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FACULTY OF ECONOMICS – PRILEP

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PROCEEDINGS

18-19 September 2026, Prilep, North Macedonia

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CONTENTS

THE PARADOX OF EARLY - STAGE ENTREPRENEURSHIP IN BOSNIA AND HERZEGOVINA AND THE CONSTRAINS OF TRANSITION TO ESTABLISHED ENTREPRENEURSHIP *Bahrija Umihanić, Umihana Umihanić Bukvić*	1
CORPORATE GOVERNANCE IN BUSINESS LAW: THE EXPERIENCE OF NORTH MACEDONIA AND TÜRKIYE *Emilija Gjorgjioska, Mustafa Yasan*	13
LEVEL OF AWARENESS AND PRACTICES REGARDING PACKAGING WASTE SELECTION IN NORTH MACEDONIA *Aleksandar Mateski, Filip Ivanovski, Emilija Gjorgjioska, Violeta Gligorovski*	30
ADVANCED HIGH-RISK INTERNET BANKING IN CROATIA: PREDICTORS AND INSIGHTS *Sandra Pepur, Mario Pepur, Dujam Kovač*	44
IMPROVING THE SUSTAINABILITY OF FOOD WASTE MANAGEMENT IN THE HOSPITALITY SECTOR: EVIDENCE FROM PRISHTINA, REPUBLIC OF KOSOVO *Flutra Mestani, Miroslav Gverovski, Aneta Risteska Jankuloska, Mergim Mestani*	56
INSTITUTIONAL MECHANISMS FOR LOCAL TAX COLLECTION *Emil Mutafov*	71
THE IMPACT OF DIGITAL TRANSFORMATION ON BUSINESS PERFORMANCE: A CASE STUDY OF SMEs IN THE VARDAR REGION *Mensure Hodja, Miroslav Gveroski, Aneta Risteska-Jankuloska*	82
PRAGMATISAM VERSUS IDEALISM IN MARITIME BOUNDARY DELIMITATION: EXPLORING CORRELATIONS, CONTRADICTIONS AND COMPETING APPROACHES IN THE EASERN MEDITERRANEAN *Nikolaos Paounis, Lefteris Topaloglou*	97
JUST ENERGY TRANSITION & LABOR MARKET TRANSFORMATION IN THE REGION OF WESTERN MACEDONIA *Lefteris Topaloglou, Despoina Kanteler, Maria Sambrakou, Pavlidou Sofia & Fenia Pliatsika*	103

REGIONAL VALIDATION OF ENERGY POVERTY INDICATORS IN JUST TRANSITION REGIONS: EVIDENCE FROM WESTERN MACEDONIA, SILESIA & STARA ZAGORA *Maria Sambrakou, Despoina Kanteler, Lefteris Topaloglou, Panayotis Pantazis*	110
ERASMUS+ STUDENTS AS CONSUMERS: ATTITUDES, INTENTIONS AND LOCAL PRODUCT PURCHASING BEHAVIOUR IN CROATIA *Ivana Jadrić*	116
STRATEGIC MANAGEMENT AND FDI IN THE DIGITAL ECONOMY: EMPIRICAL EVIDENCE FROM THE WESTERN BALKANS *Elvis Elezaj, Sokol Berisha, Halit Shabani*	130
FINANCIAL INVESTEMENTS IN RESEARCH, DEVELOPMENT AND INNOVATION: GROWTH ELASTICITY ACROSS INCOME GROUPS *Dance Nikolovska Vrateovska, Snezhana Mojsoska, Ljupco Davcev*	142
CASHLESS PAYMENTS AND CONSUMER SPENDING BEHAVIOUR IN THE BALKANS: EVIDENCE BEFORE AND AFTER COVID-19 *Ivica Tomovski, Gordana Serafimovic, Viktorija Trajkov, Filip Simonovski*	153
LOCAL GOVERNMENTS AND FOREIGN DIRECT INVESTMENT *Rositsa Raykova*	163
THE FISCAL MULTIPLIER OF TOURISM TAXATION IN BULGARIA *Violetka Zheleva*	173
INNOVATIVE MODELS IN RURAL TOURISM: THE SHARING ECONOMY AND DIGITAL NOMADISM *Elena Gospodinova, Violetka Zheleva*	182
DIGITAL TRANSFORMATION IN THE INSURANCE INDUSTRY: CHALLENGES AND OPPORTUNITIES FOR THE DEVELOPMENT OF INSURANCE MARKETS IN DEVELOPING ECONOMIES *Halit Shabani, Ibish Mazreku*	192
THE ROLE OF AI TOOLS IN MODERN WEB DESIGN: A COMPARATIVE OVERVIEW *Dejan Zdraveski, Kosta Sotiroski, Petar Avramovski, Margarita Janeska*	205

E-COMMERCE TRENDS: NORTH MACEDONIA VIS-À-VIS OTHER EUROPEAN COUNTRIES *Marjan Angeleski, Olivera Kostoska*	220
INNOVATIONS IN DIGITAL BANKING SERVICES *Marina Blazhekovikj Toshevski, Stevcho Dimeski*	231
ACCESSIBILITY IN CULTURAL TOURISM: INCLUSIVE EDUCATIONAL PRACTICES IN GREEK MUSEUMS FOR DEAF AND HARD OF HEARING VISITORS *Athina Tsakiridou*	243
THE IMPACT OF ARTIFICIAL INTELLIGENCE ON INNOVATION PERFORMANCE IN GLOBAL PHARMACEUTICAL COMPANIES *Marjan Gjurikj, Marjan Angeleski*	254
DIGITAL ECOSYSTEM AND COOPERATIVES: DIGITAL MARKETPLACES FOR WOMEN'S COOPERATIVES *Burçin Başaran, Nilüfer Serinikli, Yasemin Oraman*	271
THE INFLUENCE OF DIGITAL SOCIAL PROOF ON ONLINE PURCHASE DECISION *Radoslav Nastasijevikj Vardjiski, Karolina Ilieska, Snezana Obednikovska*	283
STRATEGIES AND INITIATIVES TO REDUCE THE RISKS OF USING GENERATIVE ARTIFICIAL INTELLIGENCE SYSTEMS *Natalia Marinova, Lora Parvanova*	296
BULGARIA'S TRADE IN AGRICULTURAL PRODUCTS: CHALLENGES, OPPORTUNITIES AND DEVELOPMENT PROSPECTS *Iskra Nencheva, Nikolay Penev*	303
REGIONAL READINESS FOR THE AGENT ECONOMY: An ASSESSMENT OF TURKISH PROVINCES *Bige Küçükefe*	314
ANALYSIS OF THE PERFORMANCE OF A BUSINESS ENTITY USING ARTIFICIAL INTELLIGENCE *Mimoza Mijoska*	331
CORRELATION ANALYSIS OF NET WAGES AND THE MINIMUM CONSUMER BASKET IN THE REPUBLIC OF NORTH MACEDONIA AND THE REPUBLIC OF SERBIA *Meri Spirkoska*	346

OPPORTUNITIES AND CHALLENGES OF ARTIFICIAL INTELLIGENCE FOR WOMEN ENTREPRENEURS: EXAMPLES OF WOMEN ENTREPRENEURS IN TÜRKIYE *Nilüfer Serinikli, Burçin Basaran*	359
GLOBALIZATION AS A DRIVER OF COMPETITIVE DYNAMICS: EMPIRICAL EVIDENCE FROM NORTH MACEDONIA *Meri Boshkoska, Emilija Gjorgjioska, Monika Angeloska - Dichovska, Margarita Janeska, Tatjana Spaseska*	369
COST MANAGEMENT AS A BASIS FOR STRATEGIC DECISION-MAKING IN PRICING *Igor Zdravkoski, Pece Nikolovski, Ljupce Markuseski, Miroslav Andonovski*	385
THE IMPACT OF ARTIFICIAL INTELLIGENCE ON REAL-TIME CONSUMER PERSONALIZATION IN E-MARKETING *Goran Kotevski, Karolina Ilieska, Margarita Janeska*	396
A CORPORATE GOVERNANCE MODEL ORIENTED TOWARD ACHIEVING THE SUSTAINABLE DEVELOPMENT GOALS *Angel Sarov, Filip Elenov*	411
BANK-SPECIFIC AND MACROECONOMIC DETERMINANTS ON MARKET CAPITALIZATION: EVIDENCE FROM MACEDONIAN LISTED BANKS *Tatjana Spaseska, Vera Karadjova*	421
FINANCIAL AUTONOMY AND MUNICIPAL PERFORMANCE IN PRISHTINA BASED ON DOCUMENTARY EVIDENCE FROM 2015 TO 2025 *Gjeni Imami, Milaim Mehmeti, Fanka Risteska*	436
QUALITATIVE RESEARCH METHODS IN BANKING RESEARCH: CONTENT ANALYSIS AND CASE STUDY *Milaim Mehmeti, Gjeni Imami, Fanka Risteska*	451
THE ROLE OF EU FUNDS ON SUSTAINBLE DEVELOPMENT IN CROATIA - CASE STUDY ON KRAPINA ZAGORJE COUNTY *Dalibor Hržica, Katarina Svažić, Nikola Sinković*	461
DOMESTIC TOURISM SEASONALITY: IMPACTS OF SCALE AND GEOGRAPHIC CONCENTRATION IN A SMALL ECONOMY *Vera Karadjova, Aleksandar Trajkov*	475

COMMUNICATION AS A SOCIAL CONSTRUCT: DEVELOPING THE COMMUNICATION MATRIX *Violeta Gligorovski, Nikola Dimeski, Tatjana Spaseska, Aneta Risteska Jankuloska, Dragica Odzaklieska*	489
PRODUCTIVITY GAINS AND HERD DECLINE IN MACEDONIA'S DAIRY SECTOR: A NATIONAL AND REGIONAL DECOMPOSITION *Aleksandar Trajkov, Gordana Dimitrovska, Elena Joshevska, Vera Karadjova*	502
FROM DIGITAL DIVIDE TO SMART INTEGRATION: RECONFIGURING TOURISM-AGRICULTURE VALUE CHAINS IN RURAL DESTINATIONS OF NORTH ALBANIA *Sead Baraku, Elidiana Bashi*	510
BUDGET CONSTRAINT IMPACT ON FOOD PREFERENCES IN ECONOMIC UNCERTAINTY *Georgi Aleksiev, Violetka Zheleva*	522
DRAWDOWNS AND RECOVERY PERIODS: AN ALTERNATIVE METHODOLOGICAL PERSPECTIVE ON INVESTMENT RISK *Alexander Ganchev*	534
THE EVOLUTION OF ECONOMIC PLANNING FROM STATIC TO DYNAMIC MODELS IN THE CONTEXT OF DIGITAL TRANSFORMATION *Nadezhda Veselinova*	539
COMMERCIAL ENTREPRENEURIAL NICHES FOR THE DEVELOPMENT OF RURAL TOURISM IN BULGARIA *Tsvetelina Kabakchieva*	548

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THE PARADOX OF EARLY – STAGE ENTREPRENEURSHIP IN BOSNIA AND HERZEGOVINA AND THE CONSTRAINS OF TRANSITION TO ESTABLISHED ENTREPRENEURSHIP

Bahrija Umihanić[1], Umihana Umihanić Bukvić[2]

Abstract

This paper examines the paradox of early-stage entrepreneurship in Bosnia and Herzegovina, reflected in the coexistence of intensive entrepreneurial entry and limited transition of new ventures into established businesses. The aim of the paper is to operationalize the transition gap between early-stage and established entrepreneurship and to examine how entrepreneurial framework conditions and population-level perceptions contribute to its persistence. The analysis is based on secondary data from the Global Entrepreneurship Monitor (GEM) Global Report and the GEM Bosnia and Herzegovina Report for 2024/2025. The findings show that Bosnia and Herzegovina records one of the highest levels of early-stage entrepreneurial activity in Europe, but substantially weaker conversion into established entrepreneurship. Approximately 3.9 early-stage entrepreneurs correspond to one established entrepreneur, compared with the European average of about 1.5. The results further indicate that the entrepreneurial environment is assessed unfavorably, particularly in entrepreneurship education, public policies, support programs and knowledge transfer. At the same time, the population demonstrates high perceived capabilities, accompanied by a significant fear of failure. The paper argues that the paradox is explained less by a lack of entrepreneurial potential and more by weak ecosystem support and elevated risk perception. Its contribution lies in linking GEM activity indicators, expert assessments and population perceptions in order to interpret the transition gap as a developmental, rather than merely statistical, phenomenon.

Keywords: early-stage entrepreneurship, established entrepreneurship, entrepreneurial environment, Bosnia and Herzegovina, GEM.

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1. Introduction

Entrepreneurship is an important driver of economic development, employment, innovation and productivity, but its developmental relevance depends on whether new ventures survive and become established businesses. Bosnia and Herzegovina is a relevant case because it records high early-stage entrepreneurial activity, while established entrepreneurship remains considerably weaker (Domljan et al., 2025). Approximately 3.9 early-stage entrepreneurs correspond to one established entrepreneur, compared with the European average of about 1.5, which is conceptualized in this paper as a transition gap and the core of the early-stage entrepreneurship paradox.

The research problem is the weak conversion of early-stage entrepreneurial activity into established entrepreneurship in Bosnia and Herzegovina. This problem cannot be explained by entry rates alone, since entrepreneurial outcomes depend on individual capabilities, institutional conditions, resources and ecosystem support (Acs et al., 2014; Stam, 2015; Audretsch & Belitski, 2017). Earlier GEM-based research in Bosnia and Herzegovina emphasized the role of entrepreneurship education and support mechanisms in strengthening youth self-employment, indicating that the quality of entrepreneurial entry is closely linked to competences and the broader support environment (Umihanić et al., 2013).

The main objective of this paper is to operationalize the transition gap between early-stage and established entrepreneurship in Bosnia and Herzegovina and to examine how entrepreneurial framework conditions and population-level perceptions contribute to the weak consolidation of new ventures. The paper uses secondary data from the GEM Global Report 2024/2025 and the GEM Bosnia and Herzegovina Report 2024/2025, applying a descriptive, comparative and interpretative approach. Its contribution lies in linking activity indicators, perceptions and framework conditions into a policy-relevant explanation of the transition gap.

The paper is structured as follows. Section 2 reviews the literature on early-stage and established entrepreneurship, the transition gap, entrepreneurial ecosystems and population-level perceptions. Section 3 presents the methodology, including data sources, indicators and analytical approach. Section 4 discusses the findings for Bosnia and Herzegovina, while Section 5 provides conclusions and policy recommendations.

2. Literature Review

2.1 Early-stage and Established Entrepreneurship in the GEM Framework

Entrepreneurship is increasingly conceptualized as a process that evolves from opportunity recognition and business entry to survival, consolidation and growth. The Global Entrepreneurship Monitor (GEM) captures this process through entrepreneurial activities, perceptions and framework conditions, rather than through formal registration data alone (GEM, 2025). This paper relies on two core GEM indicators: Total early-stage Entrepreneurial Activity (TEA), which refers to adults involved in starting or running a business up to 42 months old, and Established Business Ownership (EBO), which refers to owner-managers of businesses operating for more than 42 months (GEM, 2025). Therefore, high TEA does not necessarily imply sustainable entrepreneurial development, since the developmental value of entrepreneurship depends on the capacity to transform early ventures into stable and productive firms (Acs et al., 2014). Recent evidence from Bosnia and Herzegovina shows that entrepreneurial quality depends on firms' ability to transform entrepreneurial orientation into business model innovation, especially through innovativeness, proactiveness and strategic renewal (Smajlović et al., 2024). Accordingly, early-stage entrepreneurship should be analyzed together with persistence, innovation capacity and the quality of the entrepreneurial environment.

Fig. 1 presents the GEM entrepreneurial process, from potential entrepreneurship and nascent activity to new and established business ownership or business exit. The relationship between TEA and EBO provides the basis for measuring the transition gap between entrepreneurial entry and business sustainability.

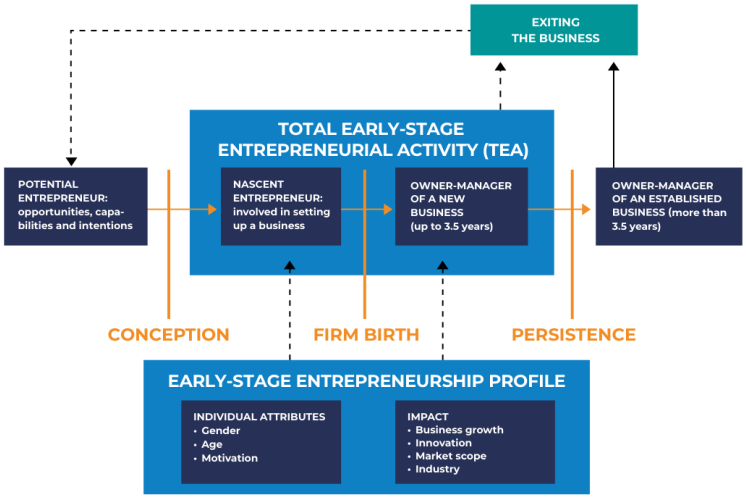


Figure 1. The entrepreneurial process and GEM indicators. Source: GEM (2025).

As shown in Fig. 1, the GEM framework treats entrepreneurship as a sequence of stages rather than a single act of business creation. This distinction is essential for the present study, since the transition from early-stage to established entrepreneurship is assessed through a limited set of GEM indicators. Table 1 summarizes these indicators and their analytical role in the paper.

Table 1. Key GEM indicators used in the paper

Indicator	Meaning	Function in the paper
TEA	Early-stage entrepreneurs up to 42 months of business activity	Measures entry into entrepreneurship
EBO	Owner-managers of businesses older than 42 months	Measures survival and maturity
TEA/EBO	Ratio of early-stage to established entrepreneurs	Measures the transition gap
APS	Adult Population Survey	Measures attitudes and activities
NES	National Expert Survey	Assesses framework conditions

Source: adapted from GEM (2025).

2.2 The Transition Gap between Early-stage and Established Entrepreneurship

The transition from early-stage to established entrepreneurship is a key dimension of entrepreneurial development. Public policies often emphasize the number of newly established businesses, while less attention is paid to how many of them survive, stabilize and grow. The quality of entrepreneurship depends not only on new entries, but also on the capacity of the system to support productive and sustainable entrepreneurial activities (Acs et al., 2014; Audretsch & Belitski, 2017).

In this paper, the transition gap is operationalized through the TEA/EBO ratio. A lower ratio indicates greater efficiency in the transition to the established phase, while a higher ratio indicates weaker conversion of early-stage ventures into stable firms. GEM emphasizes that a high TEA/EBO ratio may indicate difficulties in transforming new businesses into established entities, especially in an unsupportive environment (GEM, 2025). To clarify the analytical meaning of this indicator, Table 2 presents a conceptual operationalization of the transition gap according to the level of the TEA/EBO ratio

Table 2. Conceptual operationalization of the transition gap

TEA/EBO ratio	Meaning	Developmental interpretation
Low	Most early ventures reach the established phase	Efficient transition
Moderate	Some ventures reach the established phase	Additional support needed
High	Many ventures do not reach maturity	Pronounced transition deficit
Very high	Early-stage activity does not generate proportional established businesses	Structural problem of survival

Source: author systematization based on GEM (2025), Acs et al. (2014) and Stam (2015).

The transition gap shifts the focus from how many businesses are started to how many are sustained and developed, thereby distinguishing entrepreneurial activity from developmentally productive entrepreneurship (Isenberg, 2010; Stam, 2015).

2.3 Entrepreneurial Ecosystem and Framework Conditions

The entrepreneurial ecosystem includes institutions, resources, policies, market conditions, education, culture and support mechanisms that influence the start-up, survival and growth of new firms. The ecosystem approach emphasizes that entrepreneurial outcomes depend not only on individual characteristics, but also on the quality of the institutional and market environment (Stam, 2015).GEM combines APS and NES: APS measures population activities and perceptions, while NES assesses entrepreneurial framework conditions, including finance, public policies, support programs, education, knowledge transfer, infrastructure, market openness and cultural norms (GEM, 2025). NES data are useful for comparative research, but should be interpreted with methodological caution and in relation to the institutional context (Rietveld & Patel, 2023). For the transition from early-stage to established entrepreneurship, particularly relevant ecosystem dimensions are access to finance, entrepreneurship education, public policies and support programs, knowledge transfer, and cultural attitudes toward failure. Innovation capacity is also important, since evidence from Bosnia and Herzegovina confirms that firm innovativeness plays a determining role in

implementing circular business models, supporting the view that business maturity depends on more than entrepreneurial entry alone (Umihanić & Tipurić, 2026). Contemporary literature further emphasizes that ecosystems operate at multiple levels through the interaction of entrepreneurs, universities, incubators, support organizations, public policies and national institutions (Sohail et al., 2025)

2.4 Entrepreneurial Perceptions, Fear of Failure and Business Persistence

Entrepreneurial behavior is shaped not only by objective conditions, but also by how individuals perceive opportunities, risks, their own capabilities and the possibility of success. GEM measures these dimensions through perceived opportunities, perceived capabilities, fear of failure and entrepreneurial intentions (GEM, 2025). Fear of failure is one of the most important perceptual barriers to entrepreneurship. It can discourage entrepreneurial entry and constrain the growth, innovation and persistence of those who have already started a business. Recent research shows that fear of failure is associated with exit intention, while a supportive social environment can reduce its negative effects (Shahid et al., 2024). This phenomenon has psychological, social, educational and institutional dimensions (Gao et al., 2024). High perceived capabilities and opportunity recognition do not automatically lead to established entrepreneurship if they are not accompanied by finance, mentoring, market access and a stable institutional environment (Ndour & Asongu, 2025).

3. Methodology

3.1 Data Sources

The paper is based on a secondary analysis of Global Entrepreneurship Monitor (GEM) data for 2024/2025. The main sources are the GEM Global Report 2024/2025 and the GEM Bosnia and Herzegovina Report 2024/2025. GEM methodology relies on the Adult Population Survey (APS), conducted on a sample of at least 2,000 adults, and the National Expert Survey (NES), which collects expert assessments of the quality of the entrepreneurial environment (GEM, 2025). The national report enables a new comparative assessment of the entrepreneurial ecosystem in Bosnia and Herzegovina after an eleven-year absence from GEM research (Domljan et al., 2025).

3.2 Indicators and Variables

The analysis uses selected GEM indicators that capture the relationship between early-stage and established entrepreneurship. The key analytical category is the transition gap, operationalized through the TEA/EBO ratio. The analysis

also includes indicators of entrepreneurial perceptions, especially perceived opportunities, perceived capabilities, fear of failure and entrepreneurial intentions, as well as framework conditions from NES.

3.3 Analytical Approach

A descriptive, comparative and interpretative approach is applied. Descriptive analysis presents the key GEM indicators for Bosnia and Herzegovina, comparative analysis positions them against European and global averages, and interpretative analysis links entrepreneurial activity, perceptions and the quality of the entrepreneurial environment. This approach allows the paradox of early-stage entrepreneurship to be viewed as the result of an interaction between entrepreneurial potential, institutional constraints and risk perception.

4. Findings and Discussion

4.1 Bosnia and Herzegovina as a High Early-stage Entrepreneurship Economy

GEM findings show that Bosnia and Herzegovina has a high level of early-stage entrepreneurial activity. According to the national GEM report, 22.7% of adults are involved in early-stage entrepreneurial activity, positioning the country among the leading European economies according to this indicator (Domljan et al., 2025). The global GEM profile additionally shows that Bosnia and Herzegovina ranks 8th among 51 economies, with 25.7% of men and 19.7% of women involved in TEA (GEM, 2025). Table 4 presents selected indicators of early-stage entrepreneurship and perceptions.

Table 3. Selected indicators of early-stage entrepreneurial activity and perceptions in Bosnia and Herzegovina

Indicator	B&H	Interpretation
TEA - total	22.7%	8th among 51 economies
TEA - women	19.7%	High female participation
TEA - men	25.7%	Higher male participation
Know someone who has started a new business	81.3%	High entrepreneurial exposure
Personally have the skills and knowledge	73.3%	High self-confidence
Good opportunities to start a	55.1%	Moderate-high

Indicator	B&H	Interpretation
business in my area		opportunity perception

Source: adapted from GEM (2025).

These findings suggest that the challenge in Bosnia and Herzegovina is not the lack of willingness to enter entrepreneurship. However, early-stage activity partly reflects necessity: 77.7% of early-stage entrepreneurs agree with the motive of earning a living because jobs are scarce (GEM, 2025).

4.2 Weak Conversion of Early-stage Activity into Established Entrepreneurship

Despite high TEA, the transition to established entrepreneurship is weak. EBO rates are substantially lower than TEA, while the national GEM report emphasizes that Bosnia and Herzegovina is below the European average in established entrepreneurship (GEM, 2025; Domljan et al., 2025). The clearest expression of this problem is the ratio of early-stage to established entrepreneurs, shown in Table 5.

Table 4. Transition gap between early-stage and established entrepreneurship

Indicator	B&H	Europe	World
Early-stage entrepreneurs per one established entrepreneur	3.9	1.5	2.4
Developmental interpretation	Pronounced transition deficit	More efficient conversion	Moderate transition gap

Source: adapted from Domljan et al. (2025).

The result confirms that the paradox is not low entrepreneurial entry, but weak conversion of early-stage initiatives into stable business entities. Bosnia and Herzegovina, with a ratio of 3.9, is close to the critical threshold at which the transition from early-stage to established entrepreneurship becomes clearly unsatisfactory (Domljan et al., 2025).

4.3 Entrepreneurial Framework Conditions as Structural Constraints

The quality of the entrepreneurial environment is crucial for understanding why high early-stage activity does not translate into established entrepreneurship. According to the GEM Global Report, the overall quality of the entrepreneurial environment in Bosnia and Herzegovina is weak, with a NECI score of 3.4, ranking the country last among 56 economies included in the 2024 NES survey (GEM, 2025). Table 6 summarizes selected framework conditions.

Table 5. Selected entrepreneurial framework conditions in Bosnia and Herzegovina

Condition	Finding	Developmental implication
NECI/IPUZ	3.4	Weakest environment among 56 economies
Market dynamics	Sufficient	Potential for new entry
Physical infrastructure	Sufficient	Basic infrastructure relatively favorable
Government policies and programs	Weak / very weak	Insufficient institutional support
Entrepreneurship education	Very weak	Weak preparation for survival and growth
R&D transfer	Very weak	Limited innovation upgrading

Source: adapted from GEM (2025) and Domljan et al. (2025).

The results show that early-stage entrepreneurs operate in an ecosystem that does not provide sufficient support after business entry. Weak education, knowledge transfer, public policies and support programs increase the probability that new businesses remain small, low-productivity or exit before reaching maturity.

4.4 Entrepreneurial Perceptions and the Role of Fear of Failure

GEM findings indicate that Bosnia and Herzegovina combines high entrepreneurial awareness with significant perceptual barriers. A large share of adults knows someone who started a business, believes they have the skills to start a business, and sees local opportunities. At the same time, 46.8% of those who see opportunities would not start a business because of fear of failure, while only 31.9% of adults consider it easy to start a business (GEM, 2025). This pattern suggests that perceived capabilities coexist with perceived risk, which can reduce persistence and growth ambitions among early-stage entrepreneurs.

4.5 Explaining the Entrepreneurship Paradox in Bosnia and Herzegovina

The findings confirm the paradox of early-stage entrepreneurship in Bosnia and Herzegovina: high entrepreneurial entry, strong awareness and high perceived capabilities coexist with weak transition to established entrepreneurship, an unfavorably assessed entrepreneurial environment and a significant fear of failure. The paradox can be explained by the interaction of three factors: partly necessity-driven entrepreneurial entry, insufficient post-start-up ecosystem support, and risk perceptions that reduce persistence, investment and growth. Therefore, the problem is not a lack of entrepreneurial energy, but the weak conversion of that energy into sustainable business outcomes. The evidence supports the central argument that the paradox is explained more by weaknesses in the entrepreneurial environment and their interaction with risk perceptions than by the absence of entrepreneurial potential.

5. Conclusions and Recommendations

The results confirm the existence of a paradox of early-stage entrepreneurship in Bosnia and Herzegovina: the country records a high level of early-stage entrepreneurial activity and relatively high perceived capabilities, but a weak transition from early-stage to established entrepreneurship. This indicates that the key developmental challenge is not merely starting new businesses, but supporting their survival, consolidation and growth.

The transition gap cannot be explained by a lack of entrepreneurial potential. It is primarily associated with weaknesses in the entrepreneurial environment, especially insufficient entrepreneurship education, weak support programs, limited knowledge transfer, inadequate access to finance and the absence of effective post-start-up support. Fear of failure and the perception of high risk additionally reduce persistence, investment decisions and growth ambitions.

Policy priorities should therefore shift from encouraging business creation alone toward supporting the survival and growth of early-stage ventures. Priority should be given to post-start-up programs, mentoring, advisory support, financial instruments for consolidation and growth, and practical entrepreneurship education. Stronger links among universities, research institutions, development agencies, financial institutions and the private sector are also needed. Such an ecosystem would enable a larger share of early-stage ventures to survive, consolidate and contribute to employment, innovation, productivity and the long-term competitiveness of the economy.

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CORPORATE GOVERNANCE IN BUSINESS LAW: THE EXPERIENCE OF NORTH MACEDONIA AND TÜRKIYE

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Abstract

Corporate governance has become an increasingly important topic in the contemporary business environment, particularly in fostering sustainable and responsible corporate behavior. Effective corporate governance provides the framework through which companies are directed, controlled, and held accountable, while promoting transparency, ethical conduct, responsible decision-making, and the protection of stakeholders' interests. In the paper, authors exploit the legal framework for implementation of corporate governance codes by trade companies in the Republic of North Macedonia and Türkiye, a long-standing candidate countries for membership of the European Union. The study uses a qualitative method consisted of analysis of legal and regulatory acts and reports of the both countries. The paper shows the differences in the way of regulating corporate governance in both countries, and the difficulties in the implementation process that companies are faced with. Regarding the results of the analysis, the authors will propose recommendations for improvement of corporate governance legal framework and implementation of the contemporary corporate governance principles in the practice.

Keywords: corporate governance, compliance, OECD Principles of corporate governance, trade companies, annual reports.

1. Introduction

A series of major corporate failures during the late twentieth and early twenty-first centuries, involving companies such as Robert Maxwell's business empire, BCCI, Polly Peck, Barings Bank, Enron, Crédit Lyonnais, etc. exposed significant weaknesses in corporate governance. These scandals revealed

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widespread instances of fraud, corruption, financial mismanagement, and unethical practices at the highest levels of corporate management. They demonstrated that corporations appearing financially sound and well-managed to external stakeholders could in reality conceal serious governance failures. As a result, these corporate collapses highlighted the need for stronger corporate governance frameworks, greater transparency, enhanced accountability, and more effective oversight of management.

Corporate governance plays a crucial role in balancing and reconciling the often conflicting interests of management, shareholders, and other stakeholders. Managers may prioritize their own private interests, such as higher salaries, bonuses, and other benefits, whereas shareholders are primarily concerned with maximizing returns on their investments through dividends and the efficient use of corporate capital. This conflict becomes more pronounced when there is a clear separation between ownership and management, giving rise to the classic agency problem. Consequently, corporate governance is particularly important in corporations where ownership and managerial control are separated, as it provides the mechanisms necessary to align managers' actions with the interests of shareholders while also considering the legitimate interests of other stakeholders.

Corporate governance guides how a company is directed and its relationships with its shareholders and stakeholders. Corporate governance also regulates the relationships among key stakeholders, including the board of directors, shareholders, management, employees, and other interested parties. With the right structure and systems in place, good corporate governance enables companies to create an environment of trust, transparency and accountability, which promotes long-term patient capital and supports economic growth and financial stability (OECD).

Corporate governance is a broad term that describes the processes, customs, policies, laws, and institutions that direct and control the way organizations and corporations are governed and operated, providing a framework through which companies pursue their objectives while overseeing their management and operations (Khan, 2011). Corporate governance deals with mechanisms by which stakeholders of a corporation exercise control over corporate insiders and management such that their interests are protected (John & Senbet, 1998).

Good corporate governance requires a complex system of check and balances (Monks and Minow, 2011) According to Monks and Minow (2011) corporate governance seeks to answer two fundamental questions: How can managers be encouraged to commit to creating long-term shareholder value as if they were investing their own capital; and how can corporate value creation be managed in a way that minimizes the externalization of costs to society at large? The primary objective of good corporate governance is to ensure that an organization achieves its strategic goals while effectively managing the relationships among its key stakeholders, including the board of directors, shareholders, management, employees, creditors, customers, suppliers, and the wider community.

Awareness of the importance of good corporate governance first emerged in the United States after the Second World War, when states began amending their corporate laws to promote a better balance among the interests of shareholders, management, employees, and the public. The Delaware General Corporation Law (DGCL), renowned for its business-friendly approach, laid the foundation for a corporate legal framework in which sound corporate governance plays a central role in ensuring accountability, protecting shareholder interests, and promoting efficient corporate management. On the ground of the UK the Report for the financial aspects of corporate governance, more known as Cadbury Report is the landmark for implementation of good practices in corporate governance. This report commissioned by the Financial Reporting Council, London Stock Exchange and accountancy professionals, was one of the remedies for restoring confidence in financial reporting and reputation of the corporations. The principles of the Cadbury report were incorporated into the London Stock Exchange's Listing Rules and introduced the principle of "comply or explain" (The Committee on the Financial Aspects of Corporate Governance and Gee and Co. Ltd. 1992).

The European Union has adopted a lot of acts, directives, recommendations and Action Plan: European Company Law and Corporate Governance. Most important are: Shareholder Rights Directive II (Directive (EU) 2017/828), Accounting Directive (Directive 2013/34/EU), Directive regarding the encouragement of long-term shareholder engagement, (Directive (EU) 2017/828), Corporate Sustainability Reporting Directive (CSRD) (Directive (EU) 2022/2464), Corporate Sustainability Due Diligence Directive (Directive (EU) 2024/1760) etc. The last two Directives expanded the responsibilities of corporate governance including Environmental and Social dimensions of companies' operation. Directive on corporate sustainability reporting (Directive (EU) 2022/2464 – CSRD) strengthens corporate governance by increasing transparency and accountability regarding companies' sustainability-related impacts, risks, and opportunities, thereby supporting informed decision-making by management, supervisory bodies, and shareholders. CSRD currently requires sustainability reporting primarily from large undertakings exceeding 1,000 employees and meeting the applicable financial thresholds. With the DIRECTIVE (EU) 2025/794 of the European Parliament and of The Council of 14 April 2025 amending Directives (EU) 2022/2464 and (EU) 2024/1760 the application of CSRD for large and small and medium undertakings was postponed for two years. The Corporate Sustainability Due Diligence Directive (Directive (EU) 2024/1760 – CSDDD) strengthens corporate governance by requiring companies to integrate human rights and environmental due diligence into their strategies, decision-making, risk management, and oversight processes. CSDDD as amended in 2026, will apply from 2029 to the largest companies, establishing mandatory human rights and environmental due diligence obligations for companies exceeding 5,000 employees and €1.5 billion in worldwide net turnover, as well as certain non-EU companies meeting the corresponding EU turnover threshold.

The most influential global standard for corporate governance is the OECD G20 Principles of Corporate Governance. The Principles of Corporate

Governance adopted by the OECD Council on 8 July 2015 and revised on 8 June 2023, are intended to help policy makers evaluate and improve the legal, regulatory, and institutional framework for corporate governance, with a view to supporting economic efficiency, sustainable growth and financial stability (OECD, 2023).

The importance of Corporate governance increased dramatically and it is widely accepted that good corporate governance is one of the prerequisites for the development of a market economy. For the Republic of North Macedonia and Türkiye, as long-standing candidate countries for membership of the European Union and developing economies, establishment of good corporate governance is very important. Therefore, the main aim of the paper is exploiting the legal framework for corporate governance codes of trade companies in both countries, the difficulties in the implementation process and their harmonization with good practices in the area of well-developed market economies.

2. Historical development of corporate governance in the Republic of North Macedonia

The roots of corporate governance in the Republic of North Macedonia may be found after leaving the system of workers' self-management and privatization process when the most of joint stock companies in the country have been established (Belicanec at al. 2014). The first Law on trade companies in the country was adopted in 1996 when for the first time the operation of the joint stock companies was regulated with Macedonian legislation. The second Law on Trade Companies was adopted in 2002 and was scheduled to enter into force on 1 May 2004. However, before it could take effect, the third and current Law on Trade Companies was adopted and entered into force in May 2004. Consequently, the second Law on Trade Companies never entered into force. The current Law on trade companies was amended more than twenty times and incorporates most of the European Union directives regarding the trade companies. This Law incorporates European solutions regarding company law.

At the beginning, as a result of privatization, the ownership structure of joint stock companies in North Macedonia shows certain characteristics as significance of ownership by insiders, remaining state ownership and control, and the emergence of various forms of institutional investors, mainly former privatization funds, that creates a series of specific problems and difficulties regarding corporate governance practices described with the statement "who guards the guards" (Maassen, 2003). According to Koevski (2005), there are 300.000 shareholders, of which 98.5% are natural persons, and 1.5% legal persons. Legal persons own more than a half of shares and 88% of shareholders possess shares in only one joint stock company. According this, seemingly in the country exist wide dispersed ownership of shares, but the numbers shows that the most of the shares are possessed by only few shareholders. At the end of 2025, the number of joint-stock companies listed on MSE is 90 companies (Macedonian Stock Exchange, 2026). The peak of listed companies on MSE was gained in 2013 when 116 companies were listed. Regarding this, the number of joint-stock

companies that should apply good corporate governance practices is not so big, but taking into consideration the value of the market capitalization of these companies (357.185.104.158 mkd in 2025), this issue should receive appropriate attention.

A big step forward for improvement of corporate governance in N. Macedonia was made in 2021 when Macedonian Stock Exchange adopted Corporate governance code for companies listed on the Macedonian Stock Exchange. The purpose of the Code is to promote effective corporate governance and transparency of companies listed on the Macedonian Stock Exchange. The implementation of this Code by companies listed on the Macedonian Stock Exchange is expected to enhance corporate transparency and strengthen the balance between management bodies and shareholders. Furthermore, it may reduce information asymmetry between management and other stakeholders, promote greater awareness of companies' social responsibilities, and increase investor confidence, thereby making listed companies more attractive for future equity investments (MSE, Securities and Exchange Commission, EBRD, 2021). The Code is expected to generate a mutually beneficial outcome by enhancing companies' reputation and market value, providing shareholders with greater transparency regarding the management of their invested capital, and promoting stronger corporate social responsibility practices for the benefit of the wider community.

