32	Norway	87,995.4	68,343.0	108,805.0	13,377.0	14
33	Portugal	22,607.4	19,193.0	27,718.0	2,177.2	14
34	France	40,712.2	36,411.0	44,451.0	2,490.7	14
35	Israel	43,385.1	32,668.0	57,968.0	8,093.2	14

Source: compiled by author based on UNCTAD data

SUBMISSION GUIDELINES

The South East European Journal of Economics and Business (SEEJ) primarily addresses important issues in economics and business, with a special focus on South East European (SEE) economies. The SEEJ also publishes high-quality papers that might not be directly focused on SEE region. Articles may involve explanatory theory, empirical studies, policy studies, or methodological treatments of tests.

Manuscripts are reviewed with the understanding that they

- are substantially new;
- have not been previously published, unless without copyrights as part of the proceedings of a conference sponsored by the School of Economics and Business;
- have not been previously accepted for publication;
- are not under consideration by any other publisher, and will not be submitted elsewhere until a decision is reached regarding their publication in the SEE Journal.

The procedures guiding the selection of articles for publication in the journal require that no manuscript be accepted until it has been reviewed by the Editorial Board and at least two reviewers who are experts in their respective fields (often members of the International Editorial Board). The manuscripts are judged solely on the basis of content, clarity, and contribution to the field. All manuscripts are judged on their contribution to the advancement of science, the practice of economics and business, or both. Articles should be written in an interesting, readable manner, and technical terms should be defined. In some highly exceptional circumstances, the journal will publish a solicited manuscript from a noted scholar on a topic deemed of particular interest to the development of the fields of economics and business. Manuscripts submitted to the journal can be processed most expeditiously if they are prepared according to these instructions.

MANUSCRIPT PREPARATION

Manuscripts should be typed double-spaced, including references, and formatted for the A4 (21cm x 29,7cm) paper size. Single spacing should not be used aside from tables and figures. Page numbers are to be placed in the upper right-hand corner of every page. A tab indent should begin each paragraph. Please allow the text to wrap, rather than placing a hard return after every line. Manuscripts ordinarily should be between 4,000 and 6,000 words (ca. 15 typewritten pages of text) using Times New Roman l2-point type. Articles of shorter or longer length are also acceptable. Please refrain from using first person singular in the text of the manuscript unless it is a solicited article or book review.

In the article, please be sure that acronyms, abbreviations, and jargon are defined, unless they are well-known or in the dictionary or The Chicago Manual of Style, 15th edition (e.g., Table 14.4 and sec. 15.55). Quotes of 10 or more words must include page number(s) from the original source. Every citation must have a reference, and every reference must be cited.

For any details of manuscript preparation not included in the following sections, see The Chicago Manual of Style, 15th edition, Chicago and London: University of Chicago Press, 2003, and review recent issues of the journal.

What Goes Where?
Together with your manuscript, please prepare additional supplementary file to be uploaded after you upload the manuscript. Supplementary file should contain: article title, with full name of author(s), present position, organizational affiliation, full address including postal code and country, telephone/fax numbers, and e-mail address. Author(s) must be listed in the order in which they are to appear in the published article. Please clearly indicate which author will serve as the primary contact for the journal and be especially sure to provide an e-mail address for this person.

The sections of the manuscript should be placed in the following order: title page, body, appendices, endnotes, reference list, tables, figures. Each section should begin on a new page.

Title Page - Title of paper, without author(s) name(s), and a brief abstract of no more than 150 words substantively summarizing the article. JEL classification code to facilitate electronic access to this manuscript should also be listed on this page.

Body - The text should have its major headings centered on the page and subheadings flush with the left margin. Major headings should use all uppercase letters; side subheadings should be typed in upper- and lowercase letters. Do not use footnotes in the body of the manuscript. If used, please place endnotes in a numbered list after the body of the text and before the reference list; however, avoid endnotes wherever possible because they interrupt the flow of the manuscript. Acronyms, abbreviations, and jargon should be defined unless they are well-known (such as IMF) or they can be found in the dictionary. Quotes of 10 or more words should include page number(s) from the original source. Every citation must have a reference, and every reference must be cited.