According to article 384-a of Law on trade companies, effective from December 2020, the legislator obliged the management body of the company listed on the Macedonian Stock Exchange to give a statement on the application of the Corporate governance code for companies listed on the Macedonian Stock Exchange, as an Annex of the annual operation report. In accordance with Article 42-a of the Listing Rules the application of the Code is mandatory for all listed joint stock companies that meet certain quantitative criteria prescribed in the Listing Rules. These companies should meet at least 3 of the following 4 conditions: Market capitalization of at least 5,000,000 euros; At least 100 shareholders; At least 5% spread of the share yield in the public and the issuer's shares were traded on at least 30% of the total number of trading days in the current year. At the end of the year, the Stock Exchange publishes on its website the updated list of joint stock companies that according to the criteria are obliged to apply the CGC. For 2026 that will be only 24 joint-stock companies. All other companies may voluntarily use the Code’s recommendations and suggestions as guidelines for complying with the law and gaining ethically sound and responsible behavior. For the fulfillment of the Code, companies should answer a Questionnaire that contains seven parts, first dedicated to shareholders, second to supervisory board or board of directors, third to management board, or executive members of the board of directors, forth to conflict of interests, fifth for risk and control, sixth for stakeholders, sustainability and social issues and the last one for transparency and disclosure. While answering the Questionnaire the companies should apply the approach known as “comply or explain”. That means that companies are not obliged to meet the standards set out in the Code, but they need to have good reasons and explanations in order to justify their Code’s deviation to

shareholders (Gjorgjioska, Gligorovski and Obednikovska 2025). According to research conducted by Gjorgjioska et al. (2025) on 20 indicators related to sub-section 7.1, 7.2 and 7.3 of the Questionnaire for the 26 joint stock companies that were obliged to comply to CGC in 2023, the average transparency level is 73%, which means that the Macedonian companies can be categorized in companies with "good level" of transparency.

2.1. Exemplary Regulations Regarding the Principle of Corporate Governance in Macedonian Law

Some of the issues regarding the rights of shareholders, accurate informing, control over the work of the managing bodies etc. are defined with a lot of mandatory provisions in the Law of trade companies in the section for joint-stock companies but also in the section for major business deals and business with an interested party.

Most of these provisions are detailed in the Questionnaire that should be answered by the joint-stock companies that are obliged to apply the CGC. Some of them are given below:

- Maintaining a website with a separate section describing the rights attached to each class of shares, the Company's Statute and any other internal acts that regulate shareholders' rights.
- Publishing on the website the necessary information about the date, venue and agenda of Shareholders' General Meeting and any other materials related to the Meeting in accordance with the requirement of the law and Listing Rules.
- Disclosure whether shareholders have the ability to vote by means of communication technology and by correspondence, or to participate in the meeting by electronic means.
- Providing the option for shareholders to vote by proxy.
- Appointing a person who is responsible for ensuring a timely and adequate response to questions or provision of information to shareholders and investors. The person's name, e-mail address and telephone number shall be published on the Company's website.
- The Supervisory Board shall hold meetings at least four times a year in accordance with the law.
- The Supervisory Board Chair may not have been a member of the Management Board of the Company for at least two years before their appointment.
- The Company shall take action to ensure that it has at least 30% female members of the Supervisory and Management Boards by 2025.
- The Supervisory Board shall report in the Annual Report on the committees, including their composition and activities, the number of meetings held and how many were attended by each committee member, and the main items discussed.
- The Management Board shall report to the Supervisory Board at least every quarter, in accordance with the law, on the company's operational

performance, financial situation, its major financial and non-financial risks, the results of its engagement with shareholders and other stakeholders etc.

- The Company shall publish full and accurate data on each individual Supervisory Board Member's remuneration in the previous year in the Annual Report.
- The Remuneration Committee, or the Supervisory Board if there is no Committee, shall formulate a policy on Management Board's remuneration, which may consist of fixed and performance-related parts. The policy shall define the methodology, principles and performance criteria for determining the method and amount of remuneration for the Management Board. Fixed remuneration (salary) shall adequately reflect the expertise, experience and responsibilities of each Management Board member, as well as the size and financial standing of the Company.
- The Company shall publish full and accurate data on each individual Management Board member's remuneration in the previous year in the Annual Report.
- The independent external auditor shall be appointed by the General Shareholders Assembly at the proposal of the Supervisory Board. The proposal shall include a description of the criteria used by the Board or the Audit Committee to select the auditor.
- The Management Board shall promote a corporate culture that encourages ethical conduct, respect and a commitment to compliance in all employees. For this purpose, the Company shall adopt a Code of Ethics and establish a system for ensuring compliance and business ethics in the Company. The Code of Ethics shall be approved by the Supervisory Board and published on the Company's website.
- The Company shall have internal acts relating to its responsibilities for environmental and social issues and policies and procedures that enable it to identify material factors and assess the impact on the company's activities.
- For better transparency, in addition to the mandatory content prescribed by law and the Listing Rules, the Company shall publish on its website other additional data, listed in the Questionnaire.

According to analysis of all joint stock companies listed on MSE, Gligorovski et.al, (2026) found that almost 75% of the companies do not have published Code of Ethics on their web pages. MSE as an action for following up the level of compliance with the CGC, in the last three years examines the compliance level of the companies that are obliged to comply with CGC.

The Stock Exchange began to prepare a Report on the compliance of the listed companies with the Corporate Governance Code, which will be published every year and thus the progress of the companies in fulfilling the objectives of the Code will be monitored. The level of compliance with the provisions and sections of the Code varies in 2023; and the average rate of corporate governance compliance with the Code stands at 79%, marking a 3% increase compared to the previous year. According to the last Report (MSE, 2025) the average compliance

rate of analyzed companies is 80%, which is quite solid, and expresses a trend of a slight increase in relation to the compliance rate in 2022 and 2023According to the last Report (MSE, 2025) the average compliance rate of analyzed companies is 80%, which is quite solid, and expresses a trend of a slight increase in relation to the compliance rate in 2022 and 2023. The results show that companies are progressing in terms of their corporate governance.

Regarding the European Commission Report for North Macedonia (2025) North Macedonia's corporate governance and company law framework requires further alignment with the EU acquis, particularly regarding cross-border mergers, divisions and conversions, the use of digital tools and processes in company law, takeover bids, and long-term shareholder engagement under the SRD II Directive, while further progress is also needed in adopting the Law on Accounting, strengthening transparency requirements for listed companies, ensuring compliance with statutory audit requirements, and continuing alignment with the Corporate Sustainability Reporting Directive and the Non-Financial Reporting Directive. There is also note that CGC is mandatory only for listed companies that meet certain criteria.

3. Corporate Governance in Turkish Law: Historical Development, Fundamental Principles, and Legal Basis

3.1 Historical Development in Turkish Law

The principle of corporate governance, as one of the fundamental concepts of Turkish company law, has undergone a modernization process spanning over a century and is a strategic building block of the Turkish Commercial Code No. 6102 (TCC), which came into force in 2012. The corporate governance principle aims to ensure that companies, especially joint-stock and limited liability companies, conduct their relations with their shareholders, boards of directors, employees, creditors, and society in a fair, transparent, accountable, and responsible manner. In Turkish law, the norms related to the principle of corporate governance are based on external motivations such as developments in international comparative law, Türkiye's European Union candidacy process, and the framework studies of international organizations such as the OECD, of which Türkiye is a member, while also taking into account national market needs and expectations (Öcal, 2019). The normative order of the principle of corporate governance in Turkish law is based on the legal reflections of four fundamental principles: fairness, transparency, accountability, and responsibility. These reflections are primarily seen in the TCC and the Capital Markets Law No. 6362 (CML).

It is no coincidence that the principle of corporate governance has gained validity in capital companies, especially in joint-stock companies, which possess the most typical characteristics of capital companies under Turkish law. Joint-stock companies, in which savings are converted into investments that can be publicly traded, have a large number of shareholders, with powers and duties separated among organs, and play a locomotive role for the Turkish economy,

need to be managed corporately, as professionalism requires. The fact that the interests of society, due to the legal personality of the company and the concept of sustainability that has emerged in recent years, are placed before the interests of those who manage the joint-stock company, and even the shareholders who own the company, is causing the importance of corporate governance to increase day by day (Özdemir and Tamer, 2019).

In Turkish legal terminology, we sometimes see the term "corporate governance" used instead of "corporate management." The principle of corporate governance stands out in Turkish practice as an interdisciplinary concept involving fields such as business administration, finance, and economics (Delice, 2023). From a legal perspective, the TCC, a product of the European Union accession process that began with the Helsinki Summit in 1999, is a dynamic set of norms that inspires and lends spirit to the concept of corporate governance. It stands at the intersection of the mandatory norms of company law and the principles of public disclosure in capital market law, and is equipped with legal sanctions (Tenteriz and Akkaya, 2021).

The historical evolution of corporate governance directly parallels major global financial scandals, company bankruptcies, and economic crises. Indeed, sensitivities regarding the principle of corporate governance in Turkish company law are merely reflections of the accumulation of legal regulations, including the Cadbury Report of 1992, the OECD principles published in 1999, and the Sarbanes-Oxley Act adopted in 2012 (Zengin and Yılmaz, 2017). The clearest evidence of this is the numerous references to these legal regulations in the TCC's explanatory memorandum (Akyüz, 2009).

However, it would be incorrect to claim that corporate governance principles did not exist or have any impact on Turkish law before the enactment of the TCC in 2012. We can acknowledge that the first traces of corporate governance principles in Turkish law date back to the 1980s. The decisions of January 24, 1980, taken to help the Turkish economy overcome a deep crisis, stand out as a turning point in Türkiye, marking the clear acceptance of an open, export-oriented free market model (Özsoy, 2011; Akyüz, 2009). The enactment of the Capital Market Law No. 2499 in 1981, the first law specifically for capital markets, and the establishment of the Capital Market Board to oversee market functioning are considered the first steps towards the principle of corporate governance in Türkiye (Tenteriz and Akkaya, 2021; Akdoğan and Akdoğan, 2011). The institutionalization of corporate governance principles in Türkiye only began in the 2000s (Özsoy, 2011). This was again due to an economic crisis (Delice, 2023). The severe economic crisis of 2001 necessitated fundamental structural changes in the Turkish banking and finance sector (Öcal, 2019). Upon realizing that governance weaknesses in financial institutions were deepening the crisis, the CMB published the "Corporate Governance Principles" guide for the first time in July 2003. This guide initially contained rules that were not mandatory to implement, had no sanctions for non-compliance, but required explanations for non-compliance (Zengin and Yılmaz, 2017). Another turning point in Turkish law on corporate governance principles was the launch of the Borsa İstanbul (BIST) Corporate Governance Index (XKURY) in 2007 by the

Istanbul Stock Exchange, which lists companies with high corporate governance ratings. The structure of corporate governance principles, which were initially optional and based on principles, transitioned from a voluntary structure to a mandatory legal reform period from 2011 onwards, with non-compliance resulting in sanctions (Akdoğan and Akdoğan, 2011). The TCC, which came into force in 2012, and the CML, which repealed the previous Law No. 2499, became the highest-level legislative sources regulating the principle of corporate governance. These two fundamental laws transformed corporate governance principles from optional to binding positive legal rules for companies of a certain size (Zengin and Yılmaz, 2017).

3.2. Basic Principles of Corporate Governance According to Turkish Law

In parallel with comparative law, corporate governance under Turkish law is built on four fundamental pillars that complement one another. These principles are considered the main legal criteria for interpreting legislation and in resolving disputes among internal company bodies. These principles can be listed as equity, transparency, accountability, and responsibility (Aytar, 2022).

The principle of equity, also described as fairness and equality, aims to ensure that company management treats all stakeholders, especially minority shareholders and foreign investors, equally and impartially, preventing the majority from violating the rights of the minority. Indeed, the principle of equal treatment, which also applies to limited companies, is regulated in Article 357 of the TCC for joint-stock companies and reflects the principle of equity in the TCC. According to TCC Article 357, the board of directors is obliged to treat shareholders equally under equal conditions (Karasu, 2013).

Another pillar of corporate governance is transparency and public disclosure. Accordingly, information about company activities, financial status, ownership structure, and management strategies must be made available to the public and investors in a timely, accurate, complete, understandable, and cost-effective manner. Transparency helps prevent market manipulation. The legal implications of the principle of transparency are set out in the TCC and the CML. Financial reporting obligations and the active use of the Public Disclosure Platform (PDP) reflect this principle from the CMB's perspective (Öcal, 2019). In contrast, the obligation for joint-stock companies subject to an independent audit to establish a website and publish mandatory content elements (TCC Article 1524) is a regulation embodying transparency from the perspective of the TCC.

Accountability means that professional managers and board members who manage the company are legally and criminally accountable to the company and shareholders for every step they take and every decision they make. Thanks to this principle, a balance of power is ensured among the organs, and the principle of separation of functions among the organs is upheld. The non-transferable duties and powers of the board of directors, regulated in TCC Article 375, are among the legal reflections of the principle of accountability (Tuğ, 2019). The assumption of legal and criminal responsibilities by the board of directors is also considered among the most prominent legal reflections of accountability (TCC Articles 553

and 562). The obligation of the board of directors to inform the general assembly, their duty to make statements, the control of all the board's actions and decisions through the audit mechanism, the ability of shareholders to examine the company's books, and their ability to request information and documents from the board of directors are other reflections of the principle of accountability found in the TCC (Karasu, 2013).

Another pillar of the corporate governance principle is the principle of responsibility. Responsibility here refers to social responsibility (Ayboğa, 2021). According to this principle, in conducting its activities, the company must consider not only the profit margin for its shareholders but also the interests of society, environmental legislation, consumer rights, and its obligations under labor law. Responsibility means that the company, as a corporate citizen, must act in accordance with the law. Sustainability, social development, the green economy, and environmental protection are closely related to the principle of responsibility, and the Sustainability Principles Compliance Framework, added to the Corporate Governance Communiqué published by the Capital Markets Board (CMB), can be considered the most current reflection of that principle in Turkish law.

3.3. Exemplary Regulations Regarding the Principle of Corporate Governance in Turkish Law

First of all, regulations on corporate governance principles are found across a wide range of legislative sources in Turkish law. In this section of our study, we will focus on exemplary provisions, particularly those found in the TCC and the CML in Turkish law. However, regulations on corporate governance principles are also included in the Banking Law No. 5411 and the Insurance Law No. 5684 in Turkish law (Tuğ, 2019).

3.3.1. Corporate Governance Regulations in the Turkish Commercial Code (TCC)

3.3.1.1. Structure and Functioning of the Board of Directors

The TCC has validated radical innovations aligned with corporate governance in the board of directors' formation and decision-making processes (Cindoruk, 2026). Examples of corporate governance regulations regarding the structure and operation of the board of directors include: the ability of a single-person board to accelerate decision-making processes, especially in companies with foreign capital; the ability of legal entities to serve as members of the board of directors (managers' board) in joint-stock and limited liability companies (TCC, Article 359), but the requirement to appoint a natural person as a representative; the fact that, despite this requirement, the membership of the board of directors and all legal consequences arising from this membership, including legal responsibility, apply to the legal entity board member; the possibility of

delegating management authority, partially or completely, to one or more board members or entirely to third parties, as a requirement of professionalism, through an internal regulation to be prepared with a provision in the articles of association (TCC, Article 367); and the continuation of the board's duty of care even if delegation or division of labor occurs (Karasu, 2013; Cindoruk, 2026; Aksoy, 2013).

3.3.1.2. The Non-Delegable and Inalienable Powers and Duties of the Board of Directors

Professionalism is an important requirement of the corporate governance principle. However, to ensure professionalism, the board of directors may appoint a managing director, a commercial representative, etc (Aksoy, 2013). The powers and duties that cannot be delegated to professional managers are mandatorily regulated in Article 375 of the TCC. The management of the company at the highest level and the issuance of instructions, the determination of the company's management structure, the establishment of accounting, financial auditing and financial planning systems, the appointment and dismissal of directors and authorized signatories, the supervision of compliance of management personnel with laws and regulations, the keeping of share, decision and general assembly minutes books, the preparation of financial statements and annual activity reports, the preparation of general assembly meetings and the execution of their decisions, and notification to the court in case of insolvency are among the powers that cannot be delegated or waived according to TCC Article 375 (Aksoy, 2013). However, the non-delegable and inalienable powers of the board of directors are not limited only to those listed in TCC Article 375. Provisions regulating non-delegable and inalienable duties and powers, which are scattered among the provisions relating to joint-stock companies, are also included in the TCC (Cindoruk, 2026).

3.3.1.3. Risk Early Detection and Management Committee

The provision in Article 378 of the TCC regarding the risk early detection and management committee can be shown as the most concrete legal instrument of the principles of "responsibility" and "prudent management" in corporate governance. The risk early detection and management committee, which establishes and operates the system for the early diagnosis of reasons that endanger the existence, development, and continuity of the company, the implementation of necessary measures and remedies, and the management of the risk, is obliged to submit a report to the board of directors every two months. While the risk early detection and management committee is mandatory in companies whose shares are traded on the stock exchange, it is optional in privately held joint-stock companies. In privately held joint-stock companies, the optionality is eliminated in a possible scenario. Accordingly, if the auditor deems

it necessary, the board of directors is obliged to establish this committee even in privately held joint-stock companies (Aksoy, 2013).

3.3.1.4. Electronic General Assembly System (EGAS)

One of the important requirements of the corporate governance principle is to increase and diversify shareholders' opportunities to participate in the general assembly. The general assembly is the most important platform for ensuring democracy within the company and for shareholders to exercise their rights arising from their shareholding. Indeed, Article 1527 of the TCC has introduced the possibility of participating in, making proposals, and voting in the general assemblies of joint-stock companies electronically. In this way, the opportunity to participate in general assembly meetings, especially for foreign and minority investors who cannot attend physically, has emerged (Özdemir and Tamer, 2019).

3.3.2. Corporate Governance Regulations and Corporate Governance Principles Communiqué in the Capital Markets Law (CML)

Unlike the TCC, the CML and the regulations that have been adopted under the CML apply only to publicly traded joint-stock companies. Indeed, Article 1529 of the TCC provides that the authority to determine corporate governance principles for publicly traded joint-stock companies rests with the CMB (Avcı, 2022; Akdoğan and Akdoğan, 2011). The CMB, through its Corporate Governance Communiqué II-17.1, has implemented both mandatory and optional rules (Delice, 2023). While violations of mandatory rules lead to sanctions, in cases of non-compliance with optional rules, the directors of a joint-stock company are only expected to explain the reason for their non-compliance (Tuğ, 2019). To prevent decisions in publicly traded companies from being made solely in the interests of controlling shareholders, boards of directors must include at least one-third independent members; in any case, the number of independent board members must be at least two (Avcı, 2022). The independence of a member must be based on abstract and objective criteria; in other words, for a member to be considered independent, they or their spouse/relatives must not have established employment, capital, or significant commercial relations with the company or related companies within the last 5 years, they must not be working as a professional manager in the company, and they must not hold an executive position. These are among the mandatory requirements included in the CMB's Corporate Governance Principles (Avcı, 2022).

To enhance the board of directors' functionality and ensure the impartial performance of its audit duties, the establishment of several subcommittees is also mandatory. The Audit Committee, Corporate Governance Committee, Nomination Committee, and Remuneration Committee are among the mandatory committees.

To prevent controlling shareholders from draining the company's resources, the CMB has imposed strict restrictions on related-party transactions. For "Significant Transactions," such as the sale or lease of a substantial portion of

the company's assets or the purchase of goods/services from related parties, the approval of a majority of independent board members is required. If independent members do not approve, the transaction must be presented to the general assembly and, in cases where controlling shareholders do not vote, must be approved by the minority shareholders to become valid. This is among the mandatory corporate governance principles (Ayboğa, 2021).

3.3. Evaluation of the Turkish Corporate Governance System

The legal regime governing corporate governance principles in Turkish law reflects the influence of both the continental European and the Anglo-Saxon legal systems. In other words, one can speak of a mixed legal regime. Unlike German law, Turkish law, which accepts Swiss law as its source, is subject to a Single Management System in joint-stock companies, similar to Anglo-Saxon law. In other words, there is a single Board of Directors in the company; the audit and executive functions are separated through subcommittees within this board (Audit Committee, etc.).

Although this similarity to Anglo-Saxon law seems like an advantage, especially in the application of corporate governance principles, the direct application of Anglo-Saxon corporate governance models to developing markets like Türkiye also leads to a number of structural inconsistencies. In the US and UK, where publicly traded companies distribute shares among thousands of small investors, conflicts arise between "Managers and Shareholders." However, in Türkiye, since the vast majority of companies, even those that are publicly traded, are under the absolute control of a family or holding company, the fundamental conflicts in Türkiye occur between "Controlling Shareholders and Minority Shareholders."

In Turkish law, corporate governance principles are not implemented as grassroots necessity, but rather through top-down coercion. Therefore, many Turkish companies formally fulfill legal requirements regarding independent board memberships and committee formations. However, the will of family councils or the controlling shareholder remains dominant in decision-making processes. This results in the formal application of corporate governance principles, but without the realistic realization of the expected benefits.

Regarding the European Commission report for Türkiye (2025), Türkiye should further align its national legislation with the EU acquis by strengthening shareholder rights and long-term shareholder engagement, facilitating cross-border conversions, mergers and divisions, improving company and corporate sustainability reporting, introducing country-by-country income tax disclosure, and promoting greater gender balance on the boards of listed companies.

The fact that corporate governance principles are scattered across Turkish legislation, that the CMB is not recognized as the sole authority for the implementation, supervision, monitoring, and development of these principles, and that the majority of these principles in the CMB Corporate Governance Communiqué consist of optional rules are other criticisms that can be directed at

the Turkish corporate governance system. However, it is necessary to emphasize that another development that can answer these criticisms is the innovations in digitalization and artificial intelligence technologies. Considering that the focus of Turkish corporate governance law in the future will consist of digitalization, the integration of AI assistants into board decision-making processes, blockchain-based transparent voting systems, and ESG/Sustainability-oriented green corporate governance norms, it should be accepted that the handicaps arising from the human factor in the application of corporate governance principles can be eliminated. If Turkish legislation can adapt dynamically to these technological and global transformations, corporate governance principles can be implemented in the most effective way, and the competitiveness of the Turkish capital markets will be maximized.

4. Conclusion

The Republic of North Macedonia and Türkiye have not remained immune to the global trend towards the implementation of good corporate governance practices. However, as in other areas, these two countries have traditionally been followers rather than leaders in adopting internationally recognized corporate governance practices. Nevertheless, the effective implementation of good corporate governance practices is essential if companies in these countries are to attract investment in their shares. Increased corporate transparency, greater professionalism of management and supervisory bodies, stronger protection of shareholders' rights, enhanced investor confidence, and improved corporate reputation and market value can contribute to making listed companies more attractive to current and potential equity investors. Therefore, both countries should take further steps to promote and strengthen the implementation of internationally recognized corporate governance standards, with the first step being the implementation of the recommendations issued by the European Commission in its respective reports on the two countries.

Considering that the obligation to report on the application of the Corporate Governance Code (CGC) is still relatively new for Macedonian companies, a certain period of time is required for companies to fully adapt their corporate practices to the requirements and recommendations of the Code. Consequently, there remains considerable scope for further improvement and broader application of good corporate governance practices in North Macedonia. The fact that the CGC is not mandatory for all joint-stock companies further limits its overall impact and indicates the need for continued efforts to promote wider adoption of good corporate governance principles among all listed companies.

Türkiye has made significant progress in establishing a corporate governance framework. However, the gap between the formal adoption of corporate governance principles and their effective implementation in practice remains a significant challenge. Future reforms should therefore prioritize the substantive application of these principles, with particular emphasis on limiting the influence of controlling shareholders, strengthening independent oversight, and ensuring greater transparency and accountability.

Therefore, greater digitalization of corporate governance should be considered a future priority for both countries, particularly through the integration of AI-assisted decision-making, blockchain-based voting systems, and transparent digital reporting, as these tools could strengthen accountability, shareholder participation, and the effective implementation of corporate governance principles.

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LEVEL OF AWARENESS AND PRACTICES REGARDING PACKAGING WASTE SELECTION IN NORTH MACEDONIA

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Abstract

Amid ongoing efforts in the European Union toward a significant shift in reducing packaging waste, prevailing reports from the region indicate that Macedonian citizens do not primarily select their waste sufficiently, that there is a lack of adequate infrastructure for waste separation, and that public utility companies face financial constraints. In line with the Extended Producer Responsibility principle (EPR), producers are required to undertake activities aimed at informing the public and raising awareness in order to promote benefits and interest in packaging waste management, separate collection, and recycling of specific waste streams, with the goal of achieving higher levels of national target compliance. Continuous public awareness-raising remains one of the key challenges in effective packaging waste management, while a notable research gap exists in Macedonian academic literature regarding national waste separation habits. This paper consolidates findings from four public opinion surveys conducted on a sample of 1,200 respondents from North Macedonia. The analysis focuses on waste separation practices and habits, the attractiveness of separating different waste fractions, preferred incentives, public attitudes toward Reverse Vending Machines (RVM), and the main challenges faced by consumers in managing specific waste streams.

The authors will use analytical and comparative analysis methods to examine relevant changes in public opinion trends, habits, and behavior regarding the separation of packaging waste over the past years. The findings will identify the

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main problems that should be the focus of future activities aimed at improving packaging waste management.

Keywords: Packaging waste, collective waste management operator, reverse vending machines, deposit return system (DRS), plastic waste, ESG (Environmental, Social, and Governance)

1. Introduction

Mass production and mass consumption have shown their negative side, hyper production of waste. In our everyday life we are used to consuming goods that are packed in different packages at the same time: pallets, cartoons, plastic bags, aluminium cans etc.

According to Worldometrics, plastic bottle production totals 500 billion units each year, which generates 300 million tons of waste annually. Hundreds of thousands of tons from bottles contribute to the 8 million tons of plastic that reach the oceans (Bergman, 2026). A study based on mathematical method in order to predict the use of plastics shows that the global use of plastics is expected to increase from 464 Mt in 2020 up to 884 Mt in 2050, with up to 4725 Mt of plastics accumulated in stock in 2050 (from the year 2000) (Dokl et.al 2024).

Waste generation is projected to increase dramatically in the next dozen years, from 1.3 billion tonnes per year today to 2.2 billion tonnes per year by 2025, with high increases in middle-income developing countries (World Bank. 2012).

In the 2030 Agenda for Sustainable Development adopted by United Nations, one of the goals is ensuring sustainable consumption and production patterns that includes changing approaches and perspectives on waste to shift from end of-pipe solutions to reduce, reuse, recycle (3R) approaches, which close material loops and reduce resource extraction needs. The need to recycle (e.g., through take-back programs), reuse (e.g., by avoiding single-use plastic bags), and reduce consumption is something that many people are already aware of (Bulut, et al., 2023). In order to decrease our reliance on raw materials and increase recycling and "circular economy" approaches to reduce environmental pressure and impact, few targets have been identified as: achieve the environmentally sound management of chemicals and all wastes throughout their life cycle and significantly reduce their release to air, water and soil and also substantially reduce waste generation through prevention, reduction, recycling and reuse (United Nations General Assembly, 2015). Also, according to the Agenda, one of the targets is supporting developing countries to strengthen their scientific and technological capacity to move towards more sustainable patterns of consumption and production.

In a survey conducted by European Commission titled: Citizens action for reducing waste, over half of Europeans would consider correctly sorting their waste or using reusable packaging to reduce the amount of waste (European Commission (2024). According to Eurostat data for 2023 an average of 35.3 kg of

plastic packaging waste was generated in 2023 for each person living in the EU, and out of this, 14.8 kg were recycled. According to Eurostat, countries with the highest rate of recycling plastic waste are Belgium and Latvia with a rate almost 60%. The average recycling rate in the EU is 42%.

A survey conducted in Turkey reported that 45% of respondents regularly separate packaging waste. The findings of the survey suggest that higher education levels correlate with increased awareness and more responsible waste management practices, highlighting the importance of education in improving these practices (Elmaslar Özbaş, et al. 2026).

According to Barnosky et al. the barriers for individuals to recycle presented in the literature may be broadly categorized into three categories: lack of knowledge (How to recycle; why it is important; how does the system work), inconvenience (time cost; perception of dirtiness; lack of effective facilities and/or storage space) and lack of personal responsibility (Lack of intrinsic motivation; Lack of collective action ("Just me" won't make a difference); and Lack of trust in the other actors in the system).

The necessary factors that may trigger the public behavior in this case i.e recycling waste, in the theory (Timlett & Williams, 2008) are divided in:

- Enablers – factors that improve the infrastructure, increase the specialized education and amount of information about that usefulness of that behaviour, also and removal of barriers,
- Encouragement – implementation of taxes, penalties, rewards,
- Engagement - communication, feedback mechanisms, stakeholder consultation, community engagement, and bottom-up policy-making
- Exemplify - leading and influence of good examples and practices.

One of the possible ways to recycle packaging waste by individuals is using reverse vending machines (RVM). The Reverse Vending Machine (RVM) is an innovative waste-collection concept in which users receive a reward for properly depositing recyclable items. RVMs facilitate the efficient collection of recyclable materials, encourage recycling practices, and ultimately contribute to more effective waste management (Tomari, et al., 2017).

Implementing supplementary programs with financial incentives and raising awareness and educating the general population about the usefulness of reverse vending machines are crucial for increasing the level of using RVM (Gjorgjioska, et al. 2023). RVMs are widely used in high-income countries, particularly in Europe and North America, where established deposit-refund schemes and supporting infrastructure have contributed to high return and recycling rates (Stojanov, 2015). Countries such as Sweden, Denmark, Norway, and Germany have successfully integrated RVMs into national recycling systems. In contrast, their adoption in developing and emerging economies remains limited, with research largely focusing on pilot projects and prototypes (Fernandes, 2025). This highlights the need for further research into the potential of RVMs to support effective waste management and the transition towards a circular economy in these countries.

The Republic of North Macedonia as a middle-income developing country with high risk and potential for pollution should undertake measures in

order to minimize adverse impacts on human health and the environment. The trend for exploring the circular economy in the area of plastic packaging has become popular among academia and researchers in the country, which is shown by the increasing number of publications. Some of the important articles are focused on managing packaging and packaging waste and analyzes the results of the implementation of the Law of management of packaging and packaging waste which was enforced in 2009 (Toshevska-Trpchevska, et al. 2017), implementation of the Law on Packaging and Packaging Waste Management and the Law on extended producer responsibility for the management of special waste streams (Mateski & Gjorgjioska 2021), legislative challenges in sustainable packaging waste management in North Macedonia (Mateski, 2026), establishment of packaging waste management system in Macedonia (Sapuric, et al. 2013) etc. There are only few researches from the country that are focused on the role of the reverse vending machines (RVM) in recycling plastic packaging waste. One of them is focused on the awareness, habits, and tendencies regarding eco-practices among citizens (citizens environmental behavior) and their attitudes towards the use of reverse vending machines in the Pelagonia region of the Republic of North Macedonia (Angeloska – Dichovska et al., 2023). Pakomak, as the first Macedonian company that introduced the global trend in selection in the Republic of North Macedonia – reverse vending machines for collecting plastic bottles and cans, has conducted few researches for internal use about the trends and habits of the using reverse vending machines.

The paper is structured into four sections. The first section provides an introduction, the second presents the research methodology, the third focuses on the survey results, and the fourth presents the conclusions and recommendations for the broader use of reverse vending machines (RVMs).

2. Methodology

The analysis is based on survey about public opinion, consciousness, habits and practices in waste packaging selection. The survey was conducted on 1200 respondents from Skopje, Bitola, Kumanovo, Tetovo, Strumica, Ohrid, Stip, Veles and Prilep. The survey was conducted in the period from 9-23 February 2026 by using CATI (computer-assisted telephone interview) selecting. The survey included 1,200 complete interviews, with a total of 4,302 telephone numbers contacted (RDD sampling). The response rate was 27.9%, and the refusal rate was 41.6%. The survey was financed by Pakomak DOO Skopje, and was conducted by Quantum communications. The results are statistical and visual presented by using Microsoft Excel. Also, in order to identify and conclude the trends in PVM use, habits, and practices, the findings of the latest research are compared with the results of public opinion surveys conducted in 2019, 2022, and 2024. These surveys examined public awareness, habits, and behaviour regarding the separation of packaging waste and were conducted for the purposes and needs of Pakomak. The surveys used the same sample size and the same CATI (Computer-Assisted Telephone Interviewing) methodology, ensuring comparability of the results over the different survey periods.

The descriptive statistic of the respondents is given in the table below.

Table 1. Demographic Characteristics of the Survey Respondents

Gender	man	46.6%
	woman	53.4%
Age	18-29	14.8%
	30-45	28.9%
	46-64	36.3%
	over 65	19.9%
Education	Primary education	6.8%
	Secondary education	57.2%
	Higher education	31.8%
	Master's/Doctoral degree	3.8%
	Prefer not to answer	0,3%
Employment status	Employed	58.2%
	Unemployed	12.5%
	Student	3.7%
	Retired	23.8%
	Other	1,2%
	Prefer not to answer	0,7%
Family' monthly incomes	up to 30.000 den	17.8%
	30-50.000 den	30.5%
	50-70.000 den	23.4%
	above 70.000 den	17.4%
	prefer not to answer	10.8%

The distribution of the respondents among the cities was as follows: 33.3% from Skopje and 8,3% from each other city. 78.4% of the respondents are Macedonian, 15,3% Albanian and 6,2% other nationalities.

3. Results and discussion

On the question: Do you select waste for recycling in your household? Only 14,2% of the respondents answer that they always select waste or very often, and unfortunately 30,9% of the respondents answer that they never select the waste in their household. The results are presented in Figure 1.

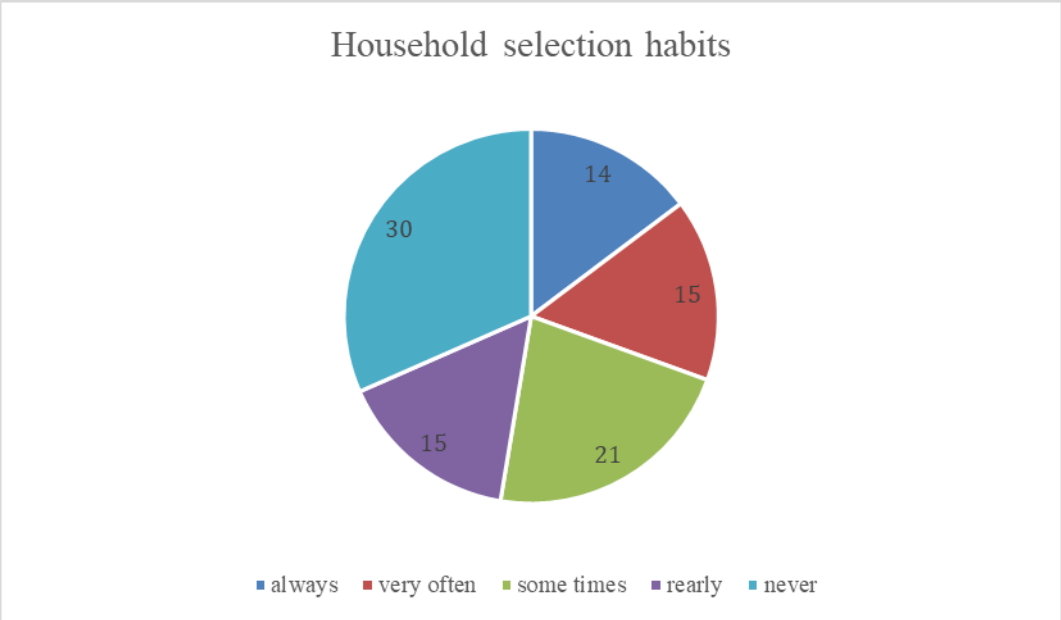


Figure 1. Household waste selection for recycling

Figure 1 shows that the largest share of respondents, 30%, reported that they never separate waste for recycling.

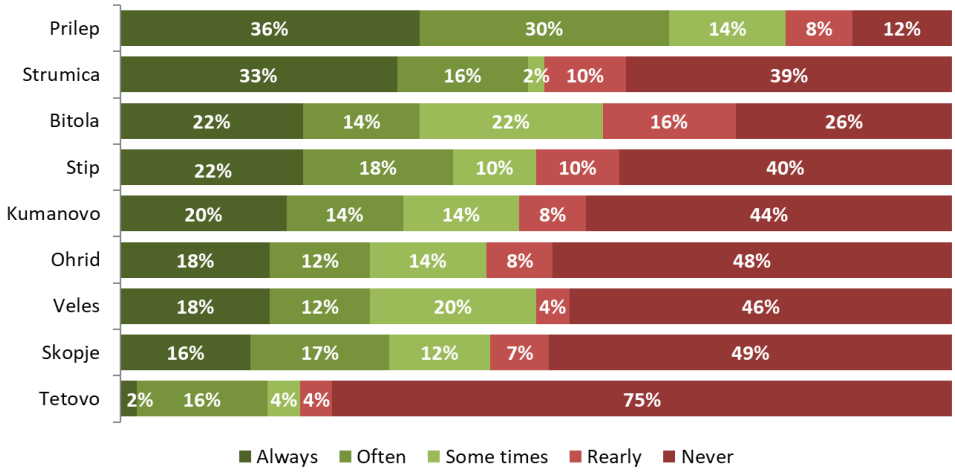


Figure 2: Household waste selection for recycling by city in 2019

Based on the results of the research conducted in 2019, regarding the question "Do you separate waste for recycling in your household?", leading in recycling are respondents from Prilep (with 36% respondents always recycling) and Strumica (with 33% respondents always recycling). Results show that 75% of the respondents from Tetovo have never selected the waste, followed by almost half of the respondents from Skopje, Ohrid and Veles. The lowest percentage of the respondents that said that never select a waste are from Prilep (12%).

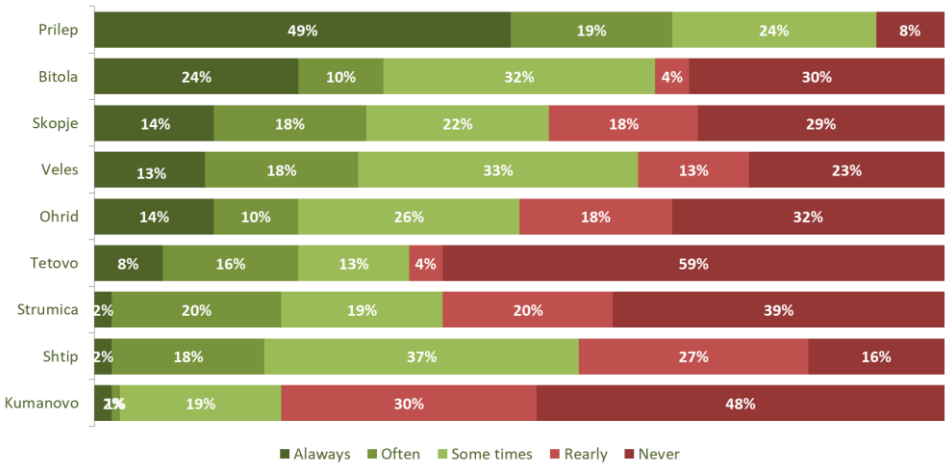


Figure 3. Household waste selection for recycling by city in 2026

In 2026, the results for the same questions show that 49% of respondents from Prilep reported that they always recycle, followed by 24% of respondents from Bitola. In contrast, almost half of the respondents from Kumanovo reported that they never separate waste for recycling, while Prilep recorded the lowest share of respondents who reported never recycling, at only 8%.

Comparing the results presented in Figures 2 and 3, it can be concluded that the share of respondents who always, often, or sometimes separate waste for recycling has increased over the past seven years, while the share of citizens who rarely or never separate waste has decreased. Prilep recorded the highest share of respondents who reported always or often separating waste for recycling in both surveys.

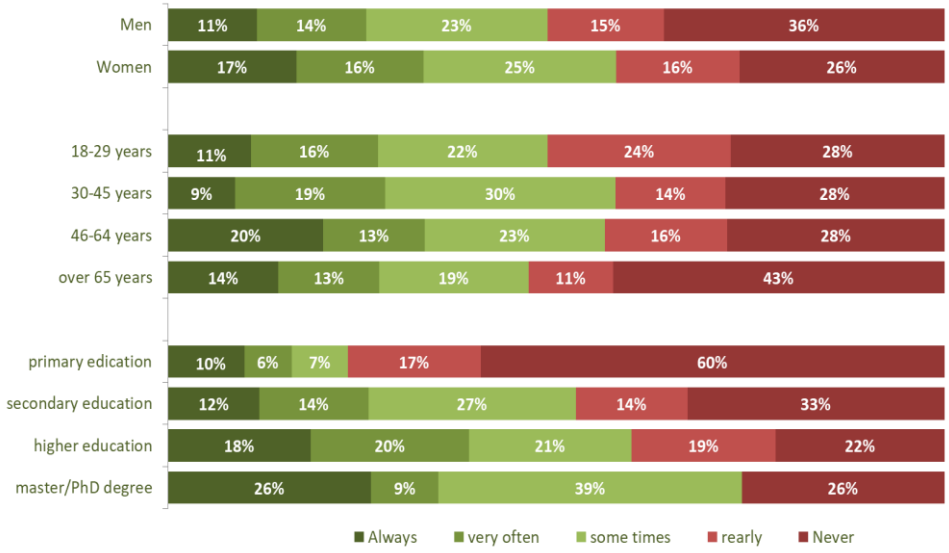


Figure 4. Household Waste Selection for Recycling by gender, age and education status.

From the figure above, it can be concluded that women are more likely to separate waste for recycling than men. This practice is most common among

respondents aged 46–64, while 43% of respondents aged 65 and over reported that they never separate waste. Respondents with higher education, including those with a master's or doctoral degree, are more likely to separate waste than those with primary or secondary education. Notably, 60% of respondents with primary education reported that they never separate waste.

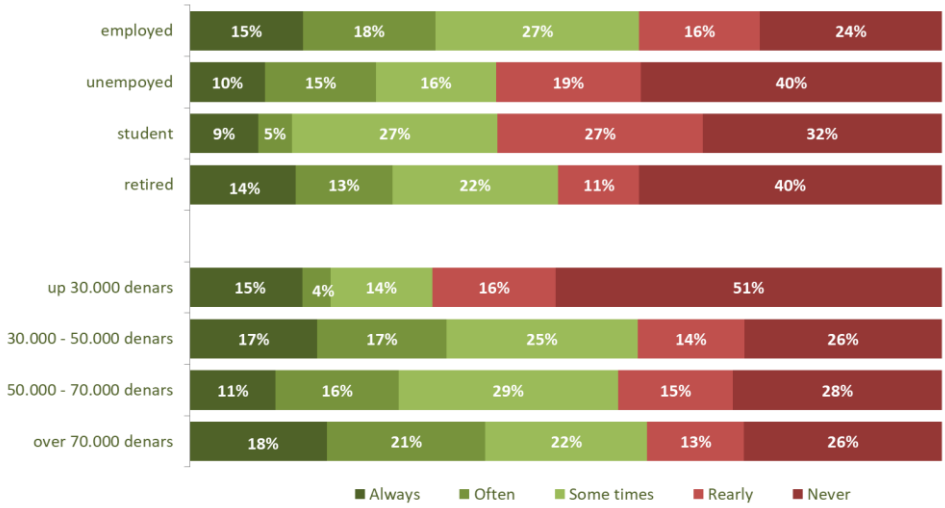


Figure 5. Household Waste Selection for Recycling by employment status and monthly family income.

The results for waste selection cross tabulated with employment status and monthly family incomes show unfortunately that unemployed and students are selecting waste less than employed and retired respondents. 40% of retired and 40% of unemployed answer that they never select waste. Regarding their incomes, the highest percentages of respondents with highest family incomes always select waste, while the most of respondents with lowest monthly incomes never select waste. It may be assumed that higher family income influences proportional on the selection practices and opposite, respondents with lower incomes select the waste less.

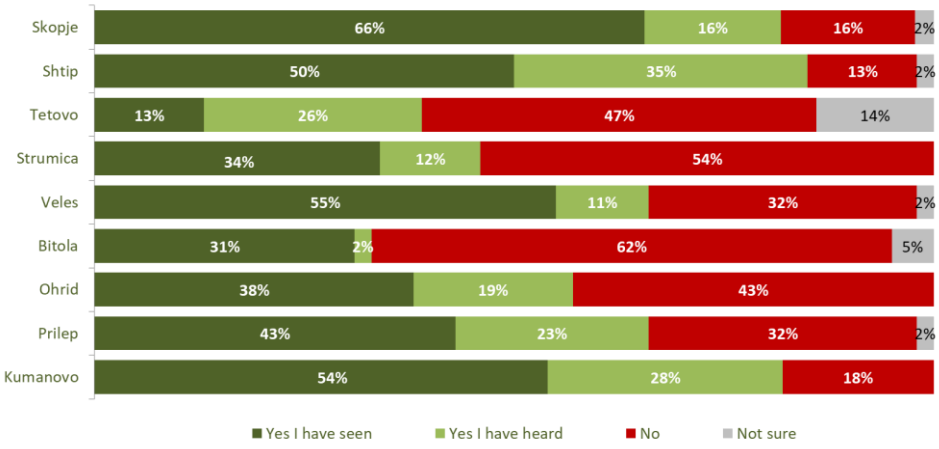


Figure 6. Awareness of reverse vending machines for collecting used plastic bottles and cans by city

Regarding the question: "Have you heard that there are or perhaps you have seen vending machines (machines) installed somewhere for collecting used plastic bottles and cans?" the most respondents from Skopje (66%) and Stip (50%) have seen RVM, an opposite only 13% of the respondents from Tetovo have seen RVM. 85% form the respondents from Stip have seen and heard about RVM, and 82% from Kumanovo and Skopje have seen and heard about RVM, while 62% of the respondents from Bitola and 54% of the respondents from Strumica have not seen or heard about RVM.

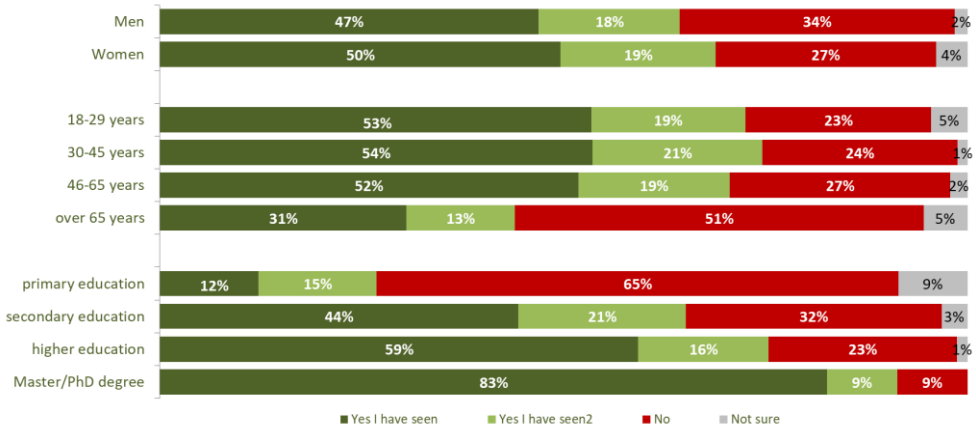


Figure 7. Awareness of reverse vending machines for collecting used plastic bottles and cans by gender, age and education.

Regarding gender, women are more aware about the existence of RVM compared to men, 54% of the respondents from the age group 30-45 years have seen RVM, while 51% of the respondents that are over 65 years have not seen or heard about RSV. The crosstabulation regarding education shows that respondents with primary education have the lowest level of awareness about existence of

RVM (12%), while the greatest level of awareness have shown respondents with master or PhD degree (83% have seen RVM).

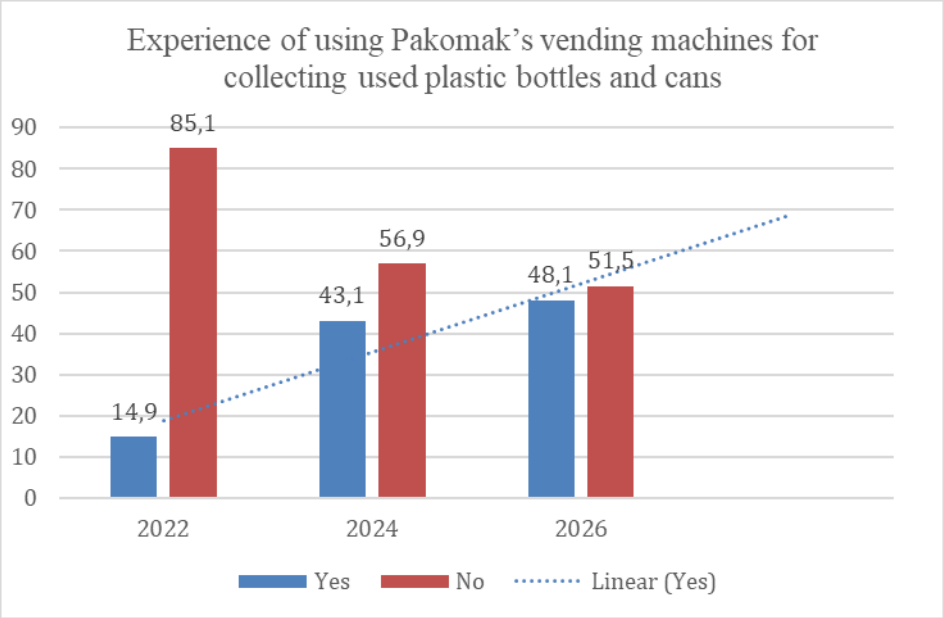


Figure 8. Experience of using Pakomak's vending machines for collecting used plastic bottles and cans in 2022, 2024 and 2026

Regarding the experience of using RVMs, the findings indicate a continuous increase in the number of people using them over the years. While only 14.9% of respondents reported using RVMs in 2022, this share increased substantially to 48.1% in 2026.

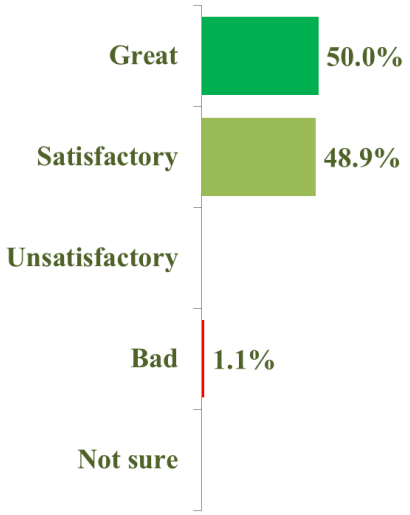


Figure 9. Experience of using Pakomak's vending machines for collecting used plastic bottles and cans

From the respondents who had personal experience using the machines, 98,9% rated it positively (50% excellent and 48,9% satisfactory). Only 1,1% stated that their experience was bad.

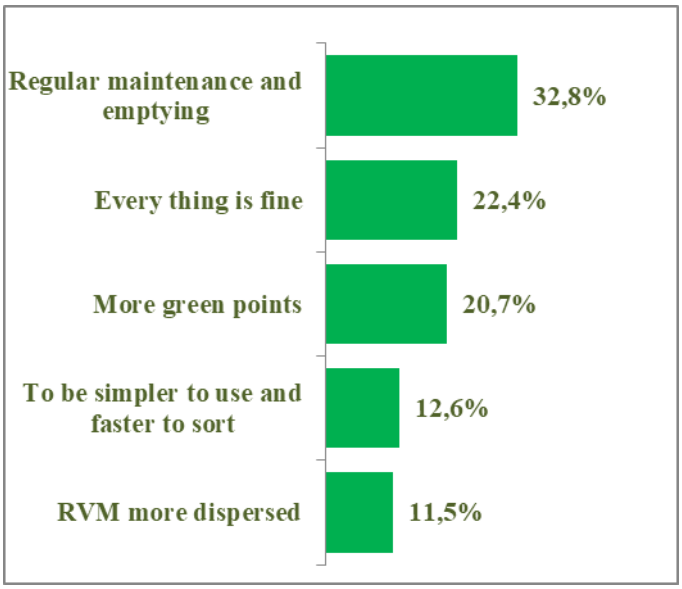


Figure 10. Recommendations for further improvement of Pakomak's reverse vending machines

Despite the high level of user satisfaction, several areas for improvement were identified. The most frequent suggestion was more regular maintenance and emptying of vending machines (33%), followed by increased rewards (21%). Other recommendations included simplifying and speeding up the process (13%) and expanding the number of locations (12%), while 22% of respondents provided no comments.

4. Conclusion

The survey findings indicate that waste separation practices vary considerably according to gender, age, education, employment status, income, and place of residence. Women are more likely to separate waste for recycling than men, while respondents aged 46–64 and those with higher education, particularly master's and doctoral degree holders, demonstrate the highest levels of participation. In contrast, waste separation is less common among respondents with primary education, older respondents, retired and unemployed individuals. Leading in recycling habits are citizens from Prilep (with 49% respondents always recycling) and Bitola (with 24% respondents always recycling). In contrast, almost half of the respondents from Kumanovo never select waste for recycling. Awareness of reverse vending machines (RVMs) also varies significantly among cities and demographic groups, with women and respondents with higher education generally demonstrating greater awareness, while awareness is lowest among respondents with primary education and those over 65 years of age.

Citizens of Stip, Kumanovo and Skopje are most aware of the existence of RVM, while lowest awareness is presented among citizens from Bitola and Strumica.

Regarding actual experience, 48,6% of respondents reported having used an RVM, while 51,4% had no such experience; however, approximately 99% of those who had used Pakomak's RVMs reported a positive experience. The findings reveal a significant upward trend in RVM use, with the proportion of respondents reporting their use increasing from 14.9% in 2022 to 48.1% in 2026.

Overall, the findings indicate a positive shift in citizens' waste separation practices over the observed period, reflected in the increased proportion of respondents who regularly separate waste for recycling and the decline in those who rarely or never do so. Prilep stands out for its consistently favourable results, recording the highest proportion of respondents who regularly separate waste for recycling in both research periods. These results suggest growing awareness and more positive recycling habits among citizens, although further efforts are needed to encourage wider and more consistent participation in waste separation.

These findings suggest that expanding RVM infrastructure, together with targeted awareness campaigns and educational activities, could contribute to increased waste separation and recycling and support the broader adoption of RVMs in North Macedonia. As key enablers, the RVM infrastructure should be improved by increasing the number of machines and ensuring their wider territorial distribution, including better coverage of smaller and less-served areas. The system of green points should also be further developed and consistently implemented to provide citizens with more accessible opportunities for waste separation and recycling. Awareness campaigns and leading-by-example initiatives should be tailored to specific target groups that lag behind in waste separation practices, with particular attention to groups demonstrating lower levels of awareness and participation.

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ADVANCED HIGH-RISK INTERNET BANKING IN CROATIA: PREDICTORS AND INSIGHTS

Sandra Pepur[1], Mario Pepur[2], Dujam Kovač[3]

Abstract

Digitalization and digital transformation processes have deeply changed the banking sector. In order to maintain their market positions, banks have been forced to adapt their business models to contemporary technological and consumer trends. The effectiveness of digital banking strategies depends, among other factors, on users' ability to adopt and effectively use new products, services, and technologies. Moreover, external shocks, such as financial crises and the recent pandemic, have further emphasized the importance of enhancing users' knowledge and skills in managing their personal finance and utilizing digital banking tools.This study examines the factors associated with the use of advanced high-risk internet banking services, offering novel empirical insights into digital financial behaviour in Croatia. Primary data was collected from 258 bank customers in Croatia. Hierarchical regression analysis was applied to assess the predictive role of demographic factors, distrust in internet banking, frequency of use, and financial knowledge. The results indicate that behavioural factors and financial literacy contribute to explaining variation in the use of advanced high-risk internet banking services. Further research could examine additional behavioural and cognitive predictors in more diverse populations to enhance understanding of advanced internet banking use.

Keywords: Internet banking use, Financial knowledge, Hierarchical regression analysis.

1. Introduction

Digitalisation has substantially transformed the provision and consumption of financial services. Internet and mobile banking serve not only as alternative distribution channels for basic banking transactions (e.g. checking an account balance or paying a domestic bill) but also provide access to a broad range of financial products and services, such as credit management, international

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transfers, investment products, and securities trading. These digital banking activities differs considerably in terms of financial complexity, potential consequences and the knowledge required from the user. Therefore, internet banking usage cannot be treated as a homogeneous form of consumer behaviour.

While a large body of research has examined the importance of financial technology for the financial industry and businesses, studies on consumer-specific factors and their influence on the use of advanced high-risk internet banking in less developed countries have been scarce. According to Eurostat data for 2025 76.6% people in Croatia used internet banking in last three months, whereas this number in total European Union was 74.3%. Despite the growing interest in Internet use, financial institutions need to increase the awareness regarding Internet banking facilities to encourage more depositors to adopt new technologies. The success of technological innovation relies on its actual usage, which highlights the importance of identifying and understanding factors that influence the usage of Internet banking services.

The literature suggests that advanced internet banking use results from the interaction of demographic, behavioural, and cognitive factors which was a basis for the hierarchical regression model applied in this research. The study contributes to the emerging literature on digital financial behaviour as it investigates the usage of advanced higher-risk internet banking services. Additionally, in a unique hierarchical framework, the analysis assesses the incremental explanatory power in a specific Croatian context. Croatia is a small bank-oriented market that received less attention in the literature on consumers' advanced internet financial behaviour.

The paper is organized as follows: following the introduction, the next section presents the literature review. The third section describes the data and methodology, while the fourth section discusses the results. The final section outlines the research limitations and concluding remarks.

2. Theoretical background and literature review

2.1 From general to advanced internet banking use

The recent research has mostly investigated the initial adoption of internet and mobile banking, the intention of users to use digital financial services or the frequency of use. Neves et al. (2023) conducted a meta analysis on 121 studies, and showed that research on digital financial services include digital banking, digital financial management, payment services, and digital wallets. The results prove the importance of conventional technology-adoption factors, and especially perceived usefulness and ease of use. Additionally, the findings emphasise the importance of security and trust in explaining the adoption and use of digital financial solutions. Moreover, the diversity of services included in this meta analysis shows that the determinants of digital financial behaviour can differ depending on the complexity and purpose of specific service.

Internet banking provides access to services that differ considerably in terms of their complexity and the level of customer involvement they require. On one hand, there are simpler and more routine services, which include checking account balances, reviewing transaction statements, monitoring income and expenditure, managing savings, and transferring funds (Furst et al., 2002). On the other hand, more complex services involve opening accounts online, making international or higher-value transfers, paying bills, conducting online purchases, and engaging in investment activities (Furst et al., 2002). The expansion from basic account-management functions to more sophisticated financial transactions illustrates how the integration of Internet technologies into banking operations has transformed traditional banking practices and significantly broadened the range of services available through digital channels (Rončević, 2006).

This study investigates predictors of advanced higher-risk internet banking use. These services require greater financial involvement or expose users to more substantial financial consequences in comparison to routine services such as account monitoring and domestic payment activities. These services do not necessarily involve excessive risk when used appropriately; however, they generally require users to process more complex financial information, evaluate potential costs and benefits, and assume greater responsibility for decisions made through the digital channel. This distinction is important because widespread adoption of internet banking does not necessarily imply the more use of its more advanced functions. Consumers may frequently use internet banking for routine transactions while being unwilling or unable to engage with digital credit and investment services. Therefore, the advanced internet banking use can be determined not only by access to technology but also by consumers' personal characteristics, accumulated internet banking experience, perceptions of reliability, and financial knowledge.

Accordingly, the conceptual framework in this study consists of three groups of predictors: demographic characteristics, which capture differences in consumers' resources, exposure, and opportunities; behavioural factors, specifically frequency of internet banking use and distrust in the digital channel; and advanced financial knowledge, as the cognitive capability.

2.2 Demographic predictors of advanced internet banking use

Demographic characteristics are among the most frequently examined determinants of technology adoption and digital financial behaviour. Age, education, and employment status may influence consumers' access to digital technologies but also their experience, financial needs, exposure to different financial products, and ability to evaluate the benefits and risks of digital services.

Age is particularly relevant because people of different generations differ in their exposure to digital technology and in the extent to which digital tools are part of their everyday life. Younger consumers are generally more familiar with digital interfaces and may adapt more easily to technological innovation. On the other hand, older consumers may experience greater difficulties related to digital skills, perceived complexity and security fears. These barriers become more

relevant in the context of advanced internet banking services when users need to independently make credit/investment decisions, or international financial decisions.

Employment status may also influence engagement with digital banking. Employed and self-employed individuals generally conduct financial transactions more regularly, receive income and may have greater need for time-efficient access to payment, credit, and investment services. Employment can therefore increase both consumers' exposure to financial products and the practical value they assign to digital banking. Çera et al. (2024), using data from 959 individuals in four Southeast European countries, found that employed respondents and those with financial experience scored more highly on the antecedents of mobile banking use included in the extended unified theory of acceptance and use of technology model (UTAUT2) model.

Based on the above mentioned, it can be said that demographic variables represent conditions that shape the context within which consumers make technology and financial decisions. The demographic context is also relevant from the perspective of the digital financial divide, which means inequality in access, use and understanding of modern digital financial services (such as internet and mobile banking, digital payments, and crypto-assets). This gap separates those who can easily use technology from those who are excluded (Zamora-Pérez et al., 2024). At the European level, findings of Ferilli et al. (2024) indicate that greater innovation in financial services is associated with a lower digital financial divide, particularly where it is supported by stronger digital infrastructure and social progress. Although their analysis is conducted at the regional rather than individual level, it demonstrates that the benefits of financial digitalisation are not automatically or uniformly distributed. Individual characteristics may continue to determine who is able to move from basic access to more sophisticated use.

Previous evidence for Croatia (Pepur et al., 2024) also suggests that general internet banking use differs according to age, education and employment status, whereas gender differences are less consistent. The previous analysis further indicated that financial literacy was more clearly associated with the frequency of internet banking use than with the binary distinction between users and non-users.

2.3 Behavioural predictors: frequency of use and distrust

Demographic characteristics alone are unlikely to provide a sufficient explanation of advanced digital banking behaviour. Consumers' actual experience with internet banking and their perceptions of the reliability of the digital channel represent more direct determinants of how they use available services. Thus, the second block of the model introduces two behavioural variables: frequency of internet banking use and distrust in internet banking.

The expected association between frequency and advanced use follows from the assumption that consumers usually become familiar with basic services before continuing towards more demanding ones. A user who frequently accesses internet banking is more likely to be familiar with the platform, security

procedures, and transaction processes. Because of the repetition, frequent users may perceive advanced services as less difficult to use and become more confident in testing advanced services that go beyond checking balance and routine payments. This is consistent with Andreou and Anyfantaki (2021), who found a positive relationship between financial knowledge and the frequency of internet banking use. Their findings suggest that digital banking behaviour reflects an interaction between financial literacy, digital proficiency, and confidence. Importantly, financially less literate respondents were more likely to report a lack of trust in internet banking and a lack of confidence in their financial and digital skills as reasons for non-use internet banking. Thus, experience, knowledge, and trust should not be viewed as fully independent aspects of digital financial behaviour; rather, they may be complements, reinforcing one another in shaping consumers' engagement with digital banking.

Neves et al. (2023) identify trust and security as important factors that ease the acceptance of digital financial service across different types of digital financial solutions. Namely, security and reliability may become particularly important when transactions involve sensitive personal information, larger amounts of money, and borrowing or investment decisions. In this study, distrust in internet banking reflects users' doubts regarding the safety, reliability or potential consequences of using the digital channel. Distrust may discourage users from entering sensitive information, transferring funds to unfamiliar recipients or executing transactions that are difficult to reverse. Its relevance may consequently increase with the complexity and perceived financial importance of the service. A consumer may be willing to check an account balance despite some security concerns but remain reluctant to conduct international transfers, manage credit or purchase investment products through the same platform.

The relationship between distrust and advanced internet banking use may also be connected with experience. Frequent and successful use may reduce some reservations by providing consumers with evidence that the system operates reliably. Conversely, distrust may restrict experience by discouraging consumers from exploring available services. Andreou and Anyfantaki's (2021) results are consistent with this relationship, as respondents with lower financial literacy more frequently reported both distrust and insufficient confidence as barriers to internet banking use.

2.4 Cognitive predictor: advanced financial knowledge

While demographic characteristics capture differences in consumers' backgrounds, and behavioural variables capture their experience and perceptions, advanced digital financial activities may additionally depend on users' cognitive ability to understand the underlying financial products. Thus, the third element of the model introduces advanced financial knowledge.

Financial knowledge is an integral part of the multidimensional financial literacy construct, together with attitudes and behaviour (OECD, 2023). Accordingly, financial literacy reflects not only what individuals know about finance but also how they evaluate available alternatives and translate their

knowledge into appropriate financial behaviour. Individuals with higher levels of financial literacy are therefore expected to be better equipped to understand and compare banking products, select services according to their needs, and recognise the potential benefits and risks of digital financial services, including internet banking. This study uses Lusardi and Mitchell (2023) "Big Five" questions, which are in the literature known as the measure of financial "literacy". However, these questions actually capture only the cognitive component of financial literacy, i.e. knowledge, and not other two dimensions: attitudes and behaviours. Therefore, the variable used in this research is more precisely interpreted as respondents' financial knowledge, rather than their overall financial literacy.

Digitalisation has simplified access to financial services and at the same time shifted the responsibility to individual users, therefore, financial knowledge becomes especially important. In digital environment a transaction can be done easily, quickly and without direct interaction with a bank employee, however, ease of execution does not necessarily imply ease of evaluation. Additionally, basic internet banking activities primarily require operational and digital skills, whereas the use of advanced services may additionally require an understanding of financial products, risk diversification, interest rate mechanisms, and potential financial consequences. Thus, advanced financial knowledge becomes more relevant when users makes more complex financial decisions and choose complex financial products within a digital channel.

Koskelainen et al. (2023) argue that digitalisation changes the knowledge, skills, and tools required for effective personal financial management. Their review identifies three interconnected areas at the intersection of finance and digitalisation: FinTech, financial behaviour in digital environments, and behavioural interventions. They consequently propose a framework that extends traditional financial literacy and financial capability to account for the opportunities and challenges created by digital financial ecosystems. This perspective suggests that effective digital financial participation requires more than the technical capacity to use an application. It also requires the ability to understand financial information and use digital financial tools in a way that aligned with the user's interests.

Andreou and Anyfantaki (2021) provide evidence of the strong positive relationship between financial literacy and internet banking usage. Additionally, the results show the importance of digital skills for internet banking use. Thus, the authors conclude that financial and digital literacy jointly influence consumers' confidence in using digital financial services and that financial literacy may affect not only traditional financial decisions but also how consumers engage with the digital delivery of financial products.

The study of Yang et al. (2023) shows that financial literacy significantly increases the use of different forms of digital finance in households, including mobile payments, online borrowing, and online financial products. This effect is more pronounced for online borrowing and online financial products than for mobile payments. This result suggests that the importance of financial literacy becomes more relevant as the digital financial activities become more complex.

The present study focuses specifically on advanced financial knowledge, as the cognitive capacity to understand and evaluate the financial content of more complex services. Consumers who understand diversification and the effects of interest-rate changes may be better equipped to evaluate and use advanced high risk internet banking services.

At the same time, financial knowledge should not be expected to explain digital banking behaviour independently of demographic and behavioural factors. Financially knowledgeable consumers may still avoid advanced services if they distrust the digital channel, lack experience with the banking platform or do not need the products offered. Conversely, frequent users may engage with advanced services despite limited financial understanding. The incremental contribution of advanced financial knowledge is therefore expected to be modest but theoretically meaningful: it should explain additional variation after demographic background, frequency of use and distrust have been taken into account.

3. Empirical research

3.1 Methodology

A cross-sectional descriptive study was conducted employing a purposive, non-probability sampling strategy. Data were collected in June 2023 via a structured online questionnaire administered to a sample of 258 participants from the Republic of Croatia. The survey instrument was adapted from the questionnaire developed by Andreou and Anyfantaki (2021) and refined to align with the specific objectives and contextual nuances of this study. The initial section of the questionnaire captured respondents' core socio-demographic characteristics, including gender, age, educational attainment, and employment status. This information enabled analysis across key demographic subgroups.

The second section of the questionnaire assesses respondents' financial knowledge using the standardized "Big Five" measure developed by Lusardi and Mitchell (2023). This instrument is widely used in empirical research on financial literacy and enables international comparability of findings. The "Big Five" operationalize financial knowledge by testing respondents' understanding of five fundamental economic concepts: inflation, interest rates, mortgage loans, the relationship between interest rates and bond prices, and risk diversification. The first three items assess basic financial knowledge relevant to everyday financial decision-making. In contrast, the questions addressing the impact of changes in interest rates on bond prices and the principles of risk diversification capture more advanced financial knowledge, as they require a deeper understanding of market mechanisms and risk management concepts. This structure allows for a differentiated assessment of financial knowledge levels and supports a more nuanced analysis of respondents' financial competence.

The third section of the survey focused on general banking practices and the use of internet banking services. Items captured information on respondents' banking behaviours, including the number of banks used, frequency of online banking, branch visits, and other related activities. This section aimed to provide

insight into both traditional and digital banking engagement patterns. Data was analysed using descriptive statistics and hierarchical regression analysis.

3.2 Research results

The convenience sample was predominantly composed of female respondents (n = 206, 79.8%), whereas male participants represented a substantially smaller proportion of the sample (n = 52, 20.2%). In terms of age distribution, respondents were relatively evenly represented across age categories, although the largest subgroup consisted of individuals aged 27–42 years (n = 89). Participants aged 43–58 accounted for 64 respondents, while 53 respondents were older than 59 years. The youngest cohort (18–26 years) was the least represented, comprising 52 respondents.

Regarding educational attainment, the majority of respondents reported holding a university degree (n = 169), while 89 participants had completed secondary education. Among those with higher education, 76 respondents possessed degrees in economics or related fields. With respect to employment status, most respondents were employed (n = 166). The remainder of the sample included 37 retirees, 37 students, and 18 unemployed individuals.

The findings further indicate a relatively stable banking relationship among respondents. Specifically, 76% reported maintaining an account with only one bank, while 89.9% had been in a relationship with their primary bank for more than four years. Consistent with this stability, a large majority of respondents (82.9%) reported that they do not consider switching banks. Moreover, traditional branch usage appears to be relatively limited, as 74.4% of respondents indicated that they visit bank branches rarely or very rarely. The long duration of banking relationships and the low intention to switch banks may indicate relatively high levels of customer loyalty and switching costs in the Croatian banking sector. Among the sample of 258 Croatian bank customers, 228 (88.4%) reported using internet banking services, while 155 (60.1%) engaged in advanced high-risk services.

The following tables show the results of hierarchical regression analysis looking at the effects of the sociodemographic variables, frequency of usage, and distrust in internet banking, and finally advanced financial knowledge on use of advanced high-risk internet banking services. In the first step, the influence of the control variable (sociodemographic variables) was considered, while in the second step, the influence of the key predictor variables (frequency of usage and distrust) was investigated. In the third step, a theoretically important predictor, financial literacy/knowledge, was added to the model. Table 1 provides an overview of descriptive statistics and bivariate correlations for all the variables in hierarchical regression analysis. From the results, a weak to moderate, statistically significant correlation between the observed variables is evident ($r = 0.08$ to $r = 0.38$, $p < 0.001$), with several relatively stronger associations. The highest positive correlation was identified between variables Actual use and Frequency of IB use and Age and Employment status ($r = 0.58$ and $r = 0.528$; $p < 0.01$), whereas the strongest negative relationship was observed between variables Distrust and Frequency of IB use ($r = -0.497$; $p < 0.01$). Based on the results in the correlation

matrix (Table 1), it can be concluded that there is no significant issue of multicollinearity in the model.

Table 1. Descriptive statistics and intercorrelation matrix of observed variables

Variables	Mean	SD	1	2	3	4	5
Actual use	*0.6008*	*0.49069*					
Age	/	/	-0.237**				
Employment status	*3.57*	*1.397*	-0.087*	0.528**			
Distrust	*1.74*	*1.061*	-0.384**	0.178**	0.130**		
Frequency of internet bank. use	*4.73*	*1.682*	0.58**	-0.262**	-0.192**	-0.497**	
Advanced financial knowledge	*0.28295*	*0.317118*	0.154**	-0.135**	-0.225**	-0.125*	0.086*

Note: N = 258; **p < 0.01, *p < 0.05.

Prior to interpreting the hierarchical regression results, the necessary diagnostic tests were conducted. The Shapiro–Wilk test indicated a deviation from normality ($p < 0.001$). However, visual inspection of the histogram revealed a bell-shaped distribution, and the Q–Q plot showed that residuals largely followed the expected normal pattern, with only minor deviations at the tails. These findings suggest that the assumption of normality was not substantially violated, and subsequent analyses were considered justified. Examination of the residuals further indicated a symmetrical distribution around zero, with no obvious patterns of heteroskedasticity. The Breusch–Pagan test confirmed homoscedasticity ($LM = 3.10$, $df = 5$, $p > 0.05$).

Table 2 presents the basic indicators of the estimated research model, and hierarchical regression analysis was conducted to examine the predictors of high-risk internet banking service usage. Hierarchical regression analysis showed that employment status and age significantly predicted the dependent variable in Model 1 ($R^2 = 0.058$, Adjusted $R^2 = 0.051$, $p < 0.001$). Distrust in internet banking and frequency of internet banking use in Model 2 substantially increased the explained variance to 35.2% ($R^2 = 0.362$, Adjusted $R^2 = 0.352$, $\Delta R^2 = 0.304$, $p < 0.001$). The inclusion of the advanced financial knowledge index in Model 3 provided a small but significant additional contribution ($R^2 = 0.373$, Adjusted $R^2 = 0.360$, $\Delta R^2 = 0.010$, $p = 0.043$), indicating that demographic factors, online banking behavior, and advanced financial knowledge together explained a considerable proportion of variance in the dependent variable, the actual use of advanced high-risk internet banking services.

The F-statistic was statistically significant ($p < 0.001$) in the first two models, whereas in the third model it remained statistically significant at the $p < 0.05$ level. The adjusted coefficient of determination (Adjusted R^2), which accounts for sample size and the number of independent variables, is 0.360. This indicates that the regression model explains 36% of the total variance in the dependent variable around its mean.

Table 2. Basic data on the estimated model

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change

1	0.241	0.058	0.051	0.47803	0.058	7.896	2	255	0.000
2	0.602	0.362	0.352	0.39497	0.304	60.267	2	253	0.000
3	0.610	0.373	0.360	0.39253	0.010	4.147	1	252	0.043

a. Predictors: (Constant), Employment status, Age; b. Predictors: (Constant), Employment status, Age, Distrust, Frequency of IB use; c. (Constant), Employment status, Age, Distrust, Frequency of IB use, Advanced financial knowledge index; d. Dependent Variable: Actual use of advanced internet banking services.

Table 3 presents the coefficients for Model 3 of the hierarchical regression analysis. As is common in this type of model development, control variables were included in Model 1. Age and employment status were significant predictors of high-risk internet banking usage, together explaining about 5.1% of the variance in the dependent variable ($F = 7.896$, $p < 0.001$). Older respondents were less likely to engage in advanced internet banking services ($\beta = -0.134$, $t = -2.234$, $p = 0.026$), while employment status had a small but significant positive effect ($\beta = 0.119$, $t = 1.983$, $p = 0.048$).

In addition to the control variables, Model 2 incorporates two behaviour dimensions, both of which are statistically significant. Overall, the model explains 35.2% of the variance, representing a notable improvement over Model 1 ($F = 60.267$, $p < 0.001$). Distrust in internet banking showed a marginal negative association with high-risk usage ($\beta = -0.112$, $t = -1.942$, $p = 0.053$), indicating that higher distrust slightly reduces the likelihood of engaging in advanced services, although this effect was only borderline significant. Frequency of internet banking use emerged as the strongest predictor ($\beta = 0.503$, $t = 8.554$, $p < 0.001$), demonstrating a substantial positive relationship with the dependent variable.

Table 3. Results of hierarchical regression analysis

Model 3	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Toler.	VIF
Constant	-0.041	0.147		-0.279	0.780		
Age	-0.064	0.028	-0.134	-2.234	0.026	0.693	1.443
Employment status	0.042	0.021	0.119	1.983	0.048	0.695	1.439
Distrust	-0.052	0.027	-0.112	-1.942	0.053	0.744	1.343
Frequency of IB use	0.147	0.017	0.503	8.554	0.001	0.720	1.389
Adv. fin. knowledge	0.162	0.080	0.105	2.036	0.043	0.940	1.064

In Model 3, advanced financial knowledge was introduced, given its well-established predictive role in prior research. This addition increased the model's explanatory power to 36% ($F = 4.147$, $p = 0.043$). Advanced financial knowledge had a positive and significant effect ($\beta = 0.105$, $t = 2.036$, $p = 0.043$), suggesting that individuals with higher financial knowledge are more likely to engage in advanced high-risk internet banking services. These findings highlight the importance of financial knowledge in shaping consumer behavior in digital

banking environments, with clear implications for targeted marketing and risk communication strategies.