Tables and Figures - Each table or figure should be included in the manuscript where appropriate. The data in tables should be arranged so that columns of like materials read down, not across. Non-significant decimal places in tabular data should be omitted. The tables and figures should be numbered in Arabic numerals, followed by brief descriptive titles. Additional details should be footnoted under the table, not in the title. In the text, all illustrations and charts should be referred to as figures. Figures must be clean, crisp, black-and-white, camera-ready copies. Please avoid the use of gray-scale shading; use hatch marks, dots, or lines instead. Please be sure captions are included. Indicate in text where tables and figures should appear. Be sure to send final camera-ready, black-and-white versions of figures and, if possible, electronic files.

References - References should be typed double-spaced in alphabetical order by author's last name.

Reference Citations within Text - Citations in the text should include the author's last name and year of publication enclosed in parentheses without punctuation, e.g., (Johnson 1999). If practical, the citation should be placed immediately before a punctuation mark. Otherwise, insert it in a logical sentence break.

If a particular page, section, or equation is cited, it should be placed within the parentheses, e.g., (Johnson 1990, p. 15). For multiple authors, use the full, formal citation for up to three authors, but for four or more use the first author's name with "et al." For example, use (White and Smith 1977) and (Brown, Green, and Stone 1984). For more than three authors, use (Hunt et al. 1975), unless another work published in that year would also be identified as (Hunt et al. 1975); in that case, list all authors, e.g., (Hunt, Bent, Marks, and West 1975).

Reference List Style - List references alphabetically, the principal author's surname first, followed by publication date. The reference list should be typed double-spaced, with a hanging indent, and on a separate page. Do not number references. Please see the reference examples below as well as reference lists in recent issues. Be sure that all titles cited in the text appear in the reference list and vice versa. Please provide translations for non-English titles in references, page ranges for articles and for book chapters, and provide all authors' and editors' names (not "et al.," unless it appears that way in the publication).

Journal article:
Smith, J. R. 2001. Reference style guidelines. Journal of Guidelines 4 (2): 2-7 [or 4:2-7].
_____.2001. Reference style guidelines. Journal of Baltic Studies 4 (2): 2-7.

Book:
Smith, J. R. 2001. Reference style guidelines. Thousand Oaks, CA: Sage.

Chapter in a book:
Smith, J. R. 2001. Be sure your disk matches the hard copy. In Reference style guidelines, edited by R. Brown, 155-62. Thousand Oaks, CA: Sage.

Editor of a book:
Smith, J. R., ed. 2001. Reference style guidelines. Thousand Oaks, CA: Sage.

Dissertation (unpublished):
Smith, J. R. 2001. Reference style guidelines. Ph.D. diss., University of California, Los Angeles.

Paper presented at a symposium or annual meeting:
Smith, J. R. 2001. A citation for every reference. Paper presented at the annual meeting of the Reference Guidelines Association, St. Louis, MO, January.

Online:
Smith, J. R. 2001. Reference style guidelines. In MESH vocabulary file (database online). Bethesda, MD: National Library of Medicine. http:// www.sagepub.com (accessed October 3, 2001).

Mathematical Notation - Mathematical notation must be clear within the text. Equations should be centered on the page. If equations are numbered, type the number in parentheses flush with the right margin. For equations that may be too wide to fit in a single column, indicate appropriate breaks. Unusual symbols and Greek letters should be identified by a marginal note.

Permission Guidelines – Authors are solely responsible for obtaining all necessary permissions. Permission must be granted in writing by the copyright holder and must accompany the submitted manuscript. Authors are responsible for the accuracy of facts, opinions, and interpretations expressed in the article.

Permission is required to reprint, paraphrase, or adapt the following in a work of scholarship or research:

- Any piece of writing or other work that is used in its entirety (e.g., poems, tables, figures, charts, graphs, photographs, drawings, illustrations, book chapters, journal articles, newspaper or magazine articles, radio/television broadcasts);
- Portions of articles or chapters of books or of any of the items in the preceding paragraph, if the portion used is a sizable amount in relation to the item as a whole, regardless of size, or it captures the "essence" or the "heart" of the work;
- Any portion of a fictional, creative, or other nonfactual work (e.g., opinion, editorial, essay, lyrics, commentary, plays, novels, short stories);
- Any portion of an unpublished work

MANUSCRIPT SUBMISSION

Submit manuscripts electronically, in MS Word format, through through the following web-page: seejournal.efsa.unsa.ba/submission.

All additional correspondence should be addressed to:
The South East European Journal of Economics and Business
University of Sarajevo, School of Economics and Business

Trg oslobodjenja-Alije Izetbegovica 1
71000 Sarajevo
Bosnia and Herzegovina
E-mail: seejournal@efsa.unsa.ba

SEP JOURNAL

ISSN 2233-1999