Several observations can be drawn from the models. First, age and frequency of internet banking use consistently retained their predictive power across all models. Second, employment status was not statistically significant in Models 1 and 2 ($p = 0.458$ and $p = 0.103$, respectively), but its predictive power increased in Model 3, becoming significant ($\beta = 0.042$, $p = 0.048$). Third, distrust in internet banking maintained a nearly constant predictive effect, although in Model 3 it reached only borderline significance ($p = 0.053$).

Collinearity diagnostics confirmed that multicollinearity was not a concern. Tolerance values ranged from 0.693 to 0.940, and VIF values ranged from 1.064 to 1.443, all well below conventional thresholds, ensuring the reliability of the regression estimates. The Durbin–Watson statistic was 1.81, indicating no significant autocorrelation among the residuals. This suggests that the assumption of independent errors was adequately met, supporting the validity of the regression estimates.

4. Conclusion

This research examines a broad set of predictors influencing the use of advanced high-risk internet banking services, providing new empirical insight into digital financial behaviour in Croatia. Hierarchical regression analysis indicated that demographic factors, particularly age and employment status, along with behavioural variables including frequency of internet banking use and distrust, were significantly associated with the use of advanced internet banking services. Advanced financial knowledge also contributed modestly but significantly to explaining variance in usage patterns, underscoring the role of economic knowledge in shaping engagement with high-risk digital financial services. These findings provide empirical insight into the interplay between demographic, behavioural, and cognitive factors in internet banking in Croatia, offering a foundation for targeted consumer engagement strategies. The study is limited by its use of a non-probability sample and national focus, suggesting that future research should replicate and extend these analyses across larger and more diverse populations.

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IMPROVING THE SUSTAINABILITY OF FOOD WASTE MANAGEMENT IN THE HOSPITALITY SECTOR: EVIDENCE FROM PRISHTINA, REPUBLIC OF KOSOVO

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Abstract

Improving operational performance through sustainable practices is an important priority for hospitality businesses seeking to reduce costs, enhance resource efficiency, and strengthen competitiveness. This study examines food waste measurement, digitalization, and managerial practices among hospitality businesses operating in the Municipality of Prishtina, Kosovo. Data were collected through structured interviews with business owners and managers and analyzed using descriptive and non-parametric statistical methods. The findings show that food waste is recognized as an operational and environmental concern, measurement practices remain largely informal and structured monitoring is still limited. The customer plate waste and losses during preparation food in the kitchen were identified as a key sources of food waste. Managerial training was associated with greater staff awareness and clearer procedures, while perceived efficiency was closely related to perceived profitability. Digitalization was linked to more consistent monitoring, but did not ensure systematic measurement or lower reported food waste levels. The results suggest that sustainable performance depends on the combined application of reliable measurement, appropriate digital support, managerial commitment, and staff development. The paper provides context-specific evidence from Kosovo and highlights the need for practical measurement systems, training, and affordable digital tools.

Keywords: food waste measurement; digitalization; managerial practices; sustainable hospitality; operational performance.

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1. Introduction

The hospitality sector supports economic development through employment, entrepreneurship, tourism, and linkages with other industries. However, hospitality operations are resource-intensive, and food waste represents both an environmental concern and a sign of operational inefficiency. In addition to the value of discarded food, businesses incur indirect costs related to labor, energy, water, storage, transportation, and disposal (Filimonau & De Coteau, 2019; United Nations Environment Programme, 2024). Systematic food waste measurement helps managers identify waste sources, monitor trends, and evaluate reduction measures. Digital technologies, including electronic inventory systems, smart weighing devices, artificial intelligence, and data analytics, can support this process. Their value, however, depends on reliable data, staff competence, clear responsibilities, standardized procedures, and integration into managerial decision-making (Ahmadzadeh et al., 2023; An & Galera-Zarco, 2025; Clark et al., 2025; Malefors et al., 2019). These issues are particularly relevant in Kosovo, where services dominate economic activity and SMEs form the backbone of the private sector (Kosovo Agency of Statistics, 2025a; OECD, 2026). Kosovo's economy is predominantly service-oriented, with services representing the dominant economic activity (Kosovo Agency of Statistics, 2025a). In 2025, the country's GDP reached USD 12.46 billion, with a real growth rate of 3.85% and a GDP per capita of USD 7,899 (World Bank, 2025; Central Bank of Kosovo, 2025). The private sector comprises approximately 53,080 active enterprises, the majority of which are small and medium-sized businesses (OECD, 2026). Within this context, the hospitality sector plays an important economic role. Travel exports accounted for approximately 19% of GDP in 2023, while accommodation and food service activities employed around 7% of the national workforce (International Labour Organization, 2025). Furthermore, HoReCa businesses represent about 9% of all registered enterprises. The continued growth of the sector is reflected in the 762,836 hotel visitors and 1,653,390 overnight stays recorded in 2025 (Kosovo Agency of Statistics, 2025b). These indicators demonstrate the sector's significant contribution to employment, tourism, entrepreneurship, and service exports, while also highlighting the importance of improving operational efficiency through food waste measurement, managerial training, and affordable digital technologies. Research examining the combined relationships among food waste measurement, digitalization, managerial practices, and operational outcomes remains limited, particularly in Kosovo and comparable transition economies.

The present study addresses this gap by distinguishing between general digitalization, food waste monitoring, structured food waste measurement, and the

managerial capabilities required to transform operational information into action. The study aims to assess current measurement and monitoring practices, examine the role of digital technologies in food waste management, and evaluate how managerial training and structured practices are associated with staff awareness and perceived operational outcomes. Because the data are cross sectional and perception-based, the study examines associations rather than causal effects. The following research questions guide the analysis:

RQ1: What are the main food waste levels, sources, and measurement practices among hospitality businesses in Prishtina?

RQ2: How are digital technologies used to support food waste monitoring and managerial decision-making?

RQ3: How are measurement, digitalization, and managerial practices associated with perceived operational outcomes?

2. Lterature Review

Food waste measurement is fundamental to effective management because it enables businesses to identify waste sources, monitor performance, and evaluate reduction initiatives (Eriksson et al., 2019; Vardopoulos et al., 2025). Since waste occurs across procurement, storage, preparation, service, and consumption, systematic measurement can improve purchasing, inventory control, production planning, menu design, and portion management. Common measurement methods include direct weighing, visual estimation, waste audits, inventory analysis, and questionnaires. Direct weighing provides the most objective results, whereas estimates and self-reported data may underestimate actual waste levels (Eriksson et al., 2019; Vardopoulos et al., 2025). Standardized indicators support benchmarking, while the Total Cost of Food Waste approach also considers indirect costs related to labor, energy, water, storage, and disposal (Filimonau & De Coteau, 2019; Papargyropoulou et al., 2014). Structured measurement programs can reduce waste and generate operational savings, particularly when the information produced supports managerial decisions (Clowes et al., 2019; Hanson et al., 2019). Digital technologies, including artificial intelligence, smart weighing systems, computer vision, IoT devices, cloud analytics, and digital inventory platforms, can strengthen monitoring and identify waste hotspots (Ahmadzadeh et al., 2023; An & Galera-Zarco, 2025). However, digital technologies should be viewed as decision-support tools rather than standalone solutions. Their effectiveness depends on implementation quality, staff participation, reliable data, clear responsibilities, and managerial capacity to translate information into action (Hanson et al., 2019; WRAP, 2022; An & Galera-Zarco, 2025; Clark et al., 2025).

Managerial practices determine whether measurement and digital information lead to operational improvements. Managers use such information to guide purchasing, inventory control, menu planning, production, portion standards, and staff supervision. Training strengthens staff awareness and competence, while standardized procedures support consistent implementation (Filimonau & De Coteau, 2019; Malefors et al., 2019). Programs combining managerial commitment, training, and systematic measurement have been associated with improved food waste prevention and resource efficiency (Hanson et al., 2019). These practices are particularly important for smaller hospitality businesses, where simple registers, standardized routines, staff engagement, and evidence-based decisions may generate benefits without substantial investment. The conceptual framework therefore presents measurement, digitalization, and managerial practices as complementary drivers of reliable operational data and evidence-based decision-making. Together, they may support reduced food waste, improved perceived operational outcomes, greater resource efficiency, and progress toward sustainable hospitality and circular economy objectives

(Geissdoerfer et al., 2017; Kirchherr et al., 2017). The framework, developed from the literature and study variables, guided the questionnaire and empirical analysis (Fig. 1).

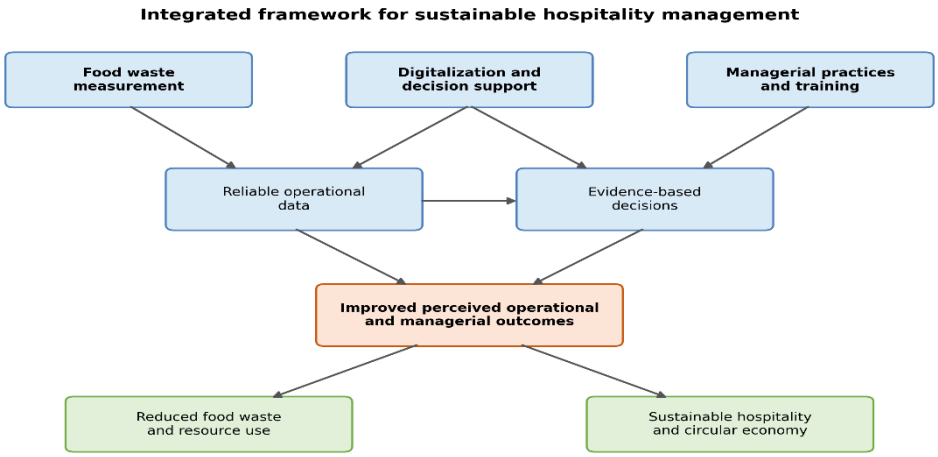


Figure 1. Integrated conceptual framework for food waste management and sustainable hospitality *Note: The framework is theoretical. The arrows represent the proposed managerial process and do not imply that the cross-sectional study establishes causal relationships.*

3. Research methodology

This study employed an exploratory cross-sectional descriptive correlational design to examine food waste measurement, digitalization, managerial practices, and perceived operational outcomes among hospitality businesses in the Municipality of Prishtina, Kosovo. The business constituted the unit of analysis and was represented by one owner or manager with direct knowledge of purchasing, inventory management, food preparation, service operations, and food waste practices. A purposive sample of 30 hospitality businesses included restaurants, cafés, hotels, catering operations, and agritourism establishments. Because some businesses operated in more than one activity, business type was treated as a multiple-response variable.

Data were collected between March and June 2026 through structured face-to-face interviews. Participation was voluntary, respondents were informed about the purpose of the study, and the findings were reported in aggregate form. The 28 item questionnaire covered business characteristics, food waste measurement and monitoring, digitalization, managerial awareness, operational practices, perceived costs and benefits, implementation barriers, required support,

and one open-ended question. Reported food waste levels represented managers' categorical estimates rather than direct physical measurements.

Multiple-response items were converted into separate binary indicators coded as 0 = not selected and 1 = selected. Structured food waste measurement was analyzed as a binary variable, while conditional items were evaluated using the relevant valid-response denominator. Five point scale items were treated as ordinal variables, with higher scores representing higher reported levels.

Categorical variables were summarized using frequencies and percentages, while five-point indicators were described using means, medians, and standard deviations. Spearman's rank-order correlation was used to examine associations among staff training, staff awareness, clear procedures, digitalization, monitoring intensity, reported food waste levels, structured measurement, and perceived operational outcomes. Exploratory Mann–Whitney U tests compared businesses with and without structured food waste measurement. All statistical tests were two tailed, with significance set at $p < 0.05$. Given the purposive sample, cross-sectional design, and perception-based measures, the findings were interpreted as exploratory associations rather than causal effects.

4. Results and discussion

4.1 Profile of the Surveyed Hospitality Businesses

The sample consisted primarily of restaurants and cafés, while hotels, catering businesses, and agritourism establishments were less represented. Small and medium sized enterprises dominated the sample, and most businesses had several years of operating experience. Because business type was treated as a multiple-response variable, some establishments were included in more than one activity category. The complete sample profile is presented in Table 1.

Table 1. Profile of the surveyed hospitality businesses (N = 30)

Characteristic	Category	n	%
Business type*	Restaurant	20	66.7
	Café / coffee shop	10	33.3
	Hotel	4	13.3
	Catering	4	13.3
	Agritourism	1	3.3

Characteristic	Category	n	%
Business size	Small (≤10 employees)	14	46.7
	Medium (11–50 employees)	14	46.7
	Large (>50 employees / chain)	2	6.7
Years of operation	Less than 1 year	3	10.0
	1–3 years	4	13.3
	4–10 years	15	50.0
	More than 10 years	8	26.7

*Note: *Business type was a multiple-response question; therefore, category counts and percentages do not sum to N or 100%. Percentages use N = 30 as the denominator.*

4.2 Food Waste Levels, Measurement, Monitoring, and Main Sources

Managers generally reported relatively low food waste levels, with most businesses placing their estimated food waste below 10% of purchased food. A smaller proportion reported waste levels between 11% and 20%, while none indicated levels exceeding 20%. These findings are based on categorical managerial estimates rather than direct physical measurements of food waste. The distribution of reported food waste levels is presented in Fig. 2.

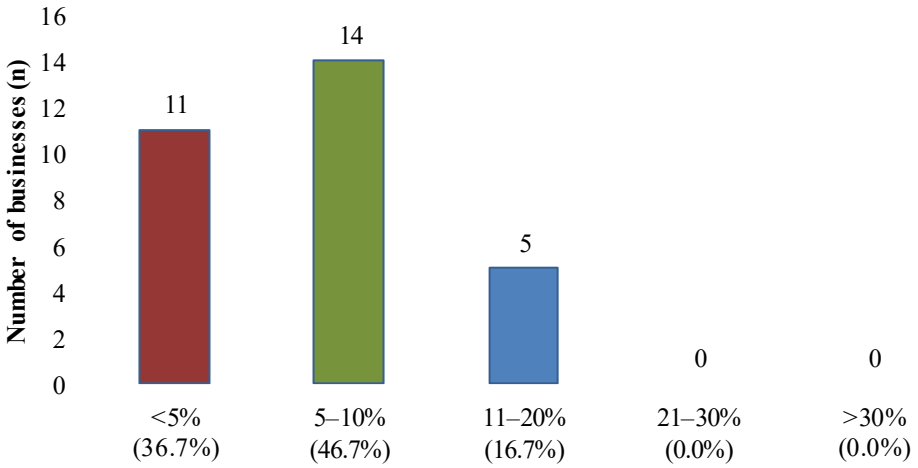


Figure 2. Distribution of reported food waste levels

Note: Values are managers' categorical estimates of the proportion of purchased food discarded; N = 30.

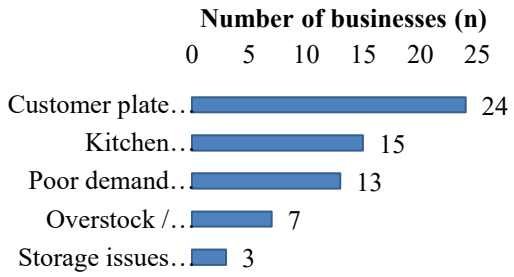
Food waste monitoring practices varied among the surveyed businesses. Monitoring was more commonly conducted occasionally than regularly, while a smaller group reported no monitoring activity. Structured food waste measurement was used by only a limited proportion of businesses, indicating that systematic and organized measurement has not yet become a standard operational practice. The monitoring and measurement results are summarized in Table 2.

Table 2. Food waste measurement and monitoring practices

Variable	Category	N	%
Monitoring	Regular	9	30.0
	Occasional	14	46.7
	No monitoring	7	23.3
Structured measurement	Yes	7	23.3
	No	23	76.7

Note: Reported food waste levels are managers' categorical estimates of the proportion of purchased food discarded and do not represent direct physical measurements. Monitoring was classified as regular, occasional, or absent. Structured measurement indicates whether the business reported using an organized measurement approach. Source: Authors' calculations based on survey data.

The predominance of occasional monitoring and the limited adoption of structured measurement indicate an important operational information gap. Without standardized and repeated measurement, businesses have limited capacity to compare performance over time, identify changes in waste generation, or evaluate the effectiveness of purchasing, production, and portion-control measures (Eriksson et al., 2019; Vardopoulos et al., 2025). Customer plate waste was the most frequently reported source of food waste, followed by food loses during preparation food in the kitchen (Kitchen preparation) and poor demand forecasting. Overstocking, expired inventory, and storage-related problems were reported less frequently. The main food waste sources are presented in Fig.



3.

Figure 3. Main reported sources of food waste

Note: Businesses could report more than one source of food waste. Each percentage was calculated using the total sample of 30 businesses; therefore, the percentages do not sum to 100%.

The prominence of customer plate waste suggests that food waste reduction should not focus exclusively on purchasing and inventory management. Portion sizes, menu design, customer expectations, and service practices should also be considered. At the same time, the importance of preparation losses and demand forecasting indicates a need for better production planning and more reliable operational information. These findings are consistent with hospitality research identifying customer behavior, portion management, and service design as important sources of food waste (Filimonau & De Coteau, 2019).

4.3. Digitalization, Managerial Practices, and Perceived Outcomes

The surveyed businesses reported moderate levels of general digitalization and moderate perceptions of the contribution of digital tools to food waste reduction. These findings indicate that digital technologies are present in hospitality operations but are not yet systematically integrated into food waste management. Managerial awareness was comparatively strong, particularly regarding environmental issues, operating costs, efficiency, and profitability. However, staff training and clearly established procedures were less developed. This difference indicates a gap between managerial recognition of food waste as an important issue and its practical integration into standardized daily operations. The descriptive results are presented in Table 3.

Table 3. Descriptive statistics for digitalization and managerial indicators

Indicator	Valid N	Mean	Median	SD
Digitalization level	30	2.77	3	0.94
Perceived digital impact	27	2.78	3	1.05
Awareness of operating costs	30	3.83	4	0.91
Perceived business efficiency	30	3.90	4	1.03
Perceived profitability	30	4.17	4	0.91
Environmental awareness	30	4.47	5	0.73
Clear procedures	30	2.93	3	1.17
Staff training	30	2.90	3	1.21
Staff awareness	30	3.43	3	1.07
Perceived reduction–profit link	30	3.50	3	0.86

Note: All indicators used five-point scales, with higher values indicating higher reported levels. Valid N shows usable responses; perceived digital impact is based on 27 responses. Efficiency and profitability reflect managerial perceptions, not audited outcomes.

The findings support the view that digital technologies cannot independently ensure effective food waste management. Their contribution depends on the availability of reliable data, staff competence, clearly defined responsibilities, and managerial routines capable of translating information into

operational decisions (Ahmadzadeh et al., 2023; An & Galera-Zarco, 2025; Clark et al., 2025). Menu planning and portion control were the most commonly reported food waste reduction practices. Waste monitoring and staff training were less consistently applied, while donation or reuse remained relatively limited. Formal food waste reduction targets were also uncommon, suggesting that many businesses applied individual practices without incorporating them into a comprehensive management system. The principal barriers were related to technology costs, insufficient staff training, time constraints, and limited knowledge or operational data. Consequently, the businesses identified consulting, affordable digital tools, financial incentives, and training programs as the forms of support most needed. Overall, the findings demonstrate that managerial awareness is stronger than systematic implementation.

4.4 Inferential Results

Spearman correlations partially supported the conceptual framework. Staff training was strongly associated with staff awareness and clear procedures, while clear procedures were related to perceived efficiency, which was strongly associated with perceived profitability. These findings indicate that training may support performance through greater awareness and more standardized procedures (Filimonau & De Coteau, 2019; Malefors et al., 2019). Digitalization was associated with monitoring intensity but not with reported food waste levels or structured food waste measurement. Training was also not directly related to perceived efficiency or profitability, suggesting that operational value depends on reliable measurement, staff competence, and managerial integration (Ahmadzadeh et al., 2023; An & Galera-Zarco, 2025; Clark et al., 2025). The complete results are presented in Table 4.

Table 4. Spearman rank-order correlations among the principal study variables

Relationship	ρ	p-value	Interpretation
Training × staff awareness	0.750	<0.001	Significant
Training × clear procedures	0.764	<0.001	Significant
Procedures × perceived efficiency	0.538	0.002	Significant
Perceived efficiency × perceived profitability	0.767	<0.001	Significant
Digitalization × monitoring intensity	0.436	0.016	Significant
Digitalization × reported waste level	−0.032	0.867	Not significant

Relationship	ρ	p-value	Interpretation
Digitalization × structured measurement	0.124	0.512	Not significant
Training × perceived efficiency	0.305	0.101	Not significant
Training × perceived profitability	0.314	0.091	Not significant

Note: Two-tailed Spearman tests; N = 30 and α = 0.05. Monitoring intensity was coded positively (1 = none, 2 = occasional, 3 = regular).

Exploratory Mann–Whitney U tests showed that businesses using structured food waste measurement reported higher perceived digital impact and perceived efficiency. No statistically significant differences were identified for measurement accuracy, clear procedures, staff training, staff awareness, or perceived profitability. These findings suggest that digital tools may generate greater value when integrated into an organized measurement process, although the exploratory results do not establish causality (Eriksson et al., 2019; Vardopoulos et al., 2025). The complete results are presented in Table 5.

Table 5. Exploratory Mann–Whitney U tests by structured measurement adoption

Variable	n (Yes / No)	Median (Yes / No)	U	p-value	Interpretation
Measurement accuracy	7 / 22	3.0 / 3.0	106.5	0.119	Not significant
Perceived digital impact	7 / 20	4.0 / 2.5	105.5	0.044	Significant
Clear procedures	7 / 23	3.0 / 3.0	105.5	0.213	Not significant
Staff training	7 / 23	3.0 / 3.0	101.5	0.298	Not significant
Staff awareness	7 / 23	4.0 / 3.0	81.0	1.000	Not significant
Perceived efficiency	7 / 23	5.0 / 4.0	120.5	0.042	Significant

Variable	n (Yes / No)	Median (Yes / No)	U	p-value	Interpretation
Perceived profitability	7 / 23	5.0 / 4.0	106.0	0.184	Not significant

Note: Two-tailed asymptotic tests. Group sizes ranged from 7/20 to 7/23 because of valid-response differences. Tests were exploratory, unadjusted for multiple comparisons, and do not establish causality.

Overall, the findings indicate that training, structured procedures, food waste measurement, and digital support function as complementary elements. General digitalization alone was not associated with lower reported waste, whereas managerial capabilities and organized monitoring were more closely related to perceived operational outcomes.

5. Practical and Policy Implications

Hospitality businesses should combine accessible food waste measurement with staff training, standardized procedures, and appropriate digital support. Manual weighing, simple registers, and standardized indicators can provide a practical starting point for SMEs with limited resources (Eriksson et al., 2019; Vardopoulos et al., 2025). Digital tools should complement reliable measurement, particularly in forecasting, inventory management, and decision-making, while staff training and feedback can strengthen consistent implementation (Filimonau & De Coteau, 2019; Malefors et al., 2019; Ahmadzadeh et al., 2023; An & Galera-Zarco, 2025; Clark et al., 2025). Because customer plate waste was the main reported source, businesses should also address portion flexibility, menu design, and customer communication. Institutional support through training, consulting, financial incentives, and affordable technologies could further promote resource efficiency and circular economy objectives (Geissdoerfer et al., 2017; Kirchherr et al., 2017).

6. Conclusion

This paper examined food waste measurement, digitalization, and managerial practices among hospitality businesses in Prishtina. The findings show that monitoring remains largely informal, while structured food waste measurement is still limited. Customer plate waste and food lose during preparation food in the kitchen were identified as the principal sources of waste. Training was strongly associated with staff awareness and clear procedures, while procedures were related to perceived efficiency. Digitalization supported more intensive monitoring but was not directly associated with lower reported waste or structured measurement. Businesses using structured measurement nevertheless

reported greater perceived digital impact and efficiency. The findings support an integrated approach in which measurement generates reliable data, digital tools support analysis, and managerial practices translate information into operational action. The study is limited by its small purposive sample, cross-sectional design, focus on one municipality, and reliance on managerial estimates. Despite these limitations, the study provides a useful baseline for improving sustainable food waste management in Kosovo's hospitality sector.

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INSTITUTIONAL MECHANISMS FOR LOCAL TAX COLLECTION

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Abstract

Eastern European municipalities face a chronic challenge in securing property tax revenues. Policymakers usually blame these shortfalls on poor tax morale or the limited financial capacity of residents. Meanwhile, local fiscal systems in the United States manage to collect nearly all owed taxes. This contrast raises a fundamental question: do high property tax collectability rates depend on local wealth, or are they simply a product of structural design? To answer this, the present study pairs panel-data econometrics with direct insights from practising tax administrators. The evidence reveals a deep divide. In Bulgaria, municipal tax collection drops significantly whenever citizens' income falls. Evidence from Nebraska, however, breaks this assumption. Tax collection proves structurally independent of local economic conditions. Interviews with US officials reveal the mechanism behind this stability: the mandatory public sale of tax lien certificates. By creating a real and immediate threat of property loss, this auction system forces compliance. It cuts the tie between a taxpayer's current liquidity and their tax obligations. The findings show that strict institutional discipline generates local revenues far more effectively than abstract tax morale. These findings offer a directly applicable lesson for Eastern Europe's ongoing decentralization reforms.

Keywords: Property Tax Collection, Institutional Design, Tax Enforcement, Fiscal Decentralization, Local Government Finance

1. Introduction

The capacity of a local government to finance its own operations and services sits at the very heart of democratic governance. Without a reliable stream of locally generated revenue, municipalities cannot respond to the preferences of their residents, cannot plan long term infrastructure investments, and cannot credibly claim political autonomy from the central state. In theory, the property tax has been considered the ideal fiscal instrument for subnational governments because its base (land and buildings) is immobile, visible, and impossible to conceal from the assessor. However, the degree to which different countries

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succeed in translating this theoretical advantage into actual budget revenue varies enormously. The gap between what is legally owed and what is collected constitutes one of the most consequential problems of fiscal decentralization, particularly in the transition economies of Eastern Europe.

Bulgaria offers a striking illustration of this challenge. Despite almost four decades of democratic governance and membership in the European Union since 2007, Bulgarian municipalities have consistently failed to collect a substantial share of the property taxes they are legally entitled to. Over the period 2015 – 2024, the average collection rate for the two main local taxes (property and vehicle tax) has been between 70% and 80%, meaning that roughly one-quarter of all local tax debts remain uncollected in any given fiscal year (Ministry of Finance of the Republic of Bulgaria, 2024).

Conventional explanations for this deficit tend to invoke low tax morale and the limited financial capacity of households. While none of these factors is entirely irrelevant, they share a common analytical weakness: they treat low tax collection because of economic underdevelopment rather than a symptom of specific institutional design choices.

A different picture emerges if we examine the local fiscal systems of the United States, and particularly the state of Nebraska. There, property tax collection rates are about 99.5%, virtually eliminating the problem of uncollected local claims. At first glance, one might attribute this perfect compliance to the greater wealth of American taxpayers. Yet closer inspection reveals that the explanation lies elsewhere. Nebraska's counties, including low populated agricultural jurisdictions where per capita incomes are modest and economic volatility is high, achieve collection rates that are statistically indistinguishable from those of the state's wealthiest urban centres. The secret, as interviews with county treasurers and assessors confirm, resides in one powerful institutional mechanism: the mandatory public sale of tax lien certificates. Under Nebraska law, when a taxpayer fails to pay the property tax by the deadline, the county treasurer places a lien on the delinquent parcel and auctions the resulting certificate to private investors. The purchaser of the certificate pays the outstanding tax on behalf of the delinquent owner and, in return, earns a statutory interest rate on the invested amount. If the original owner does not redeem the certificate within three years, the investor may initiate foreclosure proceedings and ultimately acquire the property. This mechanism generates a credible and immediate threat of property loss that fundamentally separates tax compliance from the taxpayer's current liquidity position. Whether a household is experiencing a temporary income shortfall is irrelevant to the institutional calculus; the tax will be collected because a market-driven enforcement architecture guarantees it.

The theoretical foundations for understanding why property tax performance diverges so sharply across governance models are well established in the literature on fiscal federalism and decentralization. The modern framework originates with Musgrave (1959), who identified three main functions of the public sector – macroeconomic stabilisation, income redistribution, and resource allocation – and argued that while the first two properly belong to central

government owing to the scale and mobility of economic agents, the third function is most efficiently discharged at the local level. Musgrave's insight laid the groundwork for a continuing research programme that sought to formalise the conditions under which decentralised provision of public goods yields welfare gains. Stigler (1957), in his seminal essay on the permissible scope of local government functions, proposed two complementary principles that became foundational to this research programme. First, the *Proximity Principle* posits that representative government works best when it is closest to the people it serves, because local politicians are subject to more direct electoral accountability than distant central administrators. Second, Stigler maintained that the smallest governmental unit capable of efficiently performing a function should be entrusted with that function, thereby minimising bureaucratic distance and information loss. Together, these principles provide a compelling normative case for assigning the property tax to the jurisdiction that is closest to the taxed asset and its owner.

The formal economic proof was supplied by Oates (1972) in his *Decentralization Theorem*, which demonstrates that for any public good whose consumption is geographically bounded and whose production costs are identical for central and local government, decentralised provision is always at least as efficient as centralised provision and is strictly more efficient whenever preferences differ across jurisdictions. The intuition is straightforward: a uniform, nationally imposed level of a local public good will provide more in communities with low demand and less in communities with high demand, generating deadweight welfare losses in both cases. Oates further argued that the effectiveness of the allocative function hinges on whether citizens are aware of the true "tax price" of the services they consume (Oates, 1972). In systems with high fiscal autonomy, every additional increment of public expenditure is automatically reflected in a higher local tax rate, forcing voters to weigh benefits against costs. When local budgets are instead financed predominantly through intergovernmental transfers, as is the case in many Bulgarian municipalities, where over 80% of total revenue derives from central sources, then a "fiscal illusion" takes hold (Oates, 1988).

While Oates approached the question from the supply side of public goods provision, Tiebout (1956) proposed a revolutionary demand side complement in his theory of local expenditures. Tiebout suggested that rational, mobile citizens reveal their preferences for public goods not through voting in elections but by choosing where to live ("voting with their feet" mechanism). Under this model, local governments compete with one another to attract residents by offering differentiated bundles of taxes and services; a jurisdiction with excellent schools and parks funded by higher property taxes will attract families that value those amenities, while a neighboring jurisdiction offering minimal services at lower tax rates will attract those who prefer to keep more of their income. The competitive pressure generated by this sorting process disciplines local governments into providing services at the lowest feasible cost, because any inefficiency will manifest as outmigration of the most mobile and productive taxpayers. This theoretical prediction is highly relevant to the comparative analysis undertaken in

the present study. In the United States, and particularly in Nebraska, the extreme fragmentation of local government, with over 2,300 independent taxing entities operating on the state's territory, including 93 counties, 529 municipalities, 244 autonomous school districts, and more, creates precisely the kind of competitive environment that Tiebout envisioned. Residents of Lincoln, Nebraska, for example, frequently choose to settle in surrounding suburban jurisdictions to benefit from lower property tax rates while continuing to work in the city, compelling each jurisdiction to demonstrate fiscal efficiency if it wishes to retain its tax base. In Bulgaria, by contrast, lower labor mobility, a high rate of home ownership, and the absence of competing local tax jurisdictions weaken the Tiebout mechanism considerably, reducing the competitive pressure on local governments to optimise their tax administration.

The logical extension of Tiebout's competitive framework is the benefit view of property taxation, developed in the work of Hamilton (1975) and Fischel (1975) and synthesised in modern theory by Anderson (2012). According to this perspective, under conditions of perfect consumer mobility and effective land-use regulation, the property tax ceases to function as a distortionary imposition and instead operates as a pure user charge for local public services. The disciplinary force of this mechanism is transmitted through the capitalisation of taxes and services into real estate values. Anderson (2012) formalises this relationship through the perpetual annuity model, in which the market value of a property (V) equals the net rent (R), reduced by the tax (T) and augmented by the value of local public services (S), all divided by the discount rate (r), as formalised in Eq. (1) below.

$$V = \frac{R - T + S}{r} \tag{1}$$

Any tax increase that is not accompanied by a commensurate improvement in services triggers negative capitalisation, depressing property values and eroding household wealth, which is a powerful political constraint on local officials. Conversely, well targeted investment in infrastructure and education generates positive capitalisation, raising market prices and reinforcing the fiscal contract between government and taxpayer. In decentralised systems such as the state of Nebraska, this feedback loop operates with considerable force; citizens tolerate relatively high property tax rates because they perceive a direct correspondence between the taxes paid and the quality of schools, roads, and public safety in their jurisdiction. In Bulgaria, the capitalisation mechanism is severely blunted because assessed values are set by central legislation and do not reflect actual market fluctuations, thereby severing the link between local fiscal effort and property wealth.

The divergent empirical outcomes documented above are not accidental; they are products of fundamentally different legislative and institutional architectures. The Republic of Bulgaria operates as a unitary state in which the Constitution (1991) recognises local self-government but concentrates the most elastic and high yielding revenue instruments exclusively within the central government. Municipalities are left with a constrained and highly inelastic own source revenue base consisting primarily of property taxes and user fees, which on

average cover only approximately 16% of total municipal budget needs (Ministry of Finance of the Republic of Bulgaria, 2024).

The remain funds are coming through a complex system of intergovernmental transfers: general equalisation subsidies, targeted capital subsidies, and delegated activity grants that arrive from the state budget with detailed spending restrictions. This fiscal architecture creates a structural condition that can be characterised as the "Subsidy Trap", which is a self-reinforcing cycle in which the local government ceases to function as an autonomous political entity pursuing locally defined priorities and instead becomes a territorial subdivision of the central budget, channeling its administrative energy not into expanding the local tax base but into political lobbying for larger transfers.

2. Methodology

The study employs a balanced panel dataset covering 2015 – 2024, encompassing all 265 Bulgarian municipalities and all 93 Nebraska counties. Bulgarian are collected from the Ministry of Finance's annual municipal budget reports and the National Statistical Institute. Nebraska data draw on certified tax levy records, assessed valuation files, and tax sale reports from the Department of Revenue and county treasurers. The decade-long horizon captures a full business cycle in both economies.

Two composite indicators are reviewed to the analytical framework.

The first is the *Coefficient of Fiscal Autonomy*, defined as:

$$K_{FA} = \frac{R_{own}}{R_{total}} \quad (2)$$

where *R*own is own revenues and *R*total shows total consolidated municipal revenue. This ratio isolates the share of the local budget that is generated autonomously, excluding intergovernmental transfers and delegated activity grants, and thereby captures the degree to which a municipality commands genuine fiscal sovereignty over its resource base.

Second indicator is the *Property tax collection rate*, measured as percent (%), showing how good could be the administration in both states when it comes to optimizing their revenue processes.

2.1 *Econometric Specification*

The econometric model estimates the macroeconomic and demographic determinants of the property tax collection rate across both panels. The specification takes the form of a two-way fixed effects (TWFE) panel regression:

$$CollectRate_{it} = \beta_0 + \beta_1 \ln(POP_{it}) + \beta_2 \ln(INC_{it}) + \alpha_i + \tau_t + \varepsilon_{it} \quad (4)$$

where $CollectRate_{it}$ is the property tax collection rate (as a percentage) for unit *i* in year *t*; $\ln(POP_{it})$ is the natural logarithm of resident population; $\ln(INC_{it})$

is the natural logarithm of per capita personal income; α_i captures unit specific fixed effects; τ_t captures year fixed effects; and ε_{it} is the idiosyncratic error.

The fixed effects estimator is chosen on the basis of the Hausman specification test, which consistently rejects the random effects alternative across both panels. Entity fixed effects (α_i) absorb time invariant confounders (geography, institutional culture, administrative capacity), while time fixed effects (τ_t) absorb symmetric macroeconomic shocks (legislative changes, inflation, pandemic disruptions). Robust standard errors are clustered at the entity level.

3. Empirical Results and Discussion

3.1 *Descriptive Analysis of Fiscal Autonomy*

The descriptive statistics shows structural contrast between the two fiscal systems. In Bulgaria, the average Coefficient of Fiscal Autonomy (K_{FA}) stood at just 20.69%, confirming that municipalities generate barely one-fifth of their revenue autonomously. Nebraska counties, by contrast, exhibited a mean K_{FA} of 79.04%.

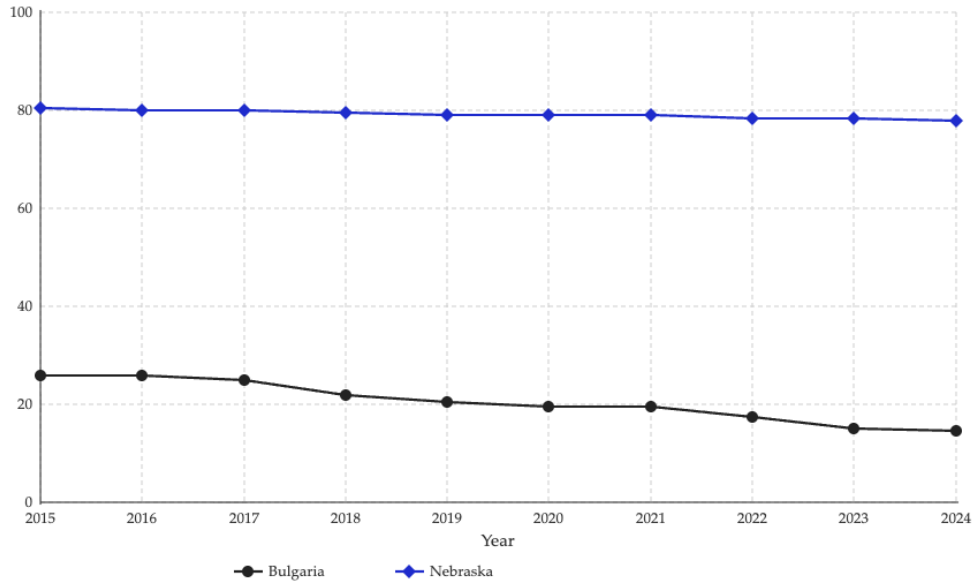


Figure 1. Dynamics of the coefficient of Fiscal autonomy

Source: Author's calculations based on data from MoF (BG) and Department of Revenue (N).

The exceptional horizontal stability of the lines for both considered territories is striking. Over the entire 10-year period, Nebraska's fiscal autonomy ratio remained in the narrow range near 80%, evidence of a predictable and sustainable pattern of decentralization. Despite the global economic turbulence and the COVID-19 pandemic, the US system has managed to maintain its capacity to generate its own resources without increasing its dependence on government transfers.

In contrast, the Bulgarian model shows an equally sustainable but critically low Fiscal autonomy, which gravitates around 20%. This institutional constant is an alarming signal about the lack of real will to reform. Even in periods of economic growth, municipalities in Bulgaria fail to expand their own revenue base relative to the total size of their budgets. This suggests that any increase in local revenue is immediately "caught up" by an increase in state delegated spending, which maintains the status of administrative dependency.

The average property tax collection rate in Bulgaria is between 70% and 80% over the panel period, as shown in Fig. 2. For the state of Nebraska, it is 99.5% on average basis for the 10 year period of this study.

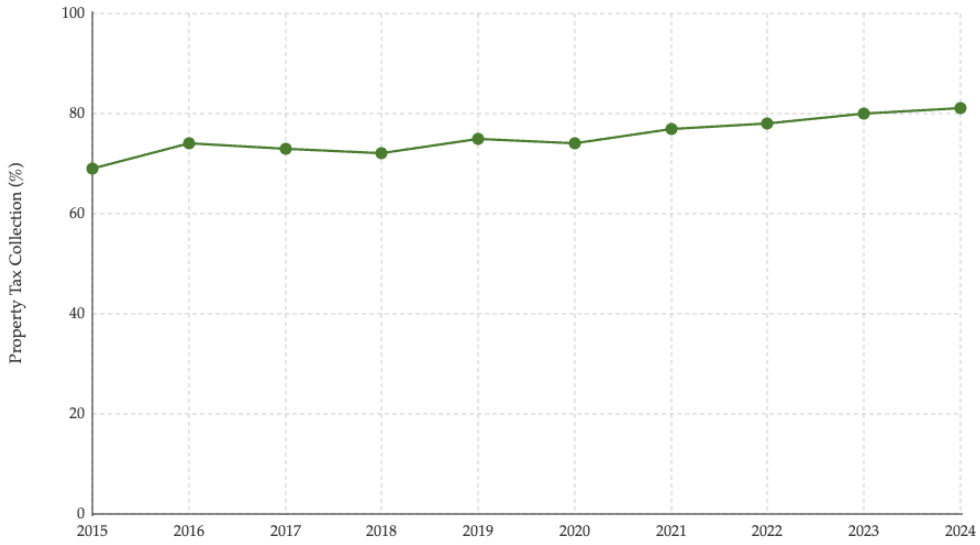


Figure 2. Average property tax collection rate (%) in Bulgaria (2015–2024)

Source: Author's calculations based on panel data.

Fig. 3 disaggregates this rate by demographic cluster, showing that larger municipalities (> 100,000 inhabitants) consistently outperform their smaller counterparts, reaching approximately 85% by 2024, while the smallest communities remain below 78%.

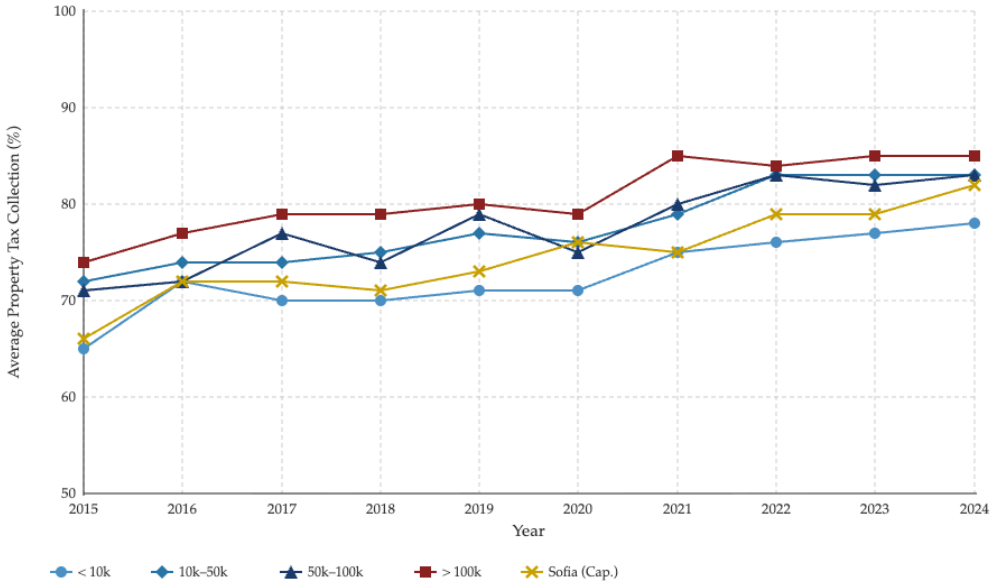


Figure 3. Average property tax collection rate by cluster in Bulgaria (2015–2024)

Source: Author's calculations based on panel data

3.2 *Econometric Results*

Table 1 reports the two-way fixed effects estimation. An initial reading of the baseline model shows a rather different picture for the two countries. In Nebraska, smaller counties seem to do better with collections, while in Bulgaria the size of the municipality seems to have no statistical significance, and everything depends only on income

Table 1. Determinants of tax collection rate (TWFE panel estimation)

	Bulgaria	Nebraska
ln_population	0.017	-0.015***
	(0.024)	(0.004)
ln_income	0.097***	0.007***
	(0.005)	(0.001)
_cons	-0.082	1.052***
	(0.249)	(0.036)
N	2640	930
R^2	0.275	0.075

Standard errors in parentheses
* p < 0.05, ** p < 0.01, *** p < 0.001

However, these baseline results can be misleading. During the studied 10-year period, serious shocks are observed - the big inflation after 2020, as well as the mass flow of electronic payments, which automatically raise collections everywhere. In order to not allow these national trends to distort the conclusions, second step is taken as a robustness check. It is added as new control the time effects (for each individual year) and it is also applied robust standard errors to ensure that data within municipalities do not overlap.

When country wide inflation and technology trends are isolated through the robust model, the real drivers of the system come to light (see Table 2).

For Bulgaria, the result is reversed. It turns out that larger municipalities actually collect their taxes much more efficiently. Based on the data presented in the table, a specific practical conclusion can be drawn: a 10% larger municipal population (ceteris paribus) corresponds to a nearly 0.9% higher collection rate. This phenomenon can be attributed to variations in administrative capacity. Large urban centers are typically equipped with legal counsel, modern software systems, and the capacity to engage private bailiffs. Conversely, smaller municipalities generally lack the personnel and financial resources required to actively pursue delinquent taxpayers.

Table 2. Robustness Check with Time Fixed Effects

	Bulgaria	Nebraska
ln_population	0.089*	-0.013
	(0.037)	(0.009)
ln_income	0.046**	-0.002
	(0.016)	(0.003)
_cons	-0.440	1.123***
	(0.386)	(0.085)
N	2640	930
R2	0.316	0.115

Standard errors in parentheses
Time Fixed Effects included for both models.
Cluster-robust standard errors in parentheses.
* p < 0.05, ** p < 0.01, *** p < 0.001

At the same time, income is the strongest driver of collections. At 10% growth in local incomes, collections jump by about half a percentage point

(0.46%). The economic logic here is extremely simple – when people have higher purchasing power, they cover their local obligations much more easily and regularly.

For Nebraska, the robust model shows a radically different result. After applying the same strict econometric filters, it is visible that neither population nor income is statistically significant for the collection. However, this is not a weakness of the model, but evidence of the strength of the American system. In Nebraska, a classic "ceiling effect" is observed, with collection rates staying at around 99% every year. The property tax system is strictly enforced – failure to pay leads to the loss of property, making tax compliance a strong, built-in habit. In this system, collection success does not depend on administrative software or changes in wages; taxes are simply paid, regardless of outside factors.

4. Conclusion and Recommendations

This study demonstrates that the persistently low property tax collection rates in Eastern European municipalities are a product of institutional design. Nebraska's 99.5% collection rate is the direct result of an institutional architecture in which every taxpayer receives an itemised bill, every dollar flows into a dedicated fund, and every instance of noncompliance triggers the tax lien certificate sale – a credible enforcement mechanism that severs the link between household liquidity and tax compliance.

The results of the two-way fixed effects (TWFE) model highlight a divergence in the determinants of property tax collection. In Bulgaria, the lack of strict enforcement tools leaves local revenues entirely exposed to income volatility, structurally limiting true fiscal autonomy. In Nebraska, while the enforcement architecture guarantees revenue collection, high fiscal autonomy is nonetheless constrained by state-imposed revenue caps. The common denominator is that external institutional constraints, whether imposed through centralised redistribution or legislative revenue ceilings, dominate the domestic economic logic of local government.

Some of the policy recommendations that could be withdrawn are related to the possible introduction of dedicated trust funds linking specific local taxes to specific public services, this way the taxpayers will know exactly for what service their funds are going. Another good practice is the establishment of an independent property valuation authority to conduct periodic market based reassessments and equalise standards across municipalities. This will guarantee adequate valuation of the properties and corresponding taxes with the economic reality.

The path forward lies not in choosing between centralisation and decentralisation, but in constructing an institutional architecture in which local governments possess real fiscal instruments, bear direct political responsibility for their use, and are held accountable by the taxpayers who fund them.

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THE IMPACT OF DIGITAL TRANSFORMATION ON BUSINESS PERFORMANCE: A CASE STUDY OF SMEs IN THE VARDAR REGION

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Abstract

Human-Computer Interaction, just like the rapid expansion of communication and information technologies, has a major effect on daily lives. Small businesses, as a core component of the economy, are in an increasing need to incorporate e-business activities if they are to gain competitiveness and streamline their operations. Given this situation, the primary goal of this study is to analyze the extent of e-business activities in small businesses and to investigate the effect of digital transformation on their performance in the business field.

In the framework of this research, 50 small enterprises from the Vardar region have been selected for in-depth assessments of digital transformation, e-business strategies with the utilization of digital tools and platforms, and the outcomes of digitalization on their performance.

The expected results of the research should indicate whether small businesses that actively implement e-business strategies achieve higher business performance. Moreover, the research work is projected to find out how much digital transformation is responsible for the companys growth, productivity, and overall efficiency of the organization. Considering the results, constructive suggestions will be made to assist managers in efficiently planning and enacting digital transformation strategies that augment competitiveness and promote business performance significantly.

Keywords: Digital transformation, digitalization, e-business, small businesses, business performance.

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1. Introduction

The development of the Internet and the rise of digital platforms and online commerce have introduced a broad range of technological solutions and applications that can effectively support business operations, improve productivity, and increase efficiency across various sectors. Globally, the use of the Internet for conducting commercial activities has experienced remarkable growth and has become increasingly widespread in recent years. This trend has been driven by technological advancements, increased Internet accessibility, and evolving consumer preferences, which have increasingly shifted toward online shopping and digital services.

Digital transformation has proven to be a real game-changer for companies and reshaped a wide variety of organizational processes in a countless number of industries. It enables companies to operate more efficiently, react more quickly to market changes and customer demands, and produce more user-centric innovation. The greater availability of data allows for improved decision-making competency.

More than 90% of businesses are Small and medium-sized enterprises (SMEs), which shows how important they are to the overall economies. SMEs have also been considered crucial in terms of employment, with their easier adaptability and responsiveness to the competitive changes in the market SMEs have been taking a significant place in many country's and global economies (Gökalp et al., 2006). Given their economic importance, competing and ensuring their long-term survival has become vital for small and medium- sized enterprises to embrace technological developments and transform digitally.

Certain small enterprises may be conscious of what e-business can do for them, yet they're reluctant to leverage it, either due to insufficient comprehension or because the associated implementation costs are too high. Furthermore, distrust in the security surrounding company and client information is a commonly reported cause of non-adoption of e-business procedures. Moreover, many businesses continue to face various challenges in implementing e-business activities, including financial constraints, limited technological expertise, and organizational barriers (Huang, Zhao, & Li, 2007).

These challenges call for the necessity to measure the level of digitalization of small businesses; i.e. how much is the Internet and modern digital technology employed in the business practice of small businesses. Moreover, this issue also gives the opportunity to examine the impact of digitalization on business performance, with productivity and profitability as a short-term outcome of the digitalization of the business as well as business survival as a long-term outcome of the digitalization. Consequently, the objectives of our research are to identify how small businesses use e-business in the Vardar region and to estimate the impact of the digitalization of the whole business on business performance. As part of the empirical research, 50 small businesses from the Vardar region will be surveyed to obtain insights into their adoption and use of digital tools and

platforms, as well as the relationship between digital transformation and business performance.

1.1 The Importance of E-Business and Digitalization in the Development of Small Businesses

E-business is the direct connection of organizations with customers and suppliers through the Internet and other digital technologies. This facilitates faster, more effective, and efficient interactions and transactions. With the rapid digitalization happening in the world, the significance of e-business is very high. This is expected to increase in the future, motivating more organizations to become e-ready and even transform themselves to be globally competitive.

Almost exclusively referring to the trading of goods and services over the Internet (or other computer networks), e-commerce is an essential component of any company's online presence. Simultaneously, e-business has a more versatile nature and is related to the processes inside of a company, including the electronic exchange of information between employees or utilizing electronic support tools in day-to-day company operations. According to Chaffey (2015), e-business includes all electronically enabled business processes within an organization, whereas e-commerce primarily refers to electronic transactions between a business and its customers.

E-business is closely related to digitalization since digitalization means the use of digital technologies in business processes while e-business is the application of that set of technologies into the organization's operations. Through digitalization, normal business functions are transferred into digital processes allowing communication, sales, payments, marketing, and data management to be carried out over the internet or software systems. Besides, digital transformation helps in enhancing the performance, competitiveness, and long-term sustainability of small and medium enterprises (Melo et al., 2023).

According to Jovanovic (2021), digitalization and digital transformation are key drivers of efficiency, competitiveness, and innovation in modern businesses. They include additional activities that lead not only to the optimization of business processes but also to the development of new business models, products, and services that create value for the business and its customers. Digitalization also enables businesses to easily adapt to changes in the business environment, reassess their position in the market, understand the competition, and proactively identify potential opportunities and risks. Additionally, can help businesses to develop new products and services, enter new markets, increase production, and create new jobs. This process should be tailored to the specific characteristics of the business and its plans for growth and development. Business owners/managers should be well informed about the benefits and potential risks of digitalization and should carefully plan and implement relevant digital solutions.

According to Dave Chaffey, e-business is a key factor in enhancing the efficiency and competitiveness of organizations operating in the digital economy. The development of information and communication technologies, the internet, and e-business applications facilitate best practice exchange and knowledge

transfer, bringing new product development opportunities to small and medium-sized businesses. The extent to which these benefits are realized depends on various factors such as awareness, technological infrastructure, skills, and education, as these businesses face many challenges related to e-business usage.

It is important to realize that technology is not an end in itself but a means to an end. It is the strategic use of appropriate technologies as a response to changes in markets, in business models, in customer demand, and as a response to competing firms that will lead to better performance. This means that any firm, small or large, that doesn't effectively adopt technology is likely to underperform in the long run.

According to the latest data from the European Union, small and medium-sized enterprises (SMEs) continue to represent the backbone of the European economy. In 2024, SMEs accounted for 99.8 % of the total number of enterprises in the EU non-financial business economy, meaning that they are a dominant part of the overall business structure of the Union. SMEs provide employment for almost 89.8 million people and play an essential role in terms of gross value added and the development of the European economy. Their advantages in quickly reacting to market changes and new technologies help them play an important role in sustainable development and the creation of new jobs.

Following the independence of the Republic of North Macedonia, considerable attention has been devoted to the development of the small and medium-sized enterprise (SME) sector, which has increasingly become a key driver of economic growth and development processes in the country. SMEs contribute significantly through their role in job creation and the generation of added value (Risteska, Gveroski, Sotirovski, & Spaseska, 2022). They represent an essential component of the Macedonian economy; however, creating a supportive business environment remains necessary to encourage their growth, innovation, and competitiveness (Risteska, Gveroski, & Spaseska, 2022).

The authors of previously published research papers identified numerous problems and limitations faced by SMEs attempting to develop effective e-business strategies and solutions, such as external barriers, internal barriers and benefits, as well as specific factors governing e-business adoption. These constraints pertain to deficiencies in: (i) former e-business performance evaluation; (ii) the identification and assessment of e-business priorities in small companies; (iii) recognizing the role of a specific e-business concept in building competitive advantage; (iv) the analysis and selection of key e-business goals and indicators; (v) competitiveness evaluation within the implementation of e-business systems; (vi) determining the possibility of using the benchmarking method to improve the efficacy of e-business implementations. Successful digital transformation in SMEs depends on a well-defined strategy, continuous education, and the gradual implementation of digital technologies (Sagala & Őri, 2024).

Studies have shown that the Internet plays a pivotal role in enhancing the performance and competitiveness of small enterprises. It does this by ensuring better communication with suppliers and customers, aiding in the management and operation of the business internally, and providing access to new markets

(Deloitte Access Economics, 2011). The results were reinforced by additional research that confirmed how Internet technology adoption leads to better business performance and higher competitiveness (Clarke et al., 2015).

2. Subject, objectives, and methodology of the research

2.1 Subject and objectives of the research

SMEs in the Republic of North Macedonia play a crucial role in the economy, with nearly two-thirds of total value added and almost three-quarters of total employment generated by this sector. As such, e-business adoption by SMEs becomes vital in enhancing competitiveness, improving operational performance, and responding to the requirements of the dynamic digital era.

This study aims to examine the extent to which small businesses in the Vardar region engage in e-business activities, as well as the effect of e-business activities on business performance. The specific objectives are to identify which e-business activities small businesses are most likely to adopt, and to assess the potential performance outcomes of these e-business activities. Within the framework of the research, a total of 50 small businesses will be analyzed to obtain preliminary findings regarding their adoption and use of digital tools and platforms.

The expected results of the research aim to determine whether small businesses that actively implement e-business strategies achieve higher levels of business performance, reflected through increased operational efficiency, improved customer interaction, and enhanced market competitiveness. Furthermore, the research is expected to determine the extent to which the level of digital transformation influences the growth and overall performance of small businesses.

The general objective of this research is to examine the level and role of digital transformation through e-business activities among small businesses in the Vardar region. In addition, the research will address the following specific objectives:

- ✓ To determine the level of adoption and use of e-business tools;
- ✓ To analyze the benefits of digitalization for small businesses;
- ✓ To identify the main challenges faced by businesses during the digital transformation process.

This will enable a theoretical discussion of the combined effects of e-business activity implementation on business performance to be formed, around which the empirical portions of the study will be concentrated.

In accordance with the defined research objectives, the hypothetical framework of the study will be based on examining the relationship between the implementation of e-business activities and their impact on business performance.

2.2 Hypothetical Framework

To achieve the main objective of the research, a hypothetical framework has been developed, consisting of a general hypothesis and corresponding sub-hypotheses. Based on the defined research objectives, the following hypotheses are formulated:

- H0 (Null Hypothesis): Digitalization activities have no significant impact on improving the business performance of small businesses.
- H1 (Alternative Hypothesis): Digitalization activities have a positive and significant impact on the business performance of small businesses.
- H2: Digitalization-related challenges have a negative impact on the business performance of small businesses.
- H3: Future digitalization plans have a positive impact on the business performance of small businesses.

A brief overview of the dependent and independent variables included in the research is presented below:

- Dependent variable: Business performance of small businesses – measured through indicators such as sales growth, acquisition of new customers, operational efficiency, customer communication, and other relevant performance-related factors.
- Independent variables: E-business activities, digitalization challenges, future digitalization plans.

2.2.1 Methodological Framework of the Study

This research employed the survey method as a suitable means to investigate the research issues and test the proposed research hypotheses. A survey questionnaire was designed based on past literature reviews of research studies that adopted a survey method and had similar research objectives. The questionnaire items were derived and developed in the context of the characteristics, nature, functions, activities, and context of small firms, and digitalization.

The methodological framework of the research is based on statistical analysis, with statistical methods applied to test and evaluate the formulated hypotheses. The research begins with an analysis of descriptive statistics, followed by an examination of the correlation coefficients among the research variables. Subsequently, the proposed theoretical model is evaluated. In this phase, factor analysis is applied to identify underlying factors and reduce the number of observed variables. After establishing the factor structure, the reliability of the measurement instruments is assessed using Cronbach's Alpha analysis. Finally, the research hypotheses are tested through various statistical

methods, including Analysis of Variance (ANOVA), correlation analysis, and multiple linear regression analysis.

We surveyed 50 small businesses in the Vardar region. The businesses were identified through an online business directory and subsequently contacted by telephone. Businesses that agreed voluntarily to participate were included in the study. Therefore, a convenience sampling method, as a form of non-probability sampling, was employed because the selection of participating businesses was based on their accessibility and willingness to participate. The questionnaire was administered to the participating businesses after their agreement to take part in the research was obtained.

The sample consisted of small businesses operating in different sectors. Since the primary objective of the study was to examine the digitalization of business activities rather than sector-specific differences, sector differences were not considered as a separate analytical dimension. The collected data were processed using the SPSS statistical software.

2.3 Results

2.3.1 Descriptive Data Analysis

Descriptive analysis is an essential part of all quantitative data processing, for instance in evaluations, research, or in daily business. Descriptive stats help the researchers describe the basic features of the data in a study and provide simple summaries about the characteristics of the sample and the data.

Table 1. Descriptive statistics of e-business activities

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
Digital tools	50	1	5	4.12	.940	0.833
Face.insta.etc	50	1	5	4.48	1.015	1.030
Website	50	1	5	2.38	1.905	3.628
Sales online	50	1	5	3.66	1.533	2.351
Digital market	50	1	5	3.72	1.278	1.634
Comun.channels	50	1	5	3.76	1.255	1.574
social media	50	1	5	4.40	1.161	1.347
New contents	50	1	5	4.34	1.154	1.331
Online adver.	50	1	5	4.12	1.256	1.577
Online questions	50	1	5	4.08	1.209	1.463
Valid N (listwise)						

Table 1. presents the results of the descriptive analysis regarding the extent to which digital tools and digital marketing practices are used among the surveyed small businesses. The analysis was conducted on a sample of 50 respondents (N = 50).

The highest mean score was recorded for the statement “The company uses Facebook, Instagram, an online store, and similar digital platforms” (M = 4.48; SD = 1.015), followed by “The company uses social networks for

promotion" (M = 4.40; SD = 1.161) and "The company regularly publishes new content" (M = 4.34; SD = 1.154). High mean values were also observed for the statements related to the use of digital tools (M = 4.12), paid online advertising (M = 4.12), and responding to online inquiries (M = 4.08).

The lowest mean score was recorded for the statement "The company has a website" (M = 2.38; SD = 1.905), indicating that a considerable proportion of surveyed businesses either do not have their own website or do not actively utilize it as part of their digital presence.

Overall, these descriptive findings provide clear picture that of the digital and social media tools enterprise, Facebook and Instagram in particular, are prevalent among small business users. The small number of firms that have a company website, though suggests that for many small businesses social networking sites are likely the extent of their digital media uses, also highliting and points to the building of new website as an area where they can improve their digital presences and capabilities.

Table 2. Descriptive statistics of the impact on performance

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
Increase sales	50	3	5	4.20	.700	.490
New customers	50	3	5	4.20	.670	.449
Operat.efficiency	50	3	5	4.04	.781	.611
Custom.feedback	50	3	5	4.06	.767	.588
Reduce o.costs	50	2	5	3.60	.808	.653
Time improvment	50	2	5	3.74	.777	.604
Data manage.	50	3	5	3.70	.763	.582
Service quality	50	2	5	3.80	.833	.694
I.comunication	50	3	5	4.02	.654	.428
Overall impact	50	3	5	4.14	.670	.449
Valid N (listwise)						

Table 2. presents the results of the descriptive analysis and indicates that respondents generally have a positive perception of the impact of digitalization on company operations. The highest mean scores were recorded for the statements that digitalization has contributed to increased sales (M = 4.20) and has helped attract new customers (M = 4.20). High mean values were also observed for the overall impact of digitalization (M = 4.14), positive customer feedback (M = 4.06), improved operational efficiency (M = 4.04), and enhanced communication (M = 4.02). The lowest mean score was recorded for the reduction of operating costs (M = 3.60), indicating that this effect is perceived as less pronounced compared to other benefits.

In general, the results indicate that digitalization has a positive impact on business operations. Most respondents pointed to increased sales levels as an area in which digital tools have had the biggest impact. This was followed by new customer acquisitions which were also widely reported as improving due to digitalization. Then, in order of the level of reported impact, with slightly lower

scores, were improvements in communication and operability as well as reduced operating costs.

Table 3. Descriptive statistics of challenges

Variable	N	Minimum	Maximum	Mean	Std. Deviation	Variance
Security	50	2	5	3.96	.856	.733
High costs	50	2	5	3.18	.983	.967
Resistance	50	2	5	2.82	.962	.926
Lack of tra.	50	2	5	2.86	.926	.858
Market comp.	50	2	5	4.34	.798	.637
Valid N (listwise)						

The results are presented in Table 3. indicate that the greatest challenge associated with digitalization is competition in the online environment (M = 4.34), followed by concerns related to the security of online transactions (M = 3.96). In contrast, factors such as high implementation costs, resistance to change, and lack of training received lower mean scores, suggesting that respondents perceive them as less significant obstacles.

Overall, the findings indicate that businesses primarily identify external factors, particularly online competition and transaction security, as the main challenges in the digitalization process. This suggests that respondents perceive market-related pressures and technological risks as more prominent barriers than internal organizational challenges.

Table 4. Descriptive statistics of the future business plans

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
Next 2 years plans	50	2	5	4.30	.763	.582
Budget	50	2	5	4.18	.873	.763
Emp. Train.	50	2	5	3.54	1.164	1.356
Website	50	2	5	3.74	1.242	1.543
Infrastruc.	50	2	5	3.70	1.199	1.439
ValidN (listwise)						

Table 4. presents the results of the descriptive analysis for the five statements related to investment and the development of small businesses. The mean values range from 3.54 to 4.30, indicating that respondents generally agree with the statements presented. The highest mean score was recorded for the statement *"Investing in the next two years"(M = 4.30; SD = 0.763), reflecting a high level of agreement among respondents. This was followed by the statement "Allocating a budget" (M = 4.18; SD = 0.873). In contrast, the statement "Training employees" (M = 3.54; SD = 1.164) received the lowest mean score, suggesting a more moderate level of agreement. The standard deviations range from 0.763 to 1.242, indicating moderate variability in respondents' answers.

In general, the descriptive analysis revealed that the respondents have the highest level of agreement with investing in the next two years and having a budget allocated over them. The other statements received relatively high mean scores as well but indicated slightly less agreement. However, overall positive attitudes were noted in terms of small business investment and development on these accounts.

2.3.2 Results of the Correlation and Regression Analyses and Discussion

Within the framework of this research, the concept of digitalization is examined, and a quantitative study was conducted to enhance understanding of the role of digital transformation through e-business activities in small businesses. The main objectives of the research were to provide a clearer understanding of the relationships between business performance and the digitalization of business activities, the challenges associated with digitalization, and the prospects for future digitalization, including plans for further digital transformation. These objectives contributed to a deeper understanding of the impact of digitalization on the performance of small businesses.

The proposed research model and its findings are significant because the relationships identified among the analyzed variables provide valuable insights into the current state of digitalization in small businesses. These findings also offer practical guidance for understanding and supporting the digital transformation process within this sector.

To achieve the research objectives, four measurement instruments were employed. Initially, their validity and reliability were assessed. The results of the Cronbach's alpha analysis confirmed that all measurement instruments demonstrated satisfactory internal consistency and reliability, indicating their suitability for further statistical analyses.

Subsequently, the distribution of the data was examined. The results showed that the skewness and kurtosis values for all examined variables fell within the acceptable range of –1.5 to +1.5. According to the criteria proposed by Tabachnick and Fidell (2013), these values indicate that the data satisfy the assumption of normality. Based on these findings, it was concluded that the application of parametric statistical methods in the subsequent analyses was appropriate.

Upon establishing the psychometric properties of our measurement instruments, the research hypotheses were assessed by first conducting a Pearson correlation analysis to determine the direction and strength of the relationships between the study's variables. Next, multiple linear regression analysis was used to assess the effects of the independent variables on the dependent variable and to evaluate the research hypotheses. We begin by presenting the correlation analysis to summarize the research results, followed by the regression analysis.

The Pearson correlation analysis results show significant positive correlations between all study variables at the 0.01 level. The highest positive correlation is between perceived digitalization impact and digitalization activities

($r = 0.832$, $p < 0.001$), and the second highest is between digitalization perspective and perceived digitalization impact ($r = 0.822$, $p < 0.001$).

What is more, the digitalization perspective showed a strong positive correlation with the digitalization activities ($r = 0.701$, $p < 0.001$) and digitalization challenges ($r = 0.670$, $p < 0.001$). Furthermore, a positive correlation was of moderate size between digitalization challenges and the perceived impact of digitalization ($r = 0.584$, $p < 0.001$) as well as digitalization challenges and digitalization activities ($r = 0.460$, $p = 0.001$). Overall, these findings suggest that improvements in one aspect of digitalization are generally associated with improvements in the others.

The results of the multiple linear regression analysis indicate that the proposed model is statistically significant and demonstrates high explanatory power. The coefficient of determination ($R^2 = 0.806$) shows that the independent variables—digitalization perspective, digitalization challenges, and digitalization activities—collectively explain 80.6% of the variance in the dependent variable. Furthermore, the adjusted coefficient of determination (Adjusted $R^2 = 0.794$) indicates that the model retains a high level of explanatory power after accounting for the number of predictors included in the analysis.

The ANOVA results further confirm that the regression model is statistically significant, $F(3, 46) = 63.857$, $p < 0.001$, indicating that the independent variables, taken together, significantly predict the dependent variable.

The analysis of the standardized regression coefficients reveals that digitalization activities have the strongest positive and statistically significant effect on the dependent variable ($\beta = 0.505$, $p < 0.001$), followed by the digitalization perspective ($\beta = 0.420$, $p < 0.001$). In contrast, digitalization challenges do not have a statistically significant effect ($\beta = 0.070$, $p = 0.427$). Moreover, the Tolerance values (0.355–0.551) and Variance Inflation Factor (VIF) values (1.816–2.818) indicate that multicollinearity is not a concern, thereby supporting the validity and stability of the regression model.

Based on these findings, it can be concluded that the successful implementation of digitalization in small businesses depends primarily on the active adoption of digitalization activities and a positive perspective toward digital transformation. Although digitalization challenges are positively correlated with the other variables, they do not independently exert a statistically significant influence on the dependent variable when considered alongside the other predictors in the regression model.

2.3.3 Findings Related to the Research Hypotheses

The results of the multiple linear regression analysis provide sufficient statistical evidence to support the main research hypothesis (H1) and reject the corresponding null hypothesis. Based on the findings, the following conclusions can be drawn:

- Null Hypothesis (H0): Digitalization activities have no impact on improving the business performance of small businesses. ***Rejected.***

- Hypothesis (H1): Digitalization activities have a positive impact on the business performance of small businesses. ***Accepted.*** The regression analysis revealed that digitalization activities have a positive and statistically significant effect on business performance ($\beta = 0.505$, $p < 0.001$).
- Hypothesis (H2): Challenges related to digitalization have a negative impact on the business performance of small businesses.***Rejected.*** Although digitalization challenges were included in the regression model, their effect was not statistically significant ($\beta = 0.070$, $p = 0.427$).
- Hypothesis (H3): Future digitalization plans have a positive impact on the business performance of small businesses. ***Accepted.*** The results indicate that a positive perspective toward future digitalization has a statistically significant positive effect on business performance ($\beta = 0.420$, $p < 0.001$).

In simple words, if you are a small business, embracing digital trends and having a positive attitude towards future digital transformations can significantly boost your performance. However, overcoming the related challenges is not directly linked to improved performance, although it certainly helps you become more digital as a business.

2.3.4 Practical Implications

The findings provide several practical implications for small business managers and other stakeholders supporting digital transformation. First, the significant effect of digitalization activities indicates that small businesses should prioritize the actual implementation and consistent use of digital tools rather than treating digitalization only as a strategic intention. Activities such as social media marketing, online communication, digital advertising, online sales, and the development of digital content can support customer engagement and business performance.

Second, the results suggest that investment decisions should be aligned with the specific digital needs and capabilities of individual businesses. The relatively low level of website adoption observed in the sample indicates an area in which some small businesses could strengthen their digital presence. Developing an effective website and integrating it with social media and other digital channels may provide opportunities to improve communication with customers and support online business activities.

Third, the findings have implications for institutions and organizations that support small businesses. Training programs, digitalization support initiatives, and advisory services could focus not only on explaining the challenges associated with digital transformation but also on helping businesses translate digital strategies into concrete activities. Such support may be particularly valuable for small businesses with limited internal digital expertise and financial resources.

2.3.5 Study Limitations and Future Research

Several limitations should be considered when interpreting the findings of this study. First, the sample size was relatively small, with data collected from 50 small businesses, which may have limited the statistical power of the analyses. Second, the use of convenience sampling may have reduced the representativeness of the sample. Third, the study was limited to small businesses in the Vardar region, which may restrict the generalizability of the findings to other regions of North Macedonia and different national contexts. Finally, although businesses from different sectors were included, sector-specific differences were not examined.

Future research should consider larger and more diverse samples and, where possible, probability-based sampling methods. Larger samples could also provide stronger validation of the factor structure and regression results. In addition, longitudinal research could offer further insights into how digitalization and business performance develop over time.

3. Conclusion

To successfully adapt to the modern business environment, small and medium-sized enterprises (SMEs) must adopt a clearly defined and strategic approach to digital transformation. This requires the development of a well-structured roadmap that outlines the steps for the gradual and effective integration of e-business activities into everyday business operations. This approach supports more effective resource planning, minimizes implementation risks, and helps companies leverage technology opportunities to their fullest advantage. Just as critical is the need to ensure a proper fit between the e-business strategy and the company's overall business strategy and existing business model.

This study examined the relationship between digitalization and the performance of small businesses based on survey data from 50 businesses. The findings indicate that digitalization is positively associated with business performance, with digitalization activities emerging as the strongest significant predictor, followed by digitalization perspective. In contrast, digitalization challenges, although positively correlated with other digitalization-related variables, did not have a statistically significant independent effect on performance.

These findings highlight the importance of actively adopting digital tools and practices rather than simply experiencing digitalization-related challenges. The results also suggest that a strategic and structured approach to digital transformation can help small businesses improve their performance and strengthen their competitiveness. Therefore, businesses should focus on developing digital capabilities, investing in appropriate technologies, and aligning digital initiatives with their overall business strategy.

However, the findings should be interpreted in light of the study's limitations, particularly the small sample size, convenience sampling, and

geographical focus on the Vardar region. Consequently, the results should be considered preliminary empirical evidence rather than broadly generalizable conclusions. Future research using larger and more diverse samples could further validate these relationships and examine differences across sectors and geographical contexts.

Overall, the study confirms that digital transformation can be an important driver of business performance and competitiveness. Continued investment in digital technologies, employee skills, and strategic digital planning can help small businesses adapt more effectively to an increasingly digital business environment.

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PRAGMATISAM VERSUS IDEALISM IN MARITIME BOUNDARY DELIMITATION: EXPLORING CORRELATIONS, CONTRADICTIONS AND COMPETING APPROACHES IN THE EASERN MEDITERRANEAN

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Abstract

This paper examines the correlations, contradictions, and tensions between pragmatic and idealist approaches to the delimitation of maritime zones in the Eastern Mediterranean, with particular emphasis on the Greek–Turkish dispute. The sea is approached not only as a geographical space, but also as a source of wealth, energy, security, communication, and geopolitical influence. In this context, maritime delimitation becomes a critical issue of national strategy, especially where overlapping claims, natural resources, energy routes, and security considerations intersect.The analysis begins with the evolution of the Law of the Sea, from early concepts of mare liberum and mare clausum to the modern legal framework established by UNCLOS. Particular attention is given to the legal status of islands, continental shelf, territorial waters, contiguous zones, and Exclusive Economic Zones, as these concepts lie at the heart of the Eastern Mediterranean disputes. The paper argues that the Greek–Turkish disagreement is not merely a technical legal dispute over maritime boundaries, but reflects deeper opposing perceptions of international order. Greece largely adopts an idealist and legalist approach, emphasizing international law, treaties, existing borders, and adjudication through international judicial bodies. Turkey, by contrast, follows a more pragmatic and revisionist strategy, combining legal selectivity, geopolitical ambition, military capability, energy policy, and doctrines such as Mavi Vatan. The paper concludes that any sustainable solution requires balancing legal principles with geopolitical realities. While recourse to international adjudication appears to be the most peaceful and legitimate path, the core challenge remains the definition of the issues to be submitted and the willingness of both states to accept a rules-based settlement within a highly competitive regional environment.

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Keywords: Maritime delimitation; Eastern Mediterranean; Law of the Sea; UNCLOS; Exclusive Economic Zone; continental shelf; Greek–Turkish relations; Mavi Vatan

1. Introduction

The sea is the largest body of water on the planet, covering most of its surface. It is a dynamic and complex ecosystem of fundamental importance. The sea is a source of wealth due to its provision of access to fishery resources and undersea reserves (such as hydrocarbons and mineral wealth), its potential for wave energy conversion, and its promotion of tourism in coastal areas. At the same time, it serves as a source of recreation for the general population and as a destination for neighbouring landlocked states.

At the analytical level, this study uses idealism and pragmatism as heuristic lenses for interpreting competing approaches to maritime delimitation rather than as rigid or mutually exclusive categories. An idealist or legalist orientation gives primacy to a rules-based international order, treaty interpretation, established legal principles and third-party adjudication. A pragmatic orientation places greater emphasis on strategic interests, bargaining power, security considerations, energy policy and the capacity of states to adapt legal arguments to changing geopolitical conditions. The value of this distinction lies in explaining why states may invoke the same body of international law while assigning different weight to legal certainty, equity, geography and strategic advantage.

The central research problem is therefore not simply which delimitation rule should apply, but how international legal principles, judicial practice and state strategy interact in a region characterised by complex coastlines, islands, overlapping jurisdictional claims and competing security interests. The paper asks how the pragmatic–idealist tension shapes the Greek–Turkish maritime dispute and what the reviewed legal sources and case law imply for the conditions of a peaceful and sustainable settlement.

The case law arising from the resolution of bilateral cases is considered to be exceptionally extensive. It establishes general guidelines and rules for the process of delimiting maritime zones.

At the same time, the jurisprudence does not operate as a mechanical formula that produces an identical outcome in every geographical setting. The treatment of islands, the weight assigned to relevant circumstances and the pursuit of an equitable result make delimitation inherently context-sensitive. Accordingly, the analysis below does not begin by selecting a preferred dispute-resolution mechanism; it first examines the legal and strategic tensions that any such mechanism would have to address.

2. Methodological Framework

The research included a literature review of scholarly works, as well as the indexing of arbitral awards, contracts and articles related to the subject under discussion. Sources were searched in libraries, archives, digital libraries, databases, and academic websites and journals on relevant topics. The reliability, validity, accuracy and objectivity of the sources were evaluated to the greatest extent possible, as was their scientific substantiation. The methodology employed was based on primary sources of international law, including the four Geneva Conventions, the subsequent Montego Bay Convention, and the relevant decisions of international courts and arbitral bodies. It also took into account customary state practice. The new Law of the Sea comprises 320 articles and nine annexes, making it a voluminous text that requires careful legal interpretation. However, it is not considered sufficient as a source since case law and customary law also play a complementary role in shaping the rules of international law. Consequently, examining and analysing cases involving the delimitation of island regions rather than the corresponding process for mainland coasts was deemed decisive in answering the question under investigation.

For the purposes of the revised analysis, the material was organised into three interconnected analytical dimensions: (i) the legal architecture of maritime zones and the status of islands; (ii) the case-specific reasoning emerging from judicial and arbitral delimitation practice; and (iii) the strategic and dispute-resolution positions associated with the Greek–Turkish context. The discussion synthesises these dimensions comparatively, with particular attention to points of convergence and contradiction between legal predictability, equitable outcomes and geopolitical interests. This structure provides the analytical basis for the conclusions rather than treating the legal review as a descriptive inventory of rules and cases.

3. Discussion

3.1 Legal rules, relevant circumstances and the limits of mechanical delimitation

The reviewed material indicates that the Law of the Sea provides an indispensable common legal vocabulary for maritime claims, but it does not eliminate the need for interpretation. The existence of legal categories such as territorial waters, the continental shelf and the Exclusive Economic Zone establishes the framework within which states formulate claims; nevertheless, delimitation between opposing or adjacent coasts remains dependent on geographical configuration and case-specific circumstances. This helps explain why the literature and jurisprudence reviewed in this study emphasise equitable

outcomes and why apparently similar disputes may not generate identical boundary lines (Collins & Rogoff, 1982; Chuanxiang, 2016).

This issue is particularly important where islands affect the projection of maritime entitlements. The legal status of islands and the effect ultimately attributed to them in a delimitation exercise are related but analytically distinct questions. The literature on the regime of islands, together with cases involving complex coastal geography, shows why the existence of an entitlement does not by itself predetermine the final boundary (Arai, 2019; Acharya, 2022; Al Faruque, 2018). Consequently, the apparent variability of judicial outcomes should be understood less as legal arbitrariness and more as the result of adjudicative efforts to reconcile general rules with the specific geography of each case.

3.2 Pragmatism and idealism as competing but overlapping strategic logics

The pragmatic–idealist distinction also requires qualification. The two approaches should not be understood as pure or mutually exclusive national characteristics. A predominantly legalist strategy still involves political judgement about timing, jurisdiction, negotiation and the risks of adjudication; conversely, a pragmatic strategy still seeks legal justification and cannot operate independently of the international legal environment. The analytical contrast is therefore one of emphasis: whether legitimacy is sought primarily through stable legal rules and third-party settlement, or through a broader combination of law, bargaining, strategic leverage and geopolitical positioning.

Viewed in this way, the Greek–Turkish disagreement is simultaneously a legal dispute and a conflict over the framework through which the dispute itself should be defined. The legalist perspective tends to narrow the controversy to questions capable of being formulated and adjudicated under international law, whereas a more pragmatic perspective may connect maritime delimitation with wider strategic, security and regional-policy concerns. This difference helps explain why agreement on procedure can be almost as difficult as agreement on substance. It also suggests that a durable settlement requires not only a technically defensible boundary but also a mutually acceptable process for identifying the questions that are actually being submitted for negotiation or adjudication.

3.3 Dispute-resolution pathways and the relationship between negotiation and adjudication

The original analysis identified three broad scenarios: bilateral dialogue, third-party settlement and escalation to armed conflict. These alternatives should not, however, be treated as equivalent dispute-resolution mechanisms. Armed conflict would represent a failure of peaceful settlement and would impose severe

political, economic and security costs. The meaningful comparison is therefore between negotiated settlement and consensual recourse to judicial or arbitral mechanisms.

Bilateral dialogue and international adjudication are not necessarily competing options. Negotiations may clarify the scope of the dispute, identify points of agreement and define the questions that could be referred to a court or tribunal. Third-party adjudication, in turn, can provide legal finality where the parties are unable to reconcile their interpretations through negotiation. The literature on peaceful settlement and provisional or alternative delimitation arrangements also indicates that interim and procedural solutions can play a stabilising role while final delimitation remains unresolved (Caflisch, 2009; Árnadóttir, 2022). Thus, the principal challenge is not simply choosing between diplomacy and law, but designing a sequence in which political consent and legal settlement reinforce rather than undermine one another.

From this perspective, the most defensible synthesis is neither a purely idealist expectation that legal rules alone will resolve the dispute nor a purely pragmatic assumption that power and strategic bargaining can substitute for legal legitimacy. A sustainable outcome must be legally reasoned, politically implementable and sufficiently responsive to the geographical and strategic circumstances of the Eastern Mediterranean. This synthesis provides the basis for the conclusions that follow.

4. Conclusion

The delimitation of maritime zones is a complex, multifactorial process linked to legal doctrine, geography, economic and geostrategic interests, diplomatic processes, security concerns and the wider regional environment. The body of international judicial and arbitral practice does not support a single mechanical rule capable of determining every EEZ or continental-shelf boundary in advance. Rather, general legal principles are applied through case-specific reasoning aimed at an equitable result. The diversity of outcomes should therefore not be equated with the absence of law; it reflects the interaction between stable legal principles and the particular circumstances of each dispute.

For the Greek–Turkish case, the analysis suggests that the deepest difficulty lies not only in the technical drawing of a maritime boundary but also in the competing conceptions of how the dispute should be framed and resolved. The idealist/legalist logic stresses rules, treaties and adjudication, while the pragmatic logic stresses strategic interests, bargaining and the broader regional balance. Neither approach is sufficient in isolation. Legal legitimacy without political consent may be difficult to implement, while geopolitical bargaining without a credible legal foundation is unlikely to produce a durable rules-based settlement.

Accordingly, the recommendation previously stated in the Introduction is more appropriately derived here from the analysis: a sustainable pathway would combine structured bilateral negotiations with the possibility of consensual referral of unresolved legal questions to an appropriate international judicial or arbitral mechanism. International adjudication can provide legitimacy and legal finality, but its effectiveness depends on prior agreement regarding jurisdiction, the precise questions submitted and acceptance of the resulting decision. The central policy challenge is therefore to create a process in which pragmatic political engagement makes a rules-based legal settlement possible, rather than treating pragmatism and idealism as irreconcilable alternatives.

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JUST ENERGY TRANSITION & LABOR MARKET TRANSFORMATION IN THE REGION OF WESTERN MACEDONIA

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Abstract

The just energy transition has emerged as a central challenge of contemporary climate policy, as societies seek to decarbonize energy systems while minimizing social, economic, and territorial inequalities. The shift from fossil fuel-based economies to renewable and low-carbon systems is not only a technological and environmental process, but also a deeply social transformation affecting employment, regional development, and social cohesion. Scientific literature shows that coal- and lignite-dependent regions are particularly vulnerable, facing risks of job displacement, economic decline, demographic shrinkage, and institutional instability. The concept of Just Transition emphasizes policies that combine environmental sustainability with social justice, ensuring that workers, local communities, and vulnerable groups are not left behind. Western Macedonia, Greece's main lignite-producing region, represents a critical case of this transition. The rapid phase-out of lignite production has accelerated structural economic change, creating both opportunities for green growth and serious concerns regarding labor market disruption and regional inequality. Existing studies underline the importance of economic diversification, workforce reskilling, institutional coordination, and participatory governance. This study presents preliminary findings from the empirical study conducted within the Living Lab process of the ISABEL HORIZON project, involving employers, workers, trade unions, environmental actors, educational providers, business associations, employment services and policy makers, examining labor market

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transformation in Western Macedonia during the post-lignite transition. The findings reveal significant economic uncertainty following lignite plant closures, including job losses and local stagnation. While sectors such as renewable energy, agri-food, tourism and digital technologies show growth potential, concerns remain regarding unequal access and weak local embeddedness. Persistent skills mismatches, brain drain, workforce aging, and limited institutional coordination further hinder adaptation. The results highlight the need for integrated regional strategies, targeted reskilling policies, and socially inclusive governance to ensure a genuinely just transition.

***Keywords**: Just Energy Transition, Economic change, Labour market transformation*

1. Introduction

Decarbonization creates benefits at national and global scales, but its costs are often geographically concentrated in communities whose employment, identity, and public revenues have developed around fossil-fuel extraction and power generation. For coal regions, a just transition therefore requires more than replacing one energy technology with another. It requires policies capable of managing employment displacement, rebuilding regional value chains, supporting vulnerable groups, and giving affected communities meaningful influence over development choices (Wang & Lo, 2021; Mark et al., 2024). Skills are a central part of this challenge because emerging low-carbon activities demand technical, digital, managerial, and cross-sectoral capabilities that are not automatically available in declining industrial regions (Bray et al., 2022).

Western Macedonia has served as Greece's principal lignite-producing and electricity-generating region for decades. This specialization created employment, technical expertise, infrastructure, and regional income, but also produced technological and economic lock-in. The accelerated lignite phase-out has consequently intensified long-standing problems of unemployment, low diversification, demographic decline, and outward migration (Ziouzios et al., 2021; Tranoulidis et al., 2022). Recent research also identifies a gap between centrally designed transition ambitions and the pace at which local communities experience new investment, secure employment, and participatory governance (Pavloudakis et al., 2023; Boulogiorgou & Kaldellis, 2025).

Against this background, this paper investigates preliminary evidence from the Western Macedonia Living Lab of the ISABEL project. It asks: (1) how stakeholders perceive the current labor-market transformation; (2) which sectors, skills, and groups are most affected; and (3) which governance and training gaps constrain an inclusive transition. The contribution is exploratory: it does not estimate net employment effects, but identifies locally grounded mechanisms that should inform the next stages of Living Lab experimentation and regional policy co-creation.

2. Methodology

The study uses a qualitative Living Lab design. Living Labs provide real-world settings for collaboration, learning, and co-creation among public authorities, firms, workers, knowledge institutions, and civil society; their value lies in connecting experiential knowledge with transition-oriented experimentation (Mbatha & Musango, 2022). Semi-structured interviews were organized with eight stakeholder categories: employers, workers, trade unions, environmental organizations, education and training providers, business associations, employment services, and government or policy actors. Interviews lasted approximately 45–60 minutes, were conducted individually, recorded with consent, and supplemented by field notes.

At the time of this preliminary analysis, 14 of the planned 50 interviews had been completed: seven with government and policy actors, two with workers, and one each with an employer, an environmental actor, an education provider, a business association, and an employment-service representative. Trade-union recruitment was still ongoing. Each transcript was manually checked, anonymized, and analyzed through three complementary stages: cross-interview thematic synthesis, question-by-question comparison, and strategic interpretation of strengths, barriers, and actionable lessons. Descriptive frequencies were used only to visualize coded response patterns. No inferential claims are made because the sample is small and currently weighted toward public-sector participants. The present paper reports an interim stage of this process (n = 14), while the completion of the planned sample will allow a more balanced representation of stakeholder perspectives and a more robust descriptive comparison across categories. Any quantitative patterns reported at this stage are therefore treated as indicative signals that complement, rather than replace, the qualitative interpretation of the interviews.

3. Preliminary Findings

The interviews portray a regional economy experiencing a rapid break with its former production model without an equally rapid consolidation of alternative employment. Six respondents characterized the last decade primarily as a significant contraction, while five described stagnation with limited job creation. Respondents linked plant closures to the loss of stable employment, reduced local purchasing power, weakening supplier networks, and uncertainty regarding the transferability of lignite-related know-how. At the same time, the strongest negative change identified was demographic shrinkage and workforce aging, followed by the loss of stable lignite jobs. These concerns are consistent with evidence that mine closures generate spatially concentrated unemployment shocks and can reinforce population decline where economic alternatives are weak (Mark et al., 2024).

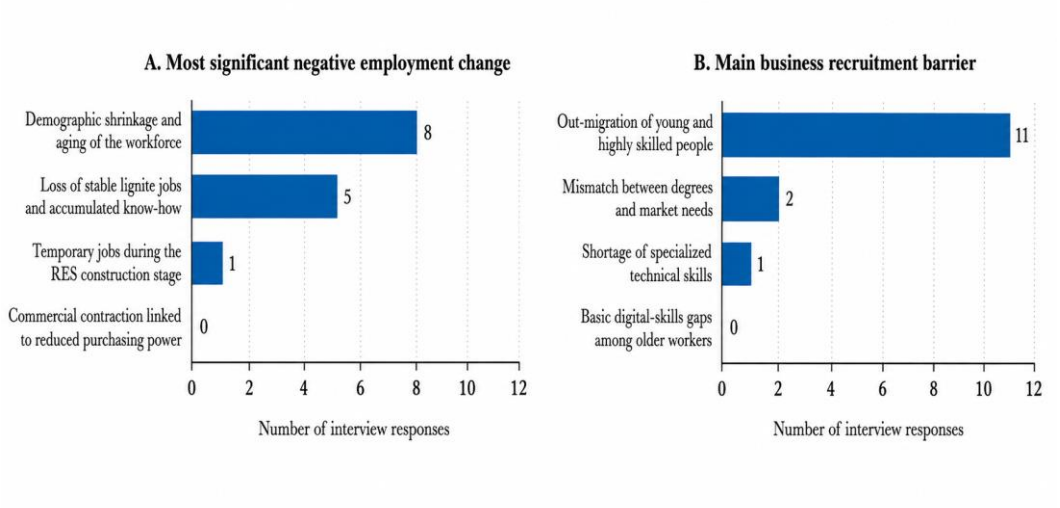


Figure 1. Employment disruption and recruitment barriers in the preliminary interviews (n = 14). Source: Own elaboration based on the ISABEL Living Lab results.

A particularly strong signal concerns labor supply. Eleven respondents identified the outward migration of young and highly skilled people as the principal difficulty businesses face when recruiting. Degree-to-market mismatch and shortages of specialized technical skills were mentioned less frequently, but the qualitative interviews emphasized that the two problems are connected: many experienced workers possess skills tied to the former energy system, while firms increasingly require hybrid technical, digital, and green profiles. Older workers, people with low digital literacy, and workers whose occupational identity is closely linked to lignite were viewed as especially exposed to exclusion.

Stakeholders nevertheless identified a diversified set of potential growth sectors. Agriculture and the processing of local products ranked first, followed by renewable energy and construction, digital technologies and IT services, and tourism, including wine and alternative tourism. The interviews did not reject renewable-energy investment; rather, they questioned whether large projects alone would generate durable local value. Construction-stage employment was often described as temporary, while ownership, procurement, and specialized jobs may remain weakly embedded in the regional economy. This finding supports the literature's emphasis on territorial plans that connect decarbonization investments to regional capabilities, SMEs, and employment pathways rather than relying only on headline investment volumes (Peretto et al., 2025).

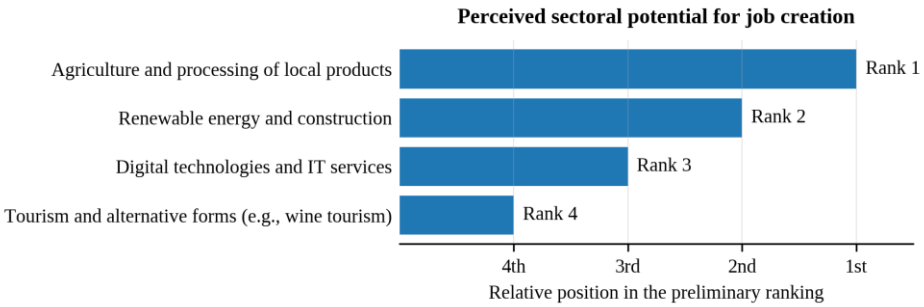


Figure 2. Preliminary ranking of sectors with job-creation potential. The ranking is ordinal and reflects the interview synthesis, not projected employment volumes. Source: Own elaboration based on the ISABEL Living Lab results.

Training and governance emerged as cross-cutting constraints. Existing programs were frequently described as procedural or voucher-driven, with insufficient alignment to real vacancies and a time lag between program design and changing employer demand. Interviewees called for more in-house and work-based training, continuous skills updating, and a regional mechanism that links employers, education providers, employment services, and workers. Centralized, top-down planning was ranked as the main obstacle to transition success, followed by slow investment implementation, infrastructure deficits, demographic decline, and the absence of a comprehensive monitoring mechanism. The evidence also suggests a dual role for digitalization and artificial intelligence: they can improve productivity and generate new services, but may increase administrative burdens and exclude workers without opportunities for retraining.

5. Discussion and Policy Implications

The preliminary results indicate that labor-market justice depends on the quality, timing, and local embeddedness of new employment, not only on the number of announced investments. A renewable project may contribute to decarbonization while producing limited regional multipliers if specialized labor, ownership, and procurement are external. Conversely, agri-food, tourism, digital services, and smaller clean-energy businesses may create broader local linkages, but require infrastructure, entrepreneurial support, and coordinated skills provision. The Living Lab findings therefore reinforce calls for community engagement and multi-level coordination as substantive components of transition governance rather than consultation after strategic choices have been made (Topaloglou et al., 2024).

Four priorities follow. First, Western Macedonia needs a permanent regional labor-market and skills observatory that integrates vacancy data, employer forecasts, training provision, and worker profiles. Second, reskilling should be modular, work-based, and linked to verified employment pathways, with tailored support for older workers and people with low digital skills. Third, investment policy should reward local procurement, SME participation, cooperative models, and stable job quality. Fourth, regional stakeholders should

participate in the design, monitoring, and revision of transition measures. These priorities can help convert the Living Lab from a consultation space into an adaptive governance mechanism that connects evidence, experimentation, and policy learning.

6. Conclusion

Western Macedonia's post-lignite transformation combines emerging economic opportunities with substantial labor-market risks. Preliminary Living Lab evidence points to economic uncertainty, demographic decline, skills mismatch, uneven access to emerging employment opportunities, and weak coordination between investment, training provision, and local labor-market needs. Although the findings are preliminary, they indicate several concrete directions for regional policy.

First, a permanent regional labor-market and skills monitoring mechanism should be established to systematically connect information on vacancies, employer skill requirements, available training programs, and workforce profiles. Such a mechanism could support the continuous adjustment of training provision to actual and emerging labor-market demand. Second, reskilling measures should move beyond generic or voucher-based provision toward modular and work-based training linked to identified employment opportunities, with dedicated pathways for older workers, former lignite-sector workers, and people with low digital skills. Third, support for new investment should incorporate criteria related to local employment, SME participation, local procurement, and job quality so that transition investment generates stronger and more durable regional economic linkages. Fourth, regional employers, workers, education and training providers, employment services, local authorities, and civil-society actors should participate systematically in the design, monitoring, and revision of Just Transition measures rather than being involved only through periodic consultation.

These recommendations should be interpreted in light of the preliminary character of the analysis. At the time of writing, 14 of the planned 50 interviews had been completed, with a comparatively strong representation of public-sector actors. Completion of the remaining interviews and subsequent Living Lab co-creation activities will therefore be necessary to test, refine and prioritize the proposed interventions across stakeholder groups. The final Living Lab process can consequently provide a stronger evidence base for translating these preliminary recommendations into regionally tailored policy measures for Western Macedonia.

Acknowledgment

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REGIONAL VALIDATION OF ENERGY POVERTY INDICATORS IN JUST TRANSITION REGIONS: EVIDENCE FROM WESTERN MACEDONIA, SILESIA & STARA ZAGORA

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Abstract

Energy poverty is an increasingly important challenge in European regions undergoing rapid decarbonization, particularly in territories historically dependent on coal and lignite. This study develops and applies a comparative, mixed-method and place-based framework for validating energy poverty indicators at the NUTS2 regional level in three Just Transition regions, Western Macedonia in Greece, Silesia in Poland and Stara Zagora in Bulgaria. Rather than relying on a single monetary or expenditure-based measure, the analysis triangulates indicators capturing experienced deprivation, housing cost pressure, climatic demand, poverty and social exclusion, and broader structural conditions. The approach combines regional statistical evidence with territorial and governance interpretation in order to assess how energy poverty manifests differently across regions and how national averages may conceal local vulnerabilities. The findings reveal three distinct regional profiles. Western Macedonia combines high and rising housing cost pressure with elevated, although recently declining, inability to keep homes adequately warm. Stara Zagora records the most severe and persistent deprivation, reflecting structural weaknesses related to household income, housing quality and limited affordability buffers. Silesia displays comparatively lower and more stable aggregate vulnerability, although specific groups remain exposed through inefficient heating systems and possible future energy-price volatility. The comparison also shows that stronger regional economic performance can reduce exposure to energy

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poverty but does not guarantee affordable energy services, as housing efficiency, income distribution, energy prices and social support remain decisive. These differences demonstrate the importance of interpreting indicators within their regional socioeconomic and institutional contexts. The study concludes that energy poverty monitoring in Just Transition regions should combine comparable European indicators with region-specific evidence on housing, climate, welfare and governance conditions. Such a triangulated framework can improve policy targeting, identify vulnerabilities hidden by aggregate statistics, support more effective allocation of transition resources and strengthen the social legitimacy of decarbonization through transparent, place-based decision-making.

Keywords: Energy Poverty, Just Energy Transition, Regional Validation

Introduction

Energy poverty is a central social challenge in regions undergoing rapid decarbonization. It describes the inability of households to secure energy services required for adequate warmth, cooling, lighting and everyday living. The phenomenon is multidimensional: income, energy prices, housing efficiency, climatic exposure and institutional capacity interact rather than operate separately. Risks are particularly acute in coal-dependent territories, where phase-out policies may weaken employment and household income before new economic activities and efficient housing are widely available (Maxim et al., 2016; Primc et al., 2019).

European measurement remains fragmented. Different definitions and indicators can produce contrasting estimates, while national averages conceal differences between regions. This scale mismatch is problematic for Just Transition policy because interventions are implemented in specific labour markets and housing systems.

Against this background, there is a need for an analytical framework that preserves comparability across European regions while remaining sensitive to the territorial conditions that shape energy vulnerability. In coal-dependent regions, energy poverty cannot be understood only as a question of household expenditure, because the effects of decarbonization interact with regional labour-market restructuring, housing quality, climatic conditions, income distribution and access to social support. A regional perspective is therefore essential for identifying vulnerabilities that may be obscured by national-level indicators and for designing measures that correspond to the specific mechanisms producing energy hardship. This study addresses this gap by comparatively validating a multidimensional set of energy poverty indicators at NUTS2 level in Western Macedonia, Silesia and Stara Zagora. Combining the outcome, affordability and contextual indicators, it aims to provide a more territorially grounded evidence base for monitoring energy poverty and supporting place-based Just Transition policy.

1. Methodological Framework

This study applied a comparative, mixed-method and place-based research design to validate energy poverty indicators at the NUTS2 regional level. The methodology was developed for three coal-dependent territories undergoing different forms and speeds of structural transformation: Western Macedonia in Greece, Silesia in Poland and Stara Zagora in Bulgaria. The regions were selected because of their long-term dependence on coal mining and coal-based electricity production, their exposure to employment and income losses associated with decarbonization, and their inclusion in European and national Just Transition policy frameworks. At the same time, their different economic structures, welfare conditions, housing systems and governance arrangements provided an appropriate basis for cross-regional comparison.

The methodological design treated energy poverty as a multidimensional and territorially embedded phenomenon rather than as a condition that can be represented by a single monetary indicator. Energy poverty may result from the interaction of low household incomes, high energy and housing costs, inefficient buildings, climatic exposure, inadequate heating systems and limited access to public support. Consequently, the same level of energy expenditure may correspond to very different living conditions across regions. The analysis therefore combined statistical measurement with territorial and governance interpretation to identify both the manifestation of energy poverty and the mechanisms through which it is produced and maintained. This approach follows the broader literature arguing that variations in definitions, datasets and measurement methods can produce substantially different estimates of energy poverty, particularly when national indicators are applied to heterogeneous regional contexts (Maxim et al., 2016; Primc et al., 2019; Sokołowski et al., 2020).

2. Regional Evidence and Comparative Findings

Fig. 1 indicates a moderate positive relationship between housing cost pressure and reported inability to maintain adequate indoor warmth, but the regional clusters also show that affordability alone does not explain deprivation. Western Macedonia (EL53) occupies the high-pressure area of the plot, combining elevated housing cost overburden with high warmth deprivation. Silesia (PL22) remains in the lower-left cluster, with both indicators comparatively low and stable. Stara Zagora (BG42) records high warmth deprivation even when housing cost overburden is only moderate, pointing to deeper structural factors such as low incomes and inefficient dwellings.

The regional trajectories are equally important. In Western Macedonia, housing cost overburden increased while the inability to keep homes warm declined in 2023-2024. This divergence suggests partial mitigation through temporary energy support, income assistance or climatic variation, although

underlying affordability pressure remains high. Silesia demonstrates relative resilience, supported by stronger economic capacity and lower housing cost pressure, but vulnerable households using inefficient coal-based heating systems still require monitoring. Stara Zagora exhibits the most persistent outcome-heavy profile: severe warmth deprivation, weak affordability buffers and recognition deficits identified through stakeholder fieldwork.

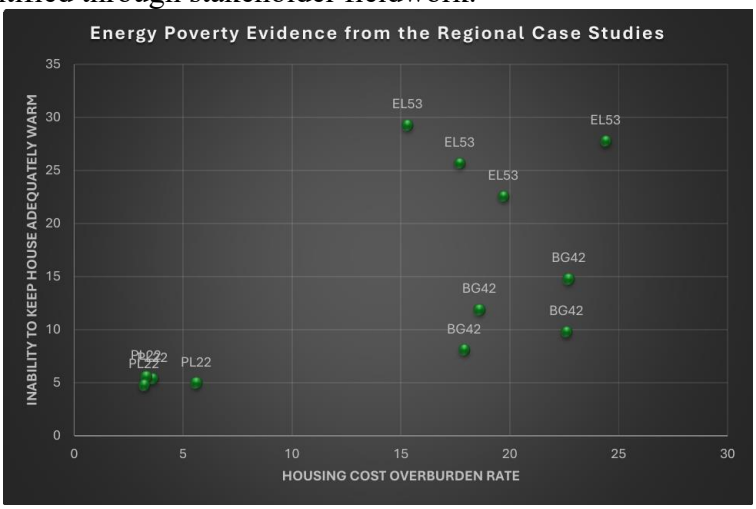


Figure 1. Housing cost overburden and inability to keep the home adequately warm in the three case studies. Source: Own elaboration.

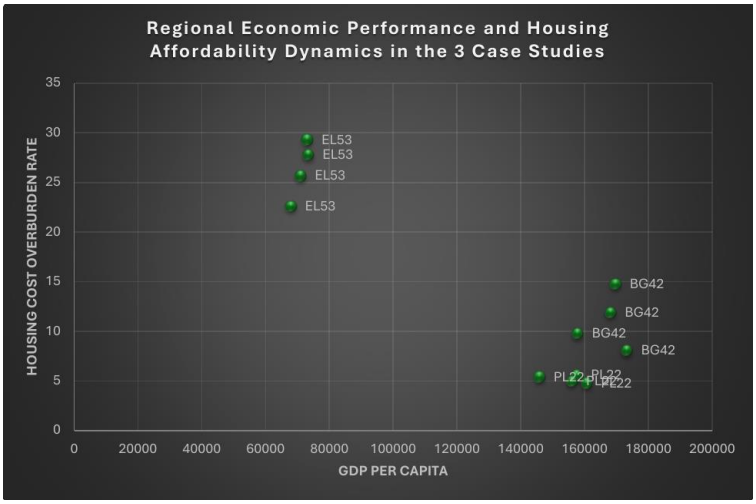


Figure 2. Regional economic performance and housing affordability dynamics in the three case studies. Source: Own elaboration.

Fig. 2 shows a negative association between regional economic performance and housing cost overburden. Silesia combines stronger economic capacity with low affordability pressure, whereas Western Macedonia combines lower economic capacity with a substantially higher burden. Stara Zagora occupies an intermediate and more volatile position. The comparison confirms that higher gross domestic product can reduce exposure but does not by itself guarantee affordable energy services; housing efficiency, income distribution,

energy prices and redistributive measures remain decisive (Sokołowski et al., 2020; Valeria, 2024).

3. Indicator Triangulation at NUTS2 Level

The indicators were interpreted as complementary layers rather than substitutes. Outcome measures identify lived deprivation; affordability measures describe the economic mechanism that can produce deprivation; and contextual measures reveal the structural conditions that amplify or buffer risk. Climatic exposure is particularly relevant because heating and cooling requirements differ across territories, while poverty and social exclusion connect energy hardship to wider welfare precarity. Table 1 summarizes the validated profiles.

Table 1. Comparative validation of regional energy poverty indicators. Source: Own elaboration.

Indicator	Western Macedonia	Silesia	Stara Zagora
Warmth deprivation	High, falling	Low, stable	Very high, persistent
Housing cost pressure	High, rising	Low, stable	Moderate-high, volatile
Climate demand	High heating	Moderate	Mixed heating/cooling
Poverty/social exclusion	High	Moderate	High
Overall risk	High	Low	Very high

The common framework produces three distinct profiles. Western Macedonia combines deprivation with acute affordability pressure; Stara Zagora combines persistent deprivation with structural housing and income weakness; and Silesia shows lower aggregate risk but retains vulnerable sub-groups. A single indicator would therefore lead to different errors in each case: cost-only monitoring would understate deprivation in Stara Zagora, while outcome-only monitoring could overlook continuing financial stress in Western Macedonia.

4. Policy Implications

Place-based responses should match the dominant regional mechanism. Western Macedonia requires targeted income support and energy-bill protection alongside deep renovation of inefficient housing, so that temporary relief is converted into durable affordability. Stara Zagora requires full or near-full renovation support for low-income households, stronger social-policy integration and more transparent community participation to address both material deprivation and mistrust. Silesia should prioritize preventive renovation and continuous monitoring of vulnerable households before energy-price volatility erodes current resilience. Across all three regions, the JT-OBSERVATORY dashboard supports map-based comparison and can help regional authorities connect indicator trends with stakeholder knowledge, funding priorities and governance accountabilit.

5. Conclusion

The regional validation confirms that energy poverty is not a uniform condition and cannot be represented by a single European indicator. A triangulated framework combining experienced deprivation, affordability pressure and structural vulnerability provides a more credible basis for comparing coal-dependent territories. Stara Zagora shows severe and persistent structural energy poverty; Western Macedonia shows high cost pressure and elevated deprivation despite signs of partial mitigation; and Silesia shows lower, more stable vulnerability. These differences demonstrate why national averages and expenditure measures alone are insufficient for Just Transition governance. NUTS2 monitoring should retain comparability with EU frameworks while incorporating regional housing, climate, welfare and governance conditions. The resulting evidence can improve targeting, reveal groups hidden by aggregate statistics and strengthen the legitimacy of decarbonization policies through transparent, place-based decision-making.

Acknowledgment

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ERASMUS+ STUDENTS AS CONSUMERS: ATTITUDES, INTENTIONS AND LOCAL PRODUCT PURCHASING BEHAVIOUR IN CROATIA

Ivana Jadrić[5]

Abstract

Recent research highlights that the Erasmus+ programme generates not only cultural but also measurable economic benefits in host countries, as the growing population of international students increasingly contributes to local consumption patterns. While motivations for mobility differ between full-degree and short-term exchange students, both groups act as consumers in the host economy, making their purchasing behaviour relevant from an economic and social integration perspective. This pilot study, conducted in November 2025 on a small sample of international students in Croatia, examines the intention to purchase local Croatian products among Erasmus+ students using the Theory of Reasoned Action and a Theory of Planned Behaviour framework. Employing a moderated mediation model, the study investigates how attitudes towards purchase influence actual purchasing behaviour through purchase intention, and whether subjective norms moderate the intention–behaviour relationship. The results indicate that attitudes significantly and positively affect purchase intention, which in turn strongly predicts actual purchasing behaviour, thereby confirming the core structure of the TBD model. However, the moderating effect of subjective norms is not statistically significant, suggesting that social influence does not substantially alter the translation of intention into actual purchase behaviour in this context.

Keywords: international students, purchase intention, local products.

1. Introduction

The number of international students in higher education increases each year, driven by their desire to develop cultural competence (Luzio-Lockett, 1998), learn foreign languages (Haugh, 2016), gain interpersonal experience (Thakur & Hourigan, 2007), or improve employability prospects (Isacsson, Slotte & Wikström-Grotell, 2020). Numerous motives encourage them to pursue full or partial qualifications abroad, and their presence in a foreign country changes not only the classroom atmosphere but also the wider society in which they live. With the rise in the number of foreign students, especially in university cities, they form

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a unique academic subculture (Li, 2016) with distinct purchasing habits, what makes them increasingly important to observe in a marketing context. There is very little research that generally examines the behaviour of foreign students, and this study specifically aims to investigate the attitudes of international students towards the intention to consume local products. The economic impact of foreign students has been little explored. Some studies, such as Ashton-Hay & Roberts (2012) in the context of higher education in Australia, state that foreign students are extremely important because education is one of the country's most significant export products, and foreign students themselves make a strong contribution to the local economy. In the Croatian context, the ACA (2006) study is mentioned, together with the recently published report that analysis insights from Croatia, Germany, Hungary, Portugal, and Serbia about Economic impact of Erasmus+ student mobility (Kupriyanova & Ferencz, 2025), which explains the economic impact of Erasmus+ student mobility, but overall, there is little research that sheds light on this topic.

This research is based on the basis of the *Theory of Planned Behaviour* (Ajzen, 1985) and the *Theory of Reasoned Action* developed by Martin Fishbein. According to the *Theory of Planned Behaviour*, there are three key factors that can be observed and used to predict behaviour: attitudes towards the behaviour – how positively or negatively a person views a particular behaviour; subjective norms – the perception of social pressure from society or significant others to behave in a certain way; and perceived behavioural control – how much a person believes they have control over performing a behaviour. According to the *Theory of Reasonable Actio*n, intention is determined by two factors, which are attitude towards behavior and subjective norms.

A recent report (ACA, 2026) states that Erasmus student mobility produces clear and measurable economic benefits, confirming that, alongside cultural and other indicators, economic factors are also clearly evident. However, as noted by Cubillo, Sánchez & Cerviño (2026), there are very few studies examining the decision-making of international students, so any contribution in this area is significant. In order to fill the identified research gap, this research focuses on the analysis of attitudes about the purchase of local Croatian products by international students during their period of mobility and subjective norms, and the analysis of their connection with purchase intention and purchase itself.

1.1 Theory of Reasoned Action (TRA) and Theory of Planned Behavior (TPB)

The Theory of Reasoned Action (Fishbein & Ajzen, 1975; Ajzen & Fishbein, 1980; Ajzen, 1985) was developed to predict voluntary behaviours and to help understand their psychological determinants. It assumes that people generally behave rationally: they consider available information and, implicitly or explicitly, weigh the possible consequences of their actions. In line with its focus on voluntary behaviours, the theory posits that a person's intention to perform or

not perform a particular behaviour is a direct predictor of that behaviour. Barring unforeseen circumstances, people are expected to act in accordance with their intentions.

However, intentions can change over time; the longer the interval between measuring intention and observing behaviour, the greater the likelihood that unforeseen events will alter intentions. Therefore, the accuracy of predicting behaviour usually decreases as the interval between measuring intention and the behaviour itself increases. Intention is determined by two fundamental factors: one personal and one social. The personal factor refers to an individual's positive or negative evaluation of performing a particular behaviour, or attitude towards that behaviour. The other factor influencing intention is the perception of social pressure to perform or not perform a particular behaviour. As this is a perception of social expectations, it is termed subjective norm. In general, people will have a stronger intention to perform a behaviour if they evaluate it positively and believe that important others think they should perform it. The more positive an individual's attitude towards a behaviour and the more strongly they perceive that significant people in their environment (such as friends, family, etc.) approve of the behaviour, the greater the likelihood that they will form an intention to perform it (Fishbein & Ajzen, 1975). Ajzen (1991) extends the theory by introducing perceived behavioural control – a person's assessment of how much ability, resources, or opportunity they have to perform the behaviour – which develops into the *Theory of Planned Behaviour* (TBD). The TBD explains how perceived attitude, subjective norms, and perceived behavioural control relate to behavioural intention and behaviour. The theory was initially developed in the context of technology acceptance, but has been widely tested in the field of economic sciences (George, 2004; De Cannière, De Pelsmacker & Geuens, 2009; Khan, Hameed & Akram, 2023). Therefore, it is proposed as a constructive basis for this research as well. Both models propose that the most important determinant of any behaviour is the person's intention to perform it. In the TPB, perceived behavioural control (PBC), that is, an individual's perception of control over behaviour despite internal and external obstacles, is also cited as an additional predictor of behaviour. Intentions are predicted by attitudes, subjective norms, and, in the TPB, PBC. Attitudes are an individual's positive or negative evaluation of performing a behaviour. Subjective norms reflect an individual's perception of social approval for performing the behaviour (Cooke & French, 2007).

To date, more research has taken these theories into account to examine purchase intention (De Cannière, De Pelsmacker & Geuens, 2009; Ketabi, Ranjbarian & Ansari, 2014; Maichum, Parichatnon & Peng, 2016), as well as specific target groups such as students regarding online purchase intention (George, 2004; Yakasai & Jusoh, 2015), green or organic products (Yazdanpanah & Forouzani, 2015), or sports products (Kim & James, 2016). However, for the specific group of international students and local products of the country they are living in during their mobility, this application has not been observed. When analysing the application of this theory among international students, it was found in the context of some other forms such as mask-wearing during the pandemic

(Sun, Qin, Hu, Li, Li, He & Huang, 2021), but not in relation to purchase intentions.

1.2 Studying in another country - Integration and social inclusion of international student

The social integration of foreign students has been examined in previous research at both the global level (Ward, Masgoret & Gezentsvey, 2009) and the local level (Senci, Hendrickson & Debevc, 2022). The relationship between foreign and local students is particularly significant, as it brings many positive effects for foreign students, including improved well-being, which is associated with reduced stress levels and better academic success (Spencer-Oatey & Dauber, 2019). As Senci, Hendrickson & Debevc (2022) note, part of the reason why foreign students do not immediately acclimatise often lies with themselves, as they frequently form their own Erasmus societies and isolate themselves, without allowing local students to join. Although student mobility is driven by various motives, their stay in a particular destination shapes them into a new consumer group that may hold specific attitudes towards local products. Purchase of the local products from the country intrenational students live in can also be considered a way of assimilating into a new society. It should be taken into consideration that sometimes international students do not have the opportunity to purchase products that they are used to consuming in their home countries, and thta's the reason why they turn to local products. But sometimes accepting local products and turning to them as primary purchases can really be seen as openness to accepting new components of the culture of the country they are staying in during their mobility. Purchasing local products may represent a form of social integration with the local environment and reflect their desire to assimilate and better understand and experience their local surroundings. Therefore, it is important to analyse subjective norms as part of social pressure in the process of purchasing local products.

1.3 Purchase intention of international students

The literature on marketing education in international markets remains relatively limited (Mazzarol, 1998). Some previous research can serve as a basis for this study. For instance, Zirena-Bejarano and Chávez Zirena (2006) investigated the mediating effect of subjective norms in the relationship between attitude and online purchase decisions. Partial mediation was also found in the relationship between green purchase attitude and subjective norm in the context of e-WOM adoption and green purchase intentions (Parveen and Chaudhary, 2025). Other relevant studies include Ali, Xiaoling, Sherwani and Ali (2017), who examined the purchase intentions of international Muslim students in China regarding factors influencing their consultation of Halal meat, and Lee, Kim, Pelton, Knight and Forney (2008), who explored factors affecting Mexican

college students' purchase intentions towards a US apparel brand available for purchase.

Orientation towards purchasing local products can serve as a tool for social inclusion among international students. It was assumed that students seeking closer integration with the local environment will be more inclined to purchase local products. This assumption is supported by research such as that conducted by Carrozzo, Lodigiani and Venturini (2024), which demonstrated that the consumption of cultural goods can play a key role in the social and economic integration of immigrants in their destination country. Based on research by Kim (2017), the TBD model can be used as a framework for examining attitudes among international students.

Although numerous studies confirm the connection between attitude and purchase intention (Ho Nguyen, Nguyen-Viet, Hoang Nguyen and Hoang Le, 2022), or between purchase intention and actual purchase (Morrison, 1979), the mechanism through which social influence (subjective norms) shapes this relationship, especially among international students, has been less explored.

Despite and perceived behavioural control is a core component of the Theory of Planned Behavior, previous research shows that this variable can have lower interitem reliability as it was emphasized in the study conducted by Sparks & Shepherd (1992) in analysis of the Green Consumerism concept. Since purchasing local products is generally a voluntary and readily accessible behaviour, this exploratory study focused on adapted model by analysing attitudes, subjective norms, purchase intention, and purchasing behaviour.

Furthermore, it is of interest to investigate whether the opinions and influences of others, known as subjective norms, can alter the relationship between purchase intention and actual purchase, as has been demonstrated in other areas such as health behaviours among women with low-risk HPV (Yarmohammadi, Mousavi, Ajori, Mohammadzade and Marashi, 2023). The mediating role of subjective norms between intention and actual performance has been demonstrated in previous studies, such as that conducted by Abdullah Al-Swidi et al (2014) in the context of service quality. In their study, they examined subjective norms and self-congruence as moderators of the relationship between customer purchase intention and service offerings, and showed that these moderators negatively influence the positive relationship between purchase intention and service offerings, such as SERVQUAL (service quality) and customized service.

Based on the above, the following fundamental research questions are posed:

RQ1: Can purchase intention act as a mediator in the relationship between attitudes towards the purchase of local products and the actual purchase among international students?

RQ2: Do subjective norms have a mediating (moderating) role in the relationship between the intention to purchase and the actual purchase of local products among international students?

2. Methodology

For the purposes of the research, a survey was conducted with 44 international students, representing 90% of the total number of international students at the selected higher education institution. The research took place in November 2025 and was analysed using IBM SPSS 23 data processing software. Students were presented with a scale based on Ajzen (1985), which was subsequently tested in numerous other studies (Liñán & Chen, 2009). Students recorded their responses on a Likert scale with five possible options (1 – Strongly disagree, 2 – Disagree, 3 – Neither agree nor disagree, 4 – Agree, 5 – Strongly agree). They answered several demographic questions, followed by the offered scales:

- Personal attitude towards Croatian local products
- Subjective norm
- Purchase intention
- Purchase

At the beginning of the research, descriptive statistics and correlation analysis between the main constructs were conducted. For the analysis of moderator mediation, a model was created and tested using PROCESS in SPSS. In developing the model, Model number 14 from Hayes' (2017) list of models was used (as represented below). For the purposes of the research, Purchase Attitude was assigned to X in the model, Purchase to Y, Purchase Intention to mediator M, and Subjective Norm to moderator W.

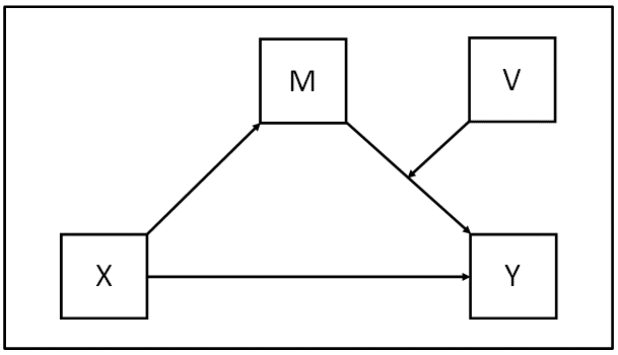


Image 1. Hayes model number 14.

Below, moderated mediation was performed according to the instructions in the publication Demming, Jahn & Boztuğ (2017). The Hayes method for data processing was used (model 14, which suggests the use of the moderated mediation method).

In this case, it was investigated whether a proposed mediator M can explain any effect of X on Y. This question is addressed by estimating the indirect effect through the mediator M (Hayes 2013). As Blanchard et al. (2016) state, researchers are often interested not only in identifying the process itself that explains the relationship between variables (which could be analysed by a pure

mediation analysis), but also in understanding the conditions under which that process is active.

3. Results

Participants in the study were 23 females and 21 males, and they came from nine countries (Bosnia and Herzegovina, Czech Republic, France, Germany, Iceland, Lithuania, Portugal, Spain, and Turkey). For data processing, descriptive statistics were initially calculated, providing insight into the central values of the scales: Purchase Attitude was 3.37 (SD = 0.14), , Subjective Norm 3.75 (SD = 0.14), Purchase Intention 3.73 (SD = 0.11), and Purchase 3.28 (SD = 0.16). Statistically significant correlations were also recorded between all scales except the Subjective Norm and Purchase Intention scales.

Table 1. Descriptive statistics and correlations among variables

Variables	M	SD	Cronbach's α	Purchase attitude	Subjective Norm	Purchase Intention	Purchase
Purchase attitude	3.37	.92	0.897	-			
Subjective Norm	3.75	.92	0.910	0.576***	-		
Purchase Intention	3.37	.74	0.822	0.431**	0.222	-	
Purchase	3.28	1.05	0.874	0.700***	0.505***	0.700***	-

In order to test the internal consistency of the scales, Cronbach's α was also calculated, which showed valid values for all observed scales, since it was 0.70 or better based on the recommendation model by Nunnally (1978).

A moderated mediation was conducted to test the proposed model. According to the table below, attitude towards purchasing significantly and positively affects purchase intention (b = 0.348). More positive attitudes are associated with greater purchase intention. The model accounts for 18.6% of the variance in purchase intention explained by attitudes. When considering both purchase intention and actual purchase, it can be concluded that individuals with higher purchase intention have a higher probability of making an actual purchase (b = 0.712).

Furthermore, in the moderating relationship where Purchase Intention × Subjective Norms was examined, it can be concluded that subjective norms moderate the relationship between purchase intention and actual purchase. the negative coefficient indicates that when subjective norms are stronger, the relationship between purchase intention and actual purchase becomes weaker. This suggests that when individuals experience stronger social pressure, intention

is less likely to translate into actual behaviour. The model explained 71.8% of the variance in actual purchase, which is a very high level of explanatory power.

Table 2. Results of regression analyses for purchase intention and purchase in the moderated mediation model

	Purchase intention - M	**Purchase - Y**
Constant	-1.174**	1.772
Purchase attitude – X	.348**	.455
Purchase intention - M		.712
Subjective norms – W	-	.144
Purchase intention X Subjective norms (MxW)	-	-.185
R2	.186**	.718**
F	9.596	24.912
df1	1	4
Df2	42	39

The following diagram shows the conditional indirect effect – that is, how the mediation effect varies depending on the level of the moderator (subjective norms, W), i.e. how much attitudes (X) influence purchase intention (M) at different levels of subjective norms (W). When subjective norms are low, there is a significant indirect effect of attitudes on purchase intention. At an average level of subjective norms, the indirect effect is also statistically significant, indicating that attitudes continue to influence purchase intention. Even at a high level of subjective norms, the indirect effect remains statistically significant, as the confidence interval does not include zero. Therefore, it can be concluded that attitudes influence purchase intention even when there is strong social influence.

Table 3. Moderator levels

Moderator level	**Predictor**	**Mediator**	**b**	**Lower level**	**Higher level**
Low W	Purchase attitude - X	Purchase intention - M	-1.083	.098	.645
Middle W	Purchase attitude - X	Purchase intention - M	.250	.079	.431
High W	Purchase attitude - X	Purchase intention - M	1.250	.028	.373

The analysis of conditional indirect effects shows that the indirect influence of purchase attitudes on purchase intention is statistically significant at low, medium, and high levels of subjective norms. However, the size of this effect varies depending on the level of subjective norms, indicating the presence of moderated mediation. Although there is a difference in principle, the moderated mediation index shows that the differences between these effects are not statistically significant (BootLLCI .0517 and BootULCI -.1818).

4. Conclusion

Based on the research conducted, it can be concluded that an adapted version of the TPB and TRA models represents a suitable theoretical framework for understanding the purchasing behavior of local products among international students (Kim, 2017). These models allow for a systematic explanation of how attitudes and intentions shape consumer decisions in a specific intercultural context, taking into account the specificities of the international student population. When comparing previous research based on the TBD theory, both subjective norm and PBC are predictors of purchase intention. However, according to research by Hagger et al. (2022), and Perceived Behavioural Control can been shown to be a moderator of the intention-behavior relationship, so this research raised the question of whether subjective norm can act as a moderator, in this relationship. The correlations and the overall statistically significant connections between attitudes towards local products, purchase intention, and actual purchase were confirmed in this research. More precisely, the analysis also confirmed the mediating role of purchase intention in relationship between purchase attitude and purchase, which supports **RQ1**. This is consistent with some previous research such already published such as Gupta (2021), who confirmed that green purchase intention has a mediating role between consumers' attitude towards green products and their actual green purchase behavior or in the case of organic food among Chinese consumers (Li & Jaharuddin, 2020).

In the continuation, it was questioned whether subjective norms can moderate the relationship between purchase intention and actual purchase. This effect was proven not to be statistically significant (**RQ2**). Since subjective norms (SN) represent social pressure from close and important people in the environment, the significance of analysis of this construct is clear. In the contect of international students, this pressure can come from various sources, such as family and friends in their home country, as well as new friends in the country where they are studying. For example, regarding food (Memon et al., 2020), foreign students often rely on subjective norms and recommendations from new friends to adapt more easily to the new environment. Although food is only one category of local products, when we talk about subjective norms in general - in this research, the influence of SN on the relationship between purchase intention and purchase was not confirmed. A difference existed, but it was not statistically significant.

Therefore, the most important finding of the research is that increasing international students' purchases of local products is more effectively achieved by fostering positive attitudes toward these products than by relying on social influence or recommendations from others. The results suggest that social influence plays a less significant role in shaping purchase behavior, whereas favorable attitudes toward local products are a stronger driver of purchase

decisions. The implications of this research can also be linked to international university practices, where local products can serve as a tool for integrating foreign students into the local community, getting to know the culture of the host country, creating a sense of belonging to the local environment and developing a positive experience of studying abroad. As attitudes are built over a long period of time and through direct experience (Fazio, Zanna & Cooper, 1978) - it is a process that can begin by coming to study in a different environment.

This research provides a theoretical contribution by confirming the application of the existing models to the context of purchasing local products by international students. It also offers additional understanding of attitudes and social influence in an intercultural context, which can help in developing strategies to better understand international students.

Finally, it is necessary to address the limitations of the research. This research has many limitations, where small sample size is certainly one of the main ones. It is an exploratory study on a limited population. Although the number of respondents is extremely small, this research is also a pilot study, the results were taken into account because it is about 90% of foreign students of one institution and on the other hand because it represents a niche in the research area. Although results of this research cannot be generalized, it can provide an interesting stimulus for further research. The inclusion of subjective norms without perceived behavioral control (PBC) is also questionable. Although PBC was omitted from this study due to its low significance in previous studies (Sparks & Shepherd, 1992), it still forms the basis of the TPB model and it would be good to analyze its significance.

Suggestions for future research include the inclusion of perceived behavioural control as an additional variable to observe, a comparison of domestic and international students in their atitudes towards local products. Also, it would be interesting to repeat the research at the beginning and end of the international students' stay in the form of a quasi-experiment to determine whether their purchase intention changes depending on the length of stay in the foreign country.

Future research should also define precisely what is meant by the term “local.” For example, a coffee can be completely differently perceived by domestic and international students (Conoly, von Massow & Lee, 2023). Domestic students often define “local” in terms of distance, such as food grown within 100 km of their residence, while international students may consider “local” to mean food grown in their home country, such as Canada.

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STRATEGIC MANAGEMENT AND FDI IN THE DIGITAL ECONOMY: EMPIRICAL EVIDENCE FROM THE WESTERN BALKANS

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Abstract

The growing digitization of the world economy is changing the factors of foreign direct investment (FDI) especially in the developing and transition countries like the Western Balkans. While conventional locational benefits such as market size, labor costs and trade openness remain significant, digital readiness and firm-level strategic managerial competence are becoming important drivers of contemporary FDI inflows. This paper proposes an integrated analytical methodology that links macro-level digital infrastructure indicators (namely, DESI, ITU IDI, and UN E-Government Index) with firm-level strategic management competencies, to analyze their combined effect on attracting FDI. We estimate a moderated panel regression model based on a balanced panel dataset of six Western Balkan transition economies (Albania, Bosnia and Herzegovina, Kosovo, Montenegro, North Macedonia and Serbia) during the period 2018-2025. The empirical findings show that although the influence of digital readiness is statistically significant and favorable on the FDI inflows, it is greatly enhanced by the level of the host-market strategic managerial ability and organizational flexibility. The results have significant implications for policymakers attempting to establish digital-first investment policies and for managers attempting to build adaptive organizational skills to harness technology transfers in transition contexts.

Keywords: Strategic Management; Foreign Direct Investment (FDI); Digital Economy; Digitalization; Managerial Capacity; International Business; Western Balkans

1. FDI in the Age of Digital Transformation

The fast acceleration of the digital economy has led to a structural change in global investment flows, fundamentally changing the way that multinational corporations (MNEs) assess geographical benefits. Traditionally, the FDI determinants have been mostly tangible resources, including natural resources availability, cheap labor, physical infrastructure and market size. However, the modern digital age is marked by the emergence of asset-light business models,

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digital platforms and cross-border data exchanges, which have all transformed the conventional drivers of foreign investment. Physical closeness is gradually being augmented or bypassed by digital connectivity: digital readiness (infrastructure, digital skills, e-government services) becomes a major locational advantage for host nations. For transition economies, notably those of the Western Balkans, the adoption of this new digital investment paradigm is not just a means to speed up economic growth, but a precondition to prevent marginalization in global value chains.

In the contemporary digital paradigm, strategic management plays a very important role in decision making inside multinational companies. Digital transformation offers MNEs with organizational flexibility, rapid expansion and real time coordination of geographically spread firms. The local management capacity is the crucial absorptive filter to capture, internalize and translate technical and digital knowledge transfers into productive economic outputs for firms in host nations. As argued in the endogenous growth theory, the development benefits of FDI are not automatic, but depend on the absorptive capacity of local firm leaders and organizations. Simply said, digital infrastructure is the hardware of the digital economy, and strategic management and firm-level competencies are the software that determines whether the foreign capital inflow can successfully update the local business environment.(United Nations Conference on Trade and Development 2026), notes that the main development challenge for transition economies is to build strong absorptive capacity around digital infrastructure and skills so that these technology-driven investments can be translated into greater integration into global value chains.

Small transition economies in the Western Balkan area confront specific structural constraints in this changing environment. They have the advantage of geographical closeness to the European Union (EU) and attractive tax regimes, but they suffer from institutional gaps, different rates of regulatory harmonization and an urgent need to update their technical workforces. The net influx of FDI to the area is dynamic yet unevenly distributed. OECD (2025) reports net FDI inflows in Montenegro in the period 2020-2023 at about 11% of GDP, whereas Albania, Kosovo and Serbia clustered at a very competitive 7% of GDP. In the Kosovo case (Kida et al. 2025) find that open market access and targeted government support are important determinants of multinational investment decisions, which add to broader regional advantages and help address structural limitations of local markets. By comparison Bosnia and Herzegovina was behind the region at roughly 3.8% of GDP. This regional dynamic is an example of the complex nature of drivers of attraction in the Western Balkans. In this respect, (Krasniqi and Fetai 2024) found that FDI determinants in the area are in transitional shift, where, aside from the classic macroeconomic considerations, the institutional quality and structural reforms are increasingly serving as key signaling mechanisms for foreign capital inflows. Attracting productive, digital-age FDI into these nations is crucial to jump-start the structural adjustments required for EU integration, raising productivity in the private sector and stemming brain drain by generating high-value employment.

This research makes an important contribution to the international business literature by providing an integrated multi-level framework linking macro-level digital readiness metrics to micro-level management qualities. More specifically, the study aims to: (1) analyze the relationship between the digital readiness indicators (e.g., ICT infrastructure, e-government platforms, and connectivity) and FDI in Western Balkan economies; (2) evaluate the role of firm-level managerial capacity and strategic leadership as enabling factors that increase a host country's capability to absorb digital FDI; and (3) offer concrete, evidence-based policy and strategic recommendations for regional regulators and corporate managers. We provide scarce empirical evidence on the interplay of strategic management and digital preparedness in determining FDI success in the transition setting, using a balanced panel data set from six Western Balkan nations for the period 2018-2025.

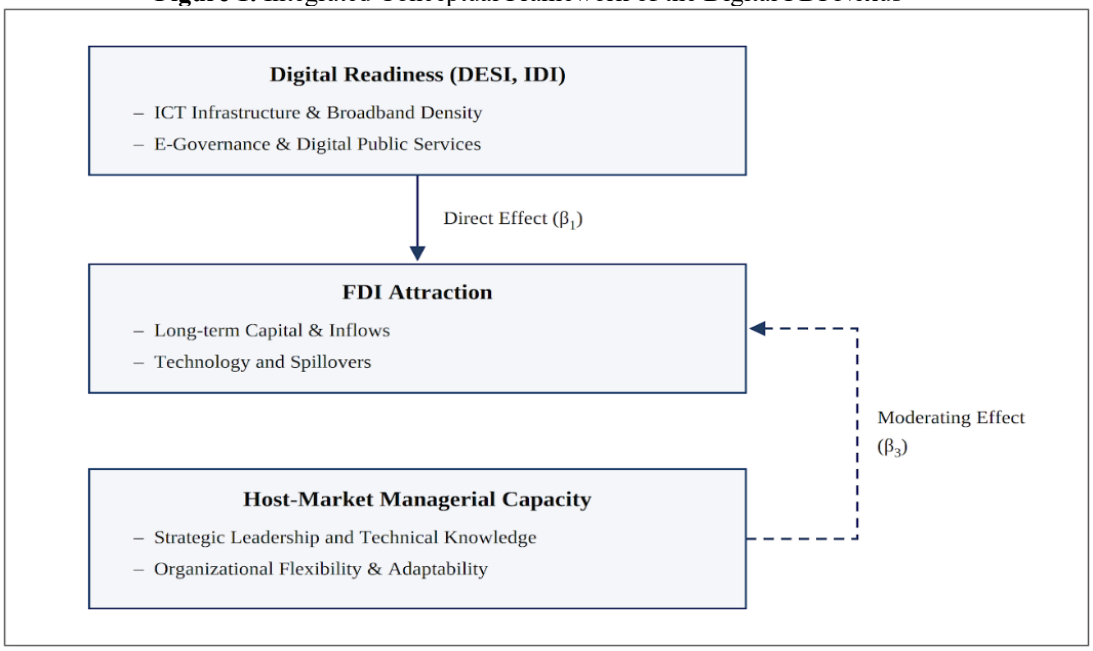
6. Conceptual Foundations and Theoretical Framework

We build upon known ideas in international business and strategic management to explore the interplay of digital change, managerial competences and international capital flows. The theoretical underpinning of FDI has long been dominated by the Eclectic Paradigm or OLI Framework developed by (Dunning 1988). Dunning says a firm's choice to invest overseas depends on three different benefits: Ownership (O) advantages, Locational (L) advantages and Internalization (I) advantages. L advantages in conventional manufacturing or physical services were physical infrastructure, fiscal incentives and low-cost labor. Digitalization, however, brings a new factor into these traditional frameworks, changing the nature of L benefits. Digital transformation is indeed changing both the home country firms' ability to invest overseas and host country settings. The internal digitalization of corporate processes significantly improves the operational efficiency of multinational enterprises (MNEs) (Wu et al. 2025), and thus facilitates outward foreign direct investment (OFDI) through better organizational coordination and lower transaction costs among subsidiaries. In the digital economy, locational benefits are increasingly determined by a host country's "digital readiness" – the density of high-speed internet, the complexity of digital public services (e-governance) and the technological literacy of the local workforce. MNEs need an environment that reduces the costs of digital transactions and enables data flows to implement digital technologies.

Furthermore, for Endogenous Growth Theory (Romer 1990), FDI is a factor of the long-term economic growth, through primarily knowledge spillovers, diffusion of technology, and productivity improvements. Digital FDI is not the same as static capital transfers; it transmits highly specialized intellectual assets, software and sophisticated organizational models. But, as the economic research demonstrates, these technology spillovers are very conditional. Michael Porter's Competitive Advantage of Nations (1990) stresses the importance of the national environment in the development of the competitive capacities of home enterprises. In transition economies, the host country's absorptive capacity determines the ability to collect and use digital knowledge. At the micro-level, the absorptive ability is ultimately

determined by the strategic management or quality of leadership, technical product expertise and organizational flexibility of domestic enterprises. Therefore, we construct a multi-level FDI-digitalization model connecting macro-environmental infrastructure and micro-corporate capabilities (Porter 1990).
To indicate this interaction connection, we provide an integrated conceptual framework as follows. This model postulates digitization as a direct, positive factor of FDI attractiveness, but this macro-relationship is actively regulated and strengthened by host-country management competence. In the case of MNEs, local businesses with strong strategic leadership and technical skills are more likely to integrate in the digital value chains of MNEs, and thus, magnify the beneficial technology spillovers in the host economy.

Figure 1. Integrated Conceptual Framework of the Digital FDI Nexus



Source: Developed by authors (2026)

Table 1. Core Digital Economy Indicators for Empirical Evaluation

Digital Index	Primary Data Source	Key Measurement Dimensions
Digital Economy and Society Index (DESI)	European Commission / Eurostat	Connectivity, human capital, integration of digital technology, digital public services
ICT Development Index (IDI)	International Telecommunication Union (ITU)	Level of ICT infrastructure development, access intensity, and actual citizen usage
E-Government Development Index (EGDI)	United Nations (UN Public Administration)	Online service provision, telecommunication connectivity, and human capital capacity

World Development Indicators (WDI)	World Bank	Macroeconomic control variables (GDP per capita, trade openness, domestic capital formation)

Source: Developed by authors (2026)

7. Digital Economy as a Determinant of FDI Inflows

The digital economy is a main driver for restructuring international commerce and direct investment, altering the location selection of the investing MNE and the competitive advantage of the host economy. The locational advantages that were traditional were static and physical. However, in the contemporary globalized digital ecosystem, the site selection of a multinational corporation is highly contingent on a host country's 'digital infrastructure' and 'digital readiness'. These components include telecommunication hardware (high speed broadband networks, 5G density, secure servers) and soft digital services like the digital public services provided by e-governance platforms. Host markets need to be highly digitally ready to let MNEs use sophisticated digital instruments, automated supply chains and online commercial platforms to reduce transactional frictions, maintain cybersecurity and facilitate continuous cross-border communication.

Digital infrastructure and e-governance have become the main non-traditional elements of investment attractiveness in the Western Balkan region. Countries that have made the biggest investments in digital governance and public sector digital transformation, such as those at the top of the UN E-Government Index, have the most transparent and predictable business environment. For example, e-governance solutions save significantly the administrative costs involved in setting up a corporation, dealing with customs and tax procedures. Digitization of administrative operations systematically reduces space for bureaucratic discretion, unwarranted delays and corruption." The findings of (Chen and Jiang 2023), also strongly corroborate this regulatory and institutional impact and highlight the major direct and moderating function of institutional quality in attracting FDI. Such institutional excellence, which always minimizes operational risks and transaction frictions for foreign investors, is very clearly shown by the digital public service portals. A transparent e-government system signals institutional stability and regulatory modernity to foreign investors, which reduces the risk premium of entrance into a transitioning market.

Moreover, domestic sector digitization enables the formation of "platform economy" and digital ecosystems that attract efficiency-seeking FDI. Efficiency-seeking MNEs are investing in transition economies to maximize their global operations, build digital supply centers or tap into particular regional tech skills, as opposed to the typical market-seeking or resource-seeking investment. The OECD Digital Economy Outlook (2024) countries with a higher connectivity index attract more Greenfield FDI in technology intensive and service focused industries (OECD 2024). The move toward a digital economy is an important way

to diversify investment inflows into digital services, software development and regional technical support hubs which offer much higher value added for the local workforce (Kimura and Flood 2025), in a Western Balkans region where manufacturing has historically dominated FDI trends. This move toward a knowledge-based digital economy implies that digitalization and foreign investment are not independent. In example (Kusairi et al. 2023) show that digitalization's interaction with FDI inflows has a strong synergistic effect that improves long-term economic development by enhancing the total factor productivity of host nations.

8. Strategic Management and Absorptive Managerial Capacity

Macro-level digital readiness provides physical and procedural groundwork for FDI but firm-level strategic management and absorptive ability are the key determinative aspects that define whether these investments will provide durable, sustainable developmental effects. Strategic management perspective: Host-country managerial ability is the strategic leadership, technical product expertise and organizational flexibility of local enterprises. Local managers are the cognitive filter and operational bridge between the home market and the advanced operational frameworks brought into the MNEs. Sophisticated strategic competencies foster local managers' proactive identification of technical synergies, strategic relationships with international affiliates, and integration of local supply chains into global corporate networks.

The current empirical research on transition markets clearly supports the essential requirement of firm-level competence in harnessing the benefits of investment. In their extensive firm-level study of transition economies, (Vujanović, Stojčić, and Hashi 2021), show that technological and knowledge spillovers from FDI are highly heterogeneous and are fundamentally conditioned by the 'absorptive capacity' of domestic firms (Vujanović, Stojčić, and Hashi 2021). In this respect, the (OECD 2026) points out that FDI inflows to the Western Balkans have risen, but their spillover benefits into domestic SMEs are still restricted owing to enduring gaps in local digital usage and business connections. This line of thought is strongly related to the wider literature on FDI, both financial and developmental. As demonstrated by (Alfaro et al. 2004), the growth-oriented benefits of FDI are dependent on the conditions of the host market and the domestic structures at the local level, such as the presence of strong financial markets and institutional capacities, which enable host economies to successfully absorb and exploit foreign technological spillovers. Local companies, with solid internal capabilities, current risk management techniques and established training systems, are very effective in adopting the sophisticated operational models, digital platforms and technological know-how brought by international investors. Conversely, local businesses without such capacities cannot reap the externalities of knowledge and may suffer from the crowding-out consequences of fierce competition. This capacity mismatch is especially severe

in highly regulated financial and service sectors. (Nguyen et al. 2023) show that foreign equity involvement results in different and very sophisticated risk-taking and operational behaviors in domestic property and casualty insurance businesses in Vietnam, elucidating the function of global corporate parentage in improving technical risk capacity. Therefore, we argue that the attraction and retention of high-quality digital FDI is a dynamic process of multi-level interaction. Macro digital preparedness and micromanagement competence are not independent factors; they are rather complementing drivers. FDI gains will "leak" out of a transition nation with good digital public services and connectivity, but serious deficiencies in strategic management abilities and organizational agility. Under such asymmetric circumstances MNEs could behave as isolated 'enclaves' in the host economy, importing their own important staff, and without producing favorable technical or managerial spillovers for local enterprises. For the transition markets in the Western Balkans to develop durable competitive advantages, they need to pursue dual-track upgrades that combine the physical digitization of the sector with the strategic professionalization of the local management corps.

9. Empirical Methodology and Western Balkan Panel Estimation

This study constructs a balanced panel dataset of the six Western Balkan transition economies: Albania, Bosnia and Herzegovina, Kosovo, Montenegro, North Macedonia and Serbia for the eight-year period 2018-2025 (T = 8, N = 6, which gives a total of 48 country-year observations) to empirically test the theoretical propositions developed in our framework. The dependent variable, FDI Performance, is assessed as net inward FDI flows as a proportion of gross domestic product (GDP) obtained from the UNCTAD World Investment Report 2025 and World Bank World Development Indicators (WDI)(UN Trade and Development 2025). The main explanatory variable, Digital Readiness (DIG), is a composite index based on the UN E-Government Development Index and ITU ICT Development Index. To reflect the macro-level conditioning environment, we build a composite indicator of Digital Readiness (DIG)... The significance of these indicators has also been emphasized by the Regional Cooperation Council (RCC 2025), who launched a special DESI dashboard to systematically track and monitor the development of digital transformation throughout the Western Balkan (WB6) economies. To test whether local management qualities actively regulate and magnify the effect of digitalization on investor attractiveness, we use a moderated panel regression model with an interaction term. The econometric model is stated as:

$$FDI_it = b0 + b1*DIG_it + b2*MAN_it + b3*(DIG_it * MAN_it) + b4*GDP_it + b5*OPEN_it + u_i + e_it$$

where 'i' is the country, t is the year, DIG * MAN is the interaction term, and control variables are the log of GDP per capita (GDP) as a proxy for market size and trade openness (OPEN) as total exports + imports as a proportion of GDP. Country-specific fixed effects (u i) are included to adjust for time-invariant

unobserved heterogeneity across the six economies and e it is the idiosyncratic error term. The model is calculated in a fixed-effects panel regression framework with robust standard errors clustered at the nation level. The empirical findings from this panel estimation are provided in Table 2.

Table 2. Panel Regression Results for FDI Performance in Western Balkans (2018–2025)

Independent Variable	Coefficient (Std. Error)	t-Statistic	p-Value
Digital Readiness Index (DIG)	0.452 (0.138)	3.275	< 0.01
Managerial Capacity (MAN)	0.284 (0.125)	2.272	< 0.05
Interaction Term (DIG * MAN)	0.198 (0.064)	3.094	< 0.01
GDP per Capita (log)	0.112 (0.089)	1.258	0.224
Trade Openness (OPEN)	0.321 (0.104)	3.086	< 0.01
R-squared (Within)	**0.642**	**--**	**--**
Adjusted R-squared	**0.598**	**--**	**--**

Source: Developed by authors (2026)

The results presented in Table 2 provide substantial and statistically significant support for our basic conceptual framework. The coefficient of Digital Readiness (DIG) is positive and extremely significant (b1 = 0.452, $p < 0.01$), which supports the macro-level digitalization as the active, positive driver of FDI inflows in the Western Balkans. More importantly, the coefficient on the interaction term (DIG * MAN) is positive and statistically significant at the 1% level (b3 = 0.198, $p < 0.01$). This statistically significant interaction term provides empirical support for our moderating hypothesis. This means that the favorable impact of digital readiness on FDI inflows is actively managed and intensified by the level of management competence in the host nation. Specifically, we show that ceteris paribus, economies with higher levels of strategic managerial ability and organizational flexibility attract much more FDI. This interaction impact is definitely large, suggesting that macro-digitalization and micro-management abilities are synergistic locational benefits.

As for control variables, the coefficient of Trade Openness (OPEN) is positive and significant (b5 = 0.321, $p < 0.01$), consistent with the regional economic profiles that trade integration is a fundamental locational benefit for efficiency-seeking investors. Interestingly, the coefficient for GDP per capita (log) is positive but not statistically significant (b_4 = 0.112, p = 0.224). This has important theoretical consequences when seen within Dunning's Eclectic Paradigm (OLI Framework). It suggests that traditional locational (L) advantages, such as physical market size

(historically the key attraction for market-seeking FDI), are losing their main supremacy inside a digitalized Western Balkans. Due to the small size of these transition economies, foreign investors are increasingly being driven by efficiency-seeking FDI. Hence, investment choices are no longer a function of local buying power (GDP per capita) but rather of the availability of digital infrastructure (DIG), trade openness (OPEN) and the domestic strategic managerial capacity (MAN) to absorb innovation. This demonstrates that in the digital age, qualitative locational factors have replaced conventional quantitative macroeconomic proxies. Overall, the fixed effects model has a strong explanatory power with an R-squared of 0.642, suggesting that our integrated, multi-level factors explain a large share of the variance in FDI inflows throughout the area.

7. Strategic Policy and Firm-Level Managerial Implications

The empirical and theoretical results of this study provide important policy relevant and company level implications for regional governments, investment promotion agencies and business managers in the Western Balkans. From an institutional and macro-economic policy point of view, our findings show that national investment policies need a structural adjustment to be able to attract sustainable FDI in the digital age. Regional authorities need to go beyond typical incentives—corporate tax holidays, administrative tax subsidies, encouragement of cheap labor—to significant structural enhancements in digital preparedness. Given the significance of digital readiness for attracting FDI, governments ought to give priority to: (1) fast-tracking the rollout of next-generation ICT infrastructure, particularly high-speed broadband networks within industrial zones; (2) thorough digitization of public administration via e-governance platforms to eliminate transactional corruption and boost regulatory transparency; and (3) recalibrating national education programs to meet the demands of the digital economy, especially by promoting professional certifications in actuarial science, software engineering, and digital management.

Our firm-level results emphasize the important need for domestic firms and managers to create active absorptive capacity. As beneficial FDI spillover effects are highly dependent on Host-Market Managerial Capacity, local business executives have to take initiative to update their internal management models, financial reporting systems and operational procedures. Local managers should not see foreign market entrance as a harmful competitive threat, but instead as a wonderful opportunity for technological and organizational development. This is particularly the case in heavily regulated financial and services industries where international norms prevail. By reducing ‘institutional distance’ – for example, by moving toward the risk-based Solvency II directive in insurance, and by integrating domestic firm structures much more closely with regulatory systems in the European Union – domestic firms can naturally become very attractive partner options for top multinational corporations. Moreover, local companies must also engage in 'human capital' development via strategic relationships with regional academic institutions to ensure a continual supply of specialized tech-talent.

8. Conclusion, Limitations, and Future Research

The study provided a multi-level conceptual and empirical examination of the interplay between digital readiness and firm-level strategic management in driving FDI attractiveness in developing and transition economies, with an emphasis on the neglected Western Balkan area. This study contributes to a major gap in the international business literature by developing an integrated framework that relates macro-level connectivity indicators to micro-level management qualities. We empirically estimate the six Western Balkan economies over the 2018-2025 timeframe and find digital readiness to be a very substantial locational advantage but its favorable effect on FDI inflows is greatly magnified by the degree of host-market strategic managerial competence. In the digital economy, the attraction of foreign capital is no more a simple game of low taxes and physical infrastructure. It is a dynamic process where macro-digitalization and micro-management skills are complementary determinants.

Although interpreting the study results, several limitations of this study need to be addressed, yet at the same time, they provide potential opportunities for further research. First, our empirical model is built on a composite indicator of Host-Market Managerial Capacity developed from company survey data, which may suffer from subjective judgment bias and cognitive framing difficulties. Future study might solve this restriction by using objective firm-level indices of financial success, such as real IT investment volume, expenditures on training employees, and quantitative measures of productivity. Secondly, our panel study is limited to the macro-economic and aggregate sectoral level of the six Western Balkan transition nations. Further research might study the moderating influence of strategic management in regulated sectors and technology-intensive sectors using micro-level, multi-sectoral datasets (e.g., banking, insurance, and manufacturing sectors). Third, while our panel data allow us to see change over time across an eight-year period, further research using longitudinal mixed-methods designs would provide more qualitative insights into the development of channels of knowledge and digital technology transfers in transition economies.

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FINANCIAL INVESTEMENTS IN RESEARCH, DEVELOPMENT AND INNOVATION: GROWTH ELASTICITY ACROSS INCOME GROUPS

Dance Nikolovska Vrateovska[1], Snezhana Mojsoska[2], Ljupco Davcev[3]

Abstract

This paper explores the relationship between financial investments in research, development, and innovation and their capacity to generate sustainable economic growth. By positioning elasticity as the central analytical concept, the study examines how economies at different income levels respond to innovation inputs, emphasizing the conditional nature of innovation-driven development. The analysis highlights structural asymmetries across income groups, shaped by institutional maturity and absorptive capacity. Rather than treating innovation investment as a universal growth engine, the findings underscore innovation-driven development as conditional, shaped by institutional and structural contexts, without assuming uniform outcomes across income groups. The contribution of the paper lies in reframing the discourse from quantitative allocation toward qualitative conditions, offering a framework for understanding how institutional structures mediate the transformation of financial inputs into growth outcomes. In doing so, it provides a roadmap for policymakers seeking to align innovation strategies with broader developmental trajectories and to foster sustainable, knowledge-based economic expansion.

Keywords: innovation inputs, innovation-driven development, conditional development, income level, absorptive capacity, institutional maturity, sustainable economic growth,

1. Introduction

Innovation investment has long been recognized as a driver of economic growth, yet its effectiveness varies across contexts. The concept of elasticity - how strongly GDP growth adjusts to changes in R&D intensity and innovation

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capacity - offers a sharper lens for comparative analysis. By focusing on responsiveness rather than absolute levels, this study investigates whether economies at different income levels translate innovation inputs into measurable growth outcomes. This perspective is particularly relevant for policy design, as it highlights the conditional nature of innovation-driven development.

2. Literature Review

Research on the relationship between innovation investment and economic growth consistently highlights differentiated effects across income groups and institutional maturity. Thia and Do (2024) identify a bidirectional relationship between technological innovation and GDP growth across 71 countries, while Licandro (2021) emphasizes firm dynamics and technology diffusion as critical transmission channels. Gondauri et al. (2024) estimate that a 1% increase in R&D expenditure can yield a 1.5–2.2% rise in GDP growth in advanced economies with strong absorptive capacity. Conversely, Gutiérrez-Sánchez and Benéitez-Andrés (2025) show that in Panama, structural challenges limit the effectiveness of R&D expenditure, underscoring the importance of institutional maturity.

Comparative studies reinforce this gradient. The conclusion of the study by Bate, Wachira, and Danka (2023) is that there exists a clear developmental gradient among economies in terms of their capacity to harness innovation as a driver of growth. High-income countries benefit from institutional maturity and robust systems that enable the effective utilization of new technologies and knowledge. In contrast, low-income countries face significant absorptive capacity constraints—namely, a lack of institutional mechanisms, human capital, and infrastructure necessary to integrate and apply innovations. Dempere et al. (2023) find that innovation positively influences GDP growth, foreign direct investment, and self-employment, but institutional quality mediates these effects. Kim (2025) highlights that returns to R&D vary across firm, sector, and national levels, with diminishing returns in emerging economies due to structural bottlenecks. The World Bank's GovTech Maturity Index (2025 update) further shows that digital government readiness enhances the effectiveness of innovation policies, while the Global Innovation Index (2025) notes that although breakthrough technologies such as AI and quantum computing advance rapidly, overall R&D growth has slowed, making responsiveness increasingly conditional on institutional adaptation.

3. Methodology

This study positions elasticity as a conceptual bridge between innovation inputs and economic growth outcomes. While econometric modeling provides statistical precision, direct elasticity offers interpretive clarity and comparability across heterogeneous economies (Nikolovska Vrateovska et al., 2026). By emphasizing elasticity, the analysis moves beyond absolute levels of R&D expenditure and instead captures the proportional responsiveness of growth to innovation investments, a perspective particularly valuable in cross-country

research where institutional maturity and absorptive capacity vary significantly. The twelve-country sample was deliberately chosen to reflect structural diversity across four World Bank income categories: high-income economies (Germany, Switzerland, Bulgaria), upper-middle income economies (North Macedonia, Serbia, Turkey), lower-middle income economies (Bolivia, Egypt, India), and low-income economies (Guinea, Congo, Madagascar). This breadth is essential, as elasticity becomes meaningful only when tested across contrasting institutional contexts. Including both advanced and emerging economies allows the analysis to reveal whether innovation investments yield proportionally greater growth in settings with weaker absorptive capacity, or whether institutional maturity amplifies responsiveness — a methodological approach and econometric framework consistent with prior work (Nikolovska Vrateovska et al., 2026). This integration ensures that the country selection and analytical design build upon established findings while allowing for new comparative insights.The dataset covers annual GDP growth and R&D expenditure from 2013 to 2024, while GovTech maturity and Global Innovation Index (GII) scores are available only for 2024/25. These indicators are interpreted as structural anchors—a snapshot of institutional maturity at the end of the period—serving as conditioning variables that contextualize the responsiveness of growth to R&D intensity. In this way, GovTech and GII are not modeled as dynamic series but as institutional baselines against which elasticity is read.

Direct elasticity is formally defined as:

$$\text{Elasticity}=\Delta\text{GDPgrowth}/\text{GDPgrowth}\Delta\text{R\&D}/\text{R\&D} \quad (1)$$

Here, GDPgrowth represents the annual growth rate of gross domestic product, serving as the dependent outcome variable. R&D denotes expenditure on research and development as a share of GDP, representing the primary innovation input. The numerator captures the relative change in economic growth, while the denominator reflects the relative change in R&D intensity. This formulation allows the analysis to measure proportional responsiveness: how strongly growth adjusts when innovation inputs change.

Regression-based elasticity, estimated through a fixed-effects panel model, remains in the background as a supporting tool, identifying marginal responsiveness while controlling for country-specific heterogeneity and global shocks. The regression framework is expressed as:

$$\text{GDPgrowth}_{it}=\alpha+\beta1\text{R\&D}_{it}+\beta2\text{GovTech}_{i}+\beta3\text{Innovation}_{i}+\mu_i+\lambda_t+\varepsilon_{it} \quad (2)$$

In this specification, GDPgrowth_it is the dependent variable (economic growth of country *i* in year *t*), R&D_it is the independent variable capturing research intensity, GovTech_i represents the institutional and digital readiness of governments, and Innovation_i denotes innovation capacity proxied by GII scores. The coefficients β1, β2, β3 quantify the marginal impact of each innovation-related variable on growth. μ_i controls for unobserved country-specific heterogeneity, while λ_t captures time-specific shocks such as crises.

Focusing on direct elasticity enables the identification of average sensitivities of economic growth to innovation investments across diverse income groups. This approach enriches the analysis by embedding quantitative estimates within a broader comparative framework, producing a dual analytical horizon: one that provides precise measurement of responsiveness, and another that interprets the structural conditions under which innovation investments are transformed into growth. Elasticity is not determined solely by the level of R&D expenditure or innovation indicators; it is shaped by the broader institutional environment. Absorptive capacity, governance quality, and digital readiness emerge as critical dimensions. High-income economies typically possess advanced infrastructures and skilled human capital, allowing R&D expenditure to translate directly into growth, while lower-income economies often lack the institutional and technological base to absorb innovation effectively. Governance quality determines whether resources are allocated efficiently and policies implemented consistently, with weak governance undermining the potential impact of innovation investment. Digital readiness, captured by GovTech indicators, enhances elasticity by facilitating innovation diffusion and improving institutional responsiveness, whereas low digital maturity constrains the translation of innovation inputs into measurable outcomes.

By profiling economies along these dimensions, the analysis demonstrates that elasticity is conditioned by structural and institutional contexts, underscoring that innovation-driven development is not universal but contingent upon absorptive structures, governance quality, and digital readiness. Descriptive visualization further illustrates these differentiated patterns, aligning GDP growth trajectories with innovation indicators across income categories. The methodological design thus expands the international debate on innovation-led growth: direct elasticity highlights the proportional effects of innovation investments on economic performance, while econometric analysis confirms their statistical significance. Despite limitations in data availability, the framework allows for an interpretation that is both relevant to the scholarly community and applicable to economic policy. This balance between analytical depth and practical applicability strengthens the value of the research within the broader discourse on economic development.

4. Results and discussion

The comparative analysis of direct elasticity across income groups reveals structural asymmetries in the ability of economies to translate financial investments in research and development into sustained growth.

High-income economies, where R&D expenditure averages around 3% of GDP, show an elasticity value of 0.28, indicating relatively low but stable responsiveness.Incremental increases in R&D intensity consistently generate proportionate growth effects, reflecting strong absorptive capacity, advanced institutional maturity, and well-integrated innovation ecosystems. The correlation between R&D and growth is weak and negative (-0.242), and regression estimates do not confirm statistical significance ($\beta 1 = -0.497$, $p = 0.215$). Elasticity provides

the clearest measure of proportionality in growth responses.*This group also records the highest average GII (≈5.4/10) and strong GovTech maturity (≈0.83), reinforcing the role of digital governance and innovation ecosystems in sustaining responsiveness.*

Upper middle-income economies Upper middle-income economies demonstrate higher responsiveness, with an elasticity value of 1.45. Despite relatively high GDP growth rates (≈4.5%), modest R&D expenditure (≈0.9% of GDP) constrains innovation-driven growth. Correlation is positive and moderate (0.374), and regression results indicate a statistically significant partial effect ($\beta1 = 3.359$, $p = 0.035$). The relatively high elasticity and regression coefficient provide complementary evidence of a strong relationship between R&D intensity and growth, although they capture different dimensions of this relationship: elasticity reflects average proportional responsiveness, while regression isolates the marginal effect of R&D on growth under the specified model conditions. Together, these results suggest that R&D intensity is associated with substantial growth responsiveness in upper middle-income economies. GovTech maturity may further support this relationship by strengthening institutional readiness and the capacity to translate R&D investments into growth outcomes. *Indeed, their average GII (≈3.3/10) and GovTech score (≈0.87) suggest transitional but promising innovation systems, where governance reforms remain decisive.*

Lower middle-income economies exhibit pronounced heterogeneity. Elasticity values reach as high as 2.10, indicating strong but uneven responsiveness. Egypt and India demonstrate significant effects, while Bolivia shows negligible impact despite similar R&D expenditure (≈0.6% of GDP). Correlation is weak (0.213), and regression results indicate a positive but statistically insignificant effect ($\beta1 = 3.193$, $p = 0.258$). Elasticity reveals the conditional nature of innovation-driven development within this group, confirming that financial investment alone is insufficient; absorptive capacity, institutional maturity, and policy coherence are decisive in mediating the translation of innovation inputs into growth outcomes.*Their average GII (≈3.1/10) and GovTech score (≈0.79) reflect uneven institutional readiness, explaining why responsiveness varies so sharply across countries in this category.*

Low-income economies Low-income economies remain structurally disconnected from innovation-led growth. With R&D expenditure at only 0.2% of GDP, elasticity is negligible, confirming that innovation inputs fail to generate measurable growth effects. Correlation is weak (0.167), and regression results indicate a positive but statistically insignificant effect ($\beta1 = 3.927$, $p = 0.370$). Economic performance is instead driven by exogenous factors such as aid, commodity cycles, and remittances. This outcome underscores the primacy of foundational reforms in governance, infrastructure, and institutional capacity as prerequisites for innovation-related investments to become effective. *Their average GII (≈1.6/10) and GovTech score (≈0.43) confirm systemic weaknesses, highlighting the absence of digital maturity and institutional capacity as binding constraints.*

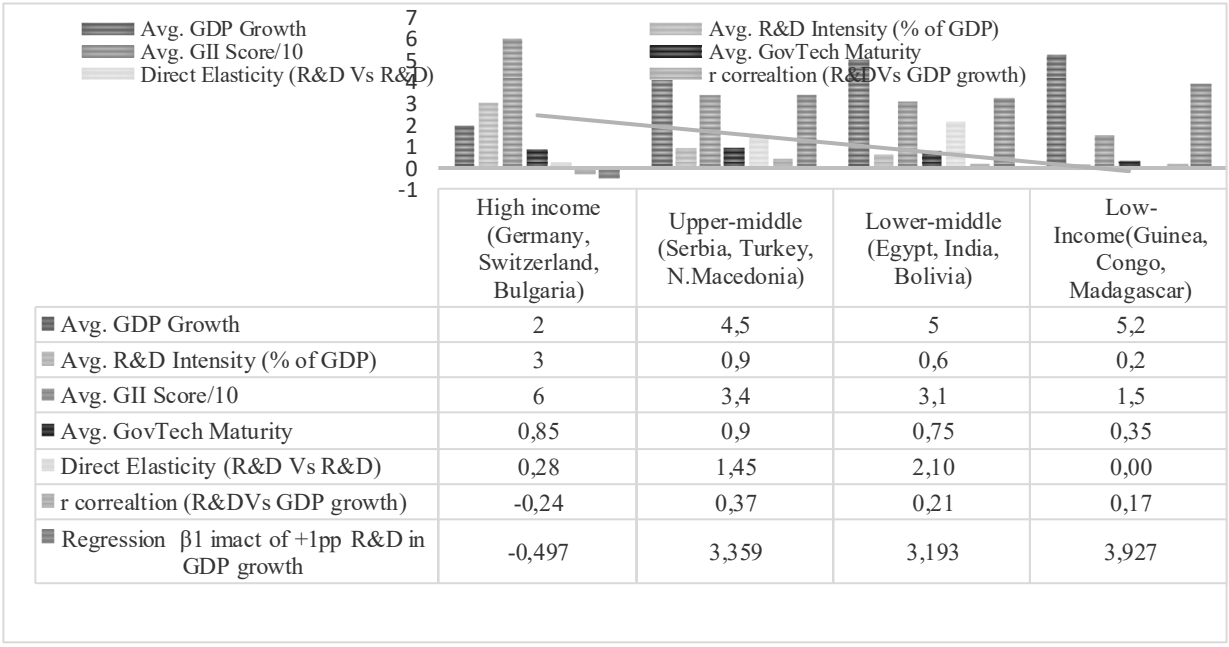
Overall, the evidence demonstrates that direct elasticity is a revealing measure of responsiveness, highlighting differentiated patterns across income groups. While

correlations and regression coefficients provide complementary evidence on the relationship between R&D and growth, their statistical significance varies across income groups. Elasticity captures the proportionality of growth responses and exposes the conditional nature of innovation-driven development. Innovation-led growth is not universal but contingent upon absorptive structures, governance quality, and digital maturity.

4.1 Implications

The analysis reveals differentiated patterns in the responsiveness of economic growth to innovation investment across income groups. High-income economies exhibit relatively low but stable responsiveness, while the negative correlation and statistically insignificant regression coefficient suggest that the relationship between R&D and growth is not consistently strong in this group. Upper middle-income economies show high responsiveness, supported by a moderate positive correlation and a statistically significant regression effect, underscoring the role of governance quality and structural conditions in their innovation systems. Lower middle-income economies exhibit high but uneven responsiveness, with significant heterogeneity within the group, highlighting the decisive role of institutional readiness and absorptive capacity. Low-income economies display negligible responsiveness, confirming that innovation policies cannot substitute for foundational reforms in governance, infrastructure, and institutional maturity.

By emphasizing elasticity, the study underscores that innovation-driven development is conditional rather than universal. For policymakers in lower-income contexts, institutional strengthening and capacity building must precede expectations that R&D expenditure will yield growth dividends. In high-income economies, relatively low elasticity suggests that higher R&D intensity does not automatically translate into proportional growth gains, while middle-income countries may achieve stronger growth responses when innovation strategies are integrated with governance and structural reforms. Elasticity of GDP growth with respect to innovation investment thus emerges as an important indicator distinguishing development trajectories across income groups: relatively low responsiveness in high-income economies, high but conditional responsiveness in middle-income economies, and negligible responsiveness in low-income economies where institutional transformation remains indispensable.



	High income (Germany, Switzerland, Bulgaria)	Upper-middle (Serbia, Turkey, N.Macedonia)	Lower-middle (Egypt, India, Bolivia)	Low-Income(Guinea, Congo, Madagascar)
Avg. GDP Growth	2	4,5	5	5,2
Avg. R&D Intensity (% of GDP)	3	0,9	0,6	0,2
Avg. GII Score/10	6	3,4	3,1	1,5
Avg. GovTech Maturity	0,85	0,9	0,75	0,35
Direct Elasticity (R&D Vs R&D)	0,28	1,45	2,10	0,00
r correaltion (R&DVs GDP growth)	-0,24	0,37	0,21	0,17
Regression β1 imact of +1pp R&D in GDP growth	-0,497	3,359	3,193	3,927

Graph 1. Cross-Country Heterogeneity in R&D Intensity, Innovation Capacity, and Growth Responsiveness across Income Groups
Source: World Bank, OECD, UNESCO, WIPO

* For visualization purposes only, Global Innovation Index (GII) values are divided by 10. In all econometric analysis and statistical estimations, original values are used without transformation.
* The results were obtained econometrically, following statistical, correlation, and regression analyses, as conducted by the authors.

The comparative visualization of grouped bar charts provides an integrated empirical representation of these structural differences, jointly presenting key input indicators, institutional and innovation-capacity measures, correlation coefficients, direct elasticity estimates, and regression coefficients. This integrated perspective captures the complexity of the relationship between innovation investment and economic growth across heterogeneous development contexts. The visual dispersion across income categories highlights substantial heterogeneity in the transmission mechanisms linking R&D intensity to economic performance, indicating that the strength and direction of this relationship are not uniform across levels of economic development. Furthermore, the distinction between direct elasticity estimates and regression-based coefficients (β) enhances analytical depth by allowing for a more nuanced interpretation of proportional responsiveness and marginal effects within the R&D–growth nexus. The coexistence of high elasticity and regression coefficients in the upper- and lower-middle-income groups, contrasted with relatively low or negligible elasticity in the high- and low-income groups, provides complementary evidence that the growth responsiveness to innovation investment is strongly conditioned by the structural and institutional environment. The correlation

coefficients further indicate that the strength and direction of the bivariate association vary across income groups, while the regression results demonstrate that statistical significance is not uniform, reinforcing the importance of distinguishing between magnitude, association, and statistical inference.

In line with these findings, policy must be differentiated and context specific, aligning innovation strategies with institutional capacity and absorptive conditions. This perspective shifts the focus from measuring innovation inputs alone to assessing the extent to which R&D investments are effectively absorbed, diffused, and transformed into sustainable economic expansion. Such an approach offers a robust analytical framework for policymakers and researchers by emphasizing that the economic returns to innovation investment are conditional upon the institutional, technological, and governance structures within which innovation activities are embedded.

5. Conclusion

Financial investments in research and development (R&D) and innovation should not be conceived merely as the allocation of resources to generate new ideas, but rather as integral components of a broader process through which economies absorb, adapt, and apply knowledge within their socio-economic systems. The effectiveness of such investments is contingent upon institutional frameworks, human capital, digital capabilities, and infrastructural conditions that facilitate knowledge diffusion and technological integration. The findings demonstrate that the relationship between innovation investment and economic growth is heterogeneous across income groups and cannot be adequately characterized by a uniform development trajectory.

In *high-income economies*, the policy imperative is not simply to expand R&D expenditure, but to improve the efficiency and productivity of established innovation systems. Mature institutional and digital environments provide a strong foundation for innovation, yet the empirical pattern indicates that additional innovation inputs do not automatically translate into proportional growth effects. Policy should therefore emphasize the quality of R&D allocation, research productivity, human capital development, knowledge-intensive sectors, and the commercialization and diffusion of research outputs. The emphasis should be placed on sustaining the adaptability and efficiency of mature innovation ecosystems rather than assuming that increasing investment intensity alone will generate equivalent growth dividends.

For *upper middle-income economies*, the findings point to a comparatively favorable environment for converting innovation investment into economic performance, while also highlighting the importance of institutional quality in sustaining this process. Policy priorities should therefore focus on strengthening governance effectiveness, transparency, digital public infrastructure, technology transfer mechanisms, and linkages between research institutions and productive sectors. Strategic support for applied research, innovation-oriented enterprises, and export-capable sectors can further strengthen absorptive capacity and enable

these economies to consolidate their transition toward more knowledge-intensive growth models.

In *lower middle-income economies*, the evidence points to substantial responsiveness but considerable heterogeneity in the mechanisms through which innovation contributes to growth. This suggests that aggregate innovation potential can coexist with significant differences in institutional and absorptive capacity across economies. Policy should consequently focus on reducing these structural disparities through stronger research institutions, entrepreneurial ecosystems, technology diffusion, regional cooperation, and targeted digital transformation. Rather than pursuing generalized increases in R&D expenditure, governments should prioritize the institutional and productive conditions that allow innovation investments to generate broad-based and sustainable economic effects.

For *low-income economies*, the central policy challenge is more foundational. Limited institutional capacity, weak infrastructure, constrained human capital, and low levels of digital maturity restrict the effective absorption and economic utilization of innovation inputs. Consequently, innovation policy should be embedded within a broader development strategy centered on governance reform, education, infrastructure, digital capability, and the gradual development of absorptive capacity. R&D investment remains important, but its effectiveness is likely to depend on the establishment of these complementary foundations. Policies should therefore prioritize the adaptation and diffusion of existing technologies, the development of local capabilities, and the creation of institutional conditions under which future innovation investments can generate stronger economic returns.

Overall, the findings support a differentiated and context-specific approach to innovation policy. Innovation-led development is neither automatic nor uniform across income groups; rather, its effectiveness depends on the capacity of economies to absorb, adapt, diffuse, and commercially exploit knowledge and technology. The policy challenge consequently shifts from the volume of innovation inputs toward the institutional and structural capacity to convert those inputs into productive economic outcomes. This perspective provides a more nuanced framework for understanding the R&D–growth nexus and for designing innovation strategies that correspond to the distinct developmental constraints and capabilities of economies at different stages of economic development.

**The views expressed in this paper do not necessarily reflect the views of the institutions in which authors are employed*

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CASHLESS PAYMENTS AND CONSUMER SPENDING BEHAVIOUR IN THE BALKANS: EVIDENCE BEFORE AND AFTER COVID-19

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Abstract

This paper explores the connection between the growing use of cashless payments and household consumption trends in selected Balkan countries before and after the COVID-19 pandemic. The analysis covers the period 2016–2024 and includes North Macedonia, Serbia, Albania, Croatia and Bulgaria. The study relies on secondary statistical data obtained from national central banks, the European Central Bank and the World Bank. The main indicators used are card payment transactions per capita, number of POS terminals and household final consumption expenditure.

The research uses comparative trend analysis and descriptive statistics, with the observed period divided into two phases: pre-pandemic (2016–2019) and pandemic and post-pandemic (2020–2024). Changes in cashless payment use are compared with changes in household consumption to identify common trends and differences across the selected countries.

The results show a clear increase in cashless payment use across all five countries, although the pace of change differs between them. Growth continued after the main COVID-19 restrictions ended, suggesting that the move towards electronic payments was not only temporary. Household consumption also recovered after the pandemic. However, the size of the changes differed across countries, and the results do not show a direct cause-and-effect relationship between cashless payment use and consumer spending.

The study provides a comparative view of changing payment and consumption patterns in Southeast Europe. The findings may be useful for policymakers, financial institutions and businesses working on payment infrastructure, digital financial services and financial inclusion.

Keywords: cashless payments, consumer spending, digital payments, Balkans, digitalization

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1. Introduction

Digital technology has changed the way people buy goods and services and make payments. Consumers increasingly use debit and credit cards, mobile banking and other electronic payment methods. Contactless payments have also become common because they are fast and easy to use.

Cashless payments were already growing before the COVID-19 pandemic, but the pandemic made this process much faster. During 2020, lockdowns, restrictions on movement and concerns about physical contact changed everyday shopping habits. Many consumers started shopping online more often and used cards or mobile payments instead of cash. The European Central Bank reported a strong fall in the use of cash for daily payments during this period. Around 40% of respondents in a 2020 Eurosystem survey stated that they were using cash less often than before the pandemic (European Central Bank, 2021).

ECB data also show a continued shift away from cash, with its share of point-of-sale payments falling from 79% in 2016 to 59% in 2022 (European Central Bank, 2022). Research also suggests that payment method may affect spending. Schomburgk et al. (2024) found a small "cashless effect", with consumers generally spending more when using cashless rather than cash payments.

Piekut and Piekut (2022) also found clear changes in household consumption across European countries during COVID-19, although the changes differed between countries and types of spending. The Balkan countries are a useful case for studying these changes because their payment systems have developed at different speeds. There are differences in access to banking services, payment infrastructure, internet use, and consumer habits. Some countries have moved more quickly towards electronic payments, while cash remains important in others. As a result, the shift towards cashless payments has not been the same across the region.

Most previous studies focus on one country, consumer surveys, or the intention to use a specific payment technology. Hellemans et al. (2023) note that there is still limited evidence comparing payment behaviour before, during and after COVID-19. Comparative research covering several Balkan economies over a longer period is also limited. This leaves room to examine whether similar changes can be seen across countries with distinct levels of payment digitalisation.

This paper examines cashless payments and consumer spending in North Macedonia, Serbia, Albania, Croatia and Bulgaria from 2016 to 2024. Card payments and payment infrastructure are used as indicators of cashless payment development, while household final consumption expenditure measures consumer spending. Comparative trend analysis and descriptive statistics are used to compare changes before and after 2020 and differences across the five countries. Based on this aim, the paper addresses three research questions:

1. How did the use of cashless payments change in the selected Balkan countries between 2016 and 2024?

2. Was the growth of cashless payments stronger during and after the COVID-19 pandemic?
3. Is there a relationship between cashless payment use and consumer spending in the selected countries?

The findings may help explain whether the move from cash to electronic payments is connected with changes in consumer spending in the region. They may also be useful for banks, businesses and policymakers working on payment systems, digital financial services, and financial inclusion.

2. Literature Review

Convenience is one of the main reasons why consumers choose cashless payments. People can pay quickly without carrying cash, while contactless cards make small everyday purchases easier. Brown et al. (2022) found that greater convenience increased the use of debit cards. Their findings indicate that the way a payment method works can influence the consumer's choice between cash and electronic payment.

The choice of payment method may also relate to the amount of money consumers spend. When people pay with cash, they see and physically give the money at the time of purchase. This experience is different when paying by card or mobile phone. Schomburgk et al. (2024) reviewed 71 studies dealing with this issue. They found that consumers generally spend more when using cashless payment methods. The authors describe this as the “cashless effect”. However, its size is not the same in every situation and may depend on the type of purchase, payment method and consumer.

The COVID-19 pandemic gave consumers another reason to use electronic payments. During lockdowns, online shopping became more important, and many people reduced their use of cash. Hellemans et al. (2023) compared mobile payment use before and during the pandemic and found an increase between 2019 and 2020. They also found a connection between mobile payments, online shopping and impulse buying. Payment habits were therefore changing together with shopping habits during this period.

COVID-19 also affected household spending and attitudes towards financial technology. Piekut and Piekut (2022) found changes in household consumption across European countries, while Daragmeh et al. (2021) found that usefulness, trust and health concerns influenced the intention to use digital payments among Generation X consumers in Hungary. These studies show that changes in payment behaviour during COVID-19 were also linked to wider changes in consumer behaviour.

European countries entered the pandemic with different levels of payment infrastructure and digital development. These differences are also present in the Balkans, where banking access, internet use, digital skills and consumer habits vary across countries.

Previous research gives useful information about the adoption of electronic payments and the effect of COVID-19 on payment behaviour. However, many

studies focus on one country, consumer surveys or a specific payment technology. Comparative studies using payment and consumption data for several Balkan countries over a longer period remain limited. This study addresses this gap by comparing developments in five countries during 2016–2024. Based on previous research, four hypotheses are tested:

H1: The use of cashless payments increased in the selected Balkan countries during the period 2016–2024.

H2: The growth of cashless payments was stronger during the pandemic and post-pandemic period (2020–2024) than during the pre-pandemic period (2016–2019).

H3: Growth in cashless payment use is accompanied by growth in consumer spending in the selected countries.

H4: The development of cashless payments and consumer spending differs among the five selected countries.

3. Data and Methodology

This study covers five Balkan countries: North Macedonia, Serbia, Albania, Croatia and Bulgaria. The period of analysis is 2016–2024. These countries were selected because they belong to the same region but have different levels of economic and digital development. There are also differences in their banking systems and use of electronic payments.

The research uses secondary quantitative data from official sources. Data on card payments and payment infrastructure are collected mainly from the central banks of the five countries: the National Bank of the Republic of North Macedonia, the National Bank of Serbia, the Bank of Albania, the Croatian National Bank and the Bulgarian National Bank. Data from the European Central Bank are used where they are available and comparable. Household consumption data are taken from the World Bank World Development Indicators.

Card payment transactions are used as the main indicator of cashless payment use. Where comparable population data are available, transactions per capita are used to support cross-country comparison. The number of transactions is used rather than only their total value because it shows how often cards are used for payments. Since the five countries have different population sizes, the total number of transactions is divided by population. This makes comparison between countries easier.

The number of point-of-sale (POS) terminals is used as an additional indicator of payment infrastructure. For cross-country comparison, POS terminals are calculated per 100,000 inhabitants where comparable data are available. A larger POS network gives consumers more opportunities to pay by card when buying goods and services.

Household final consumption expenditure is used as the main indicator of consumer spending. Data at constant prices are preferred because changes in current prices may also reflect inflation. Annual real growth in household consumption is used as an additional measure.

The period is divided into two parts. The first covers 2016–2019 and represents the years before the COVID-19 pandemic. The second covers 2020–

2024 and includes the pandemic and post-pandemic years. The two periods are compared to see whether the growth of cashless payments changed after 2020.

The analysis starts with descriptive statistics. Changes in card payments, POS terminals and household consumption are examined for each country, with particular attention to differences before and after 2020. Comparative trend analysis is used to examine how the main indicators changed over time.

The relationship between cashless payments and consumer spending is examined by comparing trends and annual changes. Since payment statistics are not reported under identical definitions in all five countries, the analysis focuses on the direction and pace of change rather than statistical correlation. The results are used to identify common patterns and possible relationships, not direct cause and effect, since household consumption is also affected by income, prices, employment and other economic conditions. The main variables and their data sources are presented in Table 1.

Table 1. Main variables and data sources

Variable	Measurement	Main data source
Card payment use	Card payment transactions per capita	National central banks / ECB
Payment infrastructure	POS terminals per 100,000 inhabitants	National central banks / ECB
Household consumption	Household final consumption expenditure, constant prices	World Bank
Consumption growth	Annual real growth of household final consumption expenditure	World Bank

All main data come from official statistical sources. However, payment statistics are not always reported in the same way in every country. Definitions are therefore checked before the indicators are compared. When an indicator is not available under a comparable definition for all countries and years, it is used only as additional information and is not included in the main cross-country analysis.

4. Results and Discussion

4.1. Development of cashless payments

The data show a clear growth in electronic payments in all five countries. The size of the change is different from country to country, but the general direction is similar. Card payments became more common, the number of POS terminals increased, and consumers used digital payment channels more often.

Albania started from a relatively low level of digital payment use. According to the Bank of Albania, there were around 4 digital payments per capita in 2016. By 2024, this number had reached 23 payments per capita. A total of 42.3 million electronic payments were made in 2024, which was 24.4% more than in the previous year (Bank of Albania, 2025).

Serbia also recorded strong growth. In 2024, 628.8 million transactions were made at merchant POS terminals with cards issued by domestic payment

service providers. This was 20.7% more than in 2023. If cards issued outside Serbia are also included, the total number of card purchases reached about 681.7 million. The National Bank of Serbia also reported that card purchases in the country were 116.8% higher in 2024 than in 2020 (National Bank of Serbia, 2025).

A similar pattern can be seen in North Macedonia. Payment cards were increasingly used for the purchase of goods and services during 2024. The number of these payments increased by 14.6% compared with 2023, while their value increased by 15.4%. The number of devices accepting payment cards also increased by 8.3% and reached 34,778 at the end of 2024 (National Bank of the Republic of North Macedonia, 2025).

Croatia has a more developed card-payment market. In 2024, 853.23 million card transactions were recorded, with a total value of EUR 41.35 billion. Of these, 644.32 million transactions were payments for goods and services. Contactless payments represented 79% of card transactions. The Croatian National Bank also reported continued growth in online card payments (Croatian National Bank, 2025).

Card use continued to grow in Bulgaria as well. Bulgarian National Bank payment statistics show an increase in both domestic and cross-border card payments during 2024. Based on the quarterly data, around 554 million card payments were sent during the year, compared with about 479 million in 2023. This represents an increase of around 16% (Bulgarian National Bank, 2025).

Table 2 gives a summary of the latest payment indicators. The national statistics are not fully identical in definition, so the figures should mainly be used to compare the direction and speed of change rather than the absolute size of the payment markets.

Table 2. Selected cashless payment indicators, 2024

Country	Selected 2024 Indicator	Change
North Macedonia	34,778 card-acceptance devices	+8.3%
Serbia	628.8 million domestic-card POS transactions	+20.7%
Albania	23 digital payments per capita	+24.4% electronic payments
Croatia	644.3 million card payments for goods and services	Continued annual growth
Bulgaria	approx. 554 million card payments sent	Approx. +16%

Source: Authors' compilation based on data from the national central banks.

The figures in Table 2 should not be read as a ranking of the five countries because the national central banks use different definitions when reporting payment statistics.

4.2 Changes before and after 2020

The results also point to faster development of electronic payments after 2020. The pandemic was not the beginning of digital payments, but it appears to have increased the speed of a process that was already taking place.

Albania provides a clear example. Digital payments increased from around 4 per capita in 2016 to 23 in 2024. The Bank of Albania also reports that the number had reached only 10 payments per capita in 2021. This means that more than half of the increase between 2016 and 2024 took place after 2021 (Bank of Albania, 2025).

Serbia shows a similar pattern. There were about 314.4 million card purchases in the country in 2020. By 2024, this number had increased to 681.7 million. The increase over four years was 116.8%. At the same time, the POS network expanded. Serbia had 160,857 POS terminals at the end of 2024, which was 64.6% more than five years earlier (National Bank of Serbia, 2025).

Payment infrastructure also improved during this period. More POS terminals, wider internet access and better mobile banking services made electronic payments easier. In North Macedonia, for example, the number of card-acceptance devices increased by 8.3% in 2024 alone. Serbia recorded a 17.7% annual increase in POS terminals in the same year (National Bank of the Republic of North Macedonia, 2025; National Bank of Serbia, 2025).

These results support H1, which states that cashless payment use increased during the observed period. The available data also support H2. Growth continued strongly after 2020, although the exact speed of change was different across countries.

4.3 Consumer Spending after the Pandemic

By 2024, real household consumption was again growing in all five countries. The World Bank data in Table 3 show that growth ranged from about 3.7% in Albania to 5.6% in Croatia. At the same time, electronic payments continued to grow across the five countries.

Table 3. Household consumption and recent payment developments

Country	Household consumption trend in 2024	Cashless payment trend
North Macedonia	about +5.0%	+14.6% card payments for goods and services
Serbia	about +4.2%	+20.7% domestic-card POS transactions
Albania	about +3.7%	+24.4% electronic payments
Croatia	about +5.6%	Continued growth in card transactions
Bulgaria	about +5.0%	Approx. +16% card payments sent

Source: World Bank, World Development Indicators (NE.CON.PRVT.KD.ZG), and national central banks.

Table 3 shows that both household consumption and cashless payments were growing in 2024. However, the growth rates were not the same across the five countries. Albania recorded particularly strong growth in electronic payments, but its household consumption growth was lower than in the other countries. Croatia recorded the strongest household consumption growth among the five countries, while its card-payment market was already more developed. North Macedonia also recorded relatively strong household consumption growth together with continued growth in card payments.

These differences show that the relationship between electronic payments and consumer spending is not simple. A faster increase in card or electronic payments does not automatically mean a similar increase in household consumption. Other economic factors also influence how much households spend.

4.4 Cashless Payments and Consumer Spending

Over the longer period, both electronic payment use and household consumption show an upward trend. Card payments increased strongly, while household consumption recovered after the fall caused by COVID-19 and continued to grow in the following years.

The national payment statistics have an important limitation for correlation analysis. The five central banks do not report one fully identical card-payment indicator for every year from 2016 to 2024. Some statistics include only cards issued domestically, some include cards issued abroad, while others combine several types of electronic payments. Changes in statistical reporting also took place during the observed period.

For this reason, calculating Pearson coefficients from a mixed series could give misleading results. Correlation analysis is therefore not used as the main basis for the cross-country comparison. Instead, the analysis focuses on the direction of change, annual growth and differences between countries.

H3 is only partly supported. Cashless payment use and household consumption generally increased over the observed period. However, the size of the changes was different across countries. The results therefore show that the two developments happened at the same time, but they do not prove that greater use of cashless payments caused higher household consumption.

H4 is supported, as clear differences can be seen among the five countries. Albania and Serbia experienced particularly fast growth in electronic payments from lower starting points, while Croatia entered the period with a more developed card-payment market. North Macedonia and Bulgaria also recorded continued growth, but at different rates.

4.5 Cross-country discussion

The cross-country comparison shows that cashless payments are becoming more common in all five countries, but the starting position matters. Albania and Serbia recorded rapid growth from lower starting levels, while Croatia entered the period with a more developed card-payment market. Percentage growth should

therefore not be interpreted as a direct measure of the overall level of payment digitalisation.

The findings are generally in line with earlier research. Hellemans et al. (2023) found that the pandemic increased mobile payment adoption, while Brown et al. (2022) showed the importance of convenience in payment choice. The continued growth found in this study suggests that the move towards electronic payments was not only a temporary response to COVID-19.

Schomburgk et al. (2024) found evidence of a "cashless effect", but the present results cannot confirm a direct effect on household spending. Consumption also depends on income, employment, inflation and other economic conditions. The findings therefore show parallel changes in payment behaviour and consumption rather than a direct causal relationship.

5. Conclusion

This paper examined the development of cashless payments and consumer spending in five Balkan countries: North Macedonia, Serbia, Albania, Croatia and Bulgaria. The analysis covered the period from 2016 to 2024, with a comparison between the pre-pandemic years and the period from 2020 onwards.

The results support H1 and H2, showing that cashless payment use increased in all five countries and continued to grow strongly after 2020. H3 is partly supported. Cashless payment use and household consumption generally increased over the observed period, but their growth rates differed across countries. The results therefore do not show that greater use of cashless payments directly causes higher consumer spending. H4 is supported, as clear differences were found in the pace of change across the five countries.

The study has some limitations. Payment statistics are not reported under exactly the same definitions in all five countries, which limits direct comparison and the use of a fully comparable correlation model. Household consumption is also affected by income, inflation, employment and other economic conditions. Future research could use longer and more comparable payment series, include additional economic factors and combine statistical data with consumer surveys.

The findings may be useful for policymakers, banks and businesses. The continued growth of electronic payments shows the importance of reliable and accessible payment infrastructure, while differences between countries suggest that digital payment policies should take national conditions into account.

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LOCAL GOVERNMENTS AND FOREIGN DIRECT INVESTMENT

Rositsa Raykova[1]

Abstract

Foreign Direct Investment (FDI) is a key driver of economic growth and regional competitiveness. While national policymakers shape broad investment policies, local governments play crucial role in securing these capital flows. However, highly centralized administrative systems often restrict this local potential. The main goal is to examine how the lack of municipal autonomy limits the economic development, specifically exploring the direct relationship between decentralization and FDI inflows. The study focuses on municipalities in Bulgaria over the period (2017-2024). Using a comparative regional analysis, the research evaluates local institutional capacity and its impact on investment attractiveness. The results reveal a clear pattern. Centralized structures reduce the ability of local governments to respond effectively to investor needs, increasing transaction costs and preventing targeted, place-based strategies. In contrast, regions demonstrating higher administrative efficiency and capable local governments successfully attract and retain more FDI. These municipalities accelerate decision-making and better align policies with local economic conditions. In the end, the findings are showing that strengthening the role of local governments significantly improves FDI performance and remains essential for balanced regional development.

Keywords: Foreign Direct Investment, Local Governments, Decentralization

1. Introduction

The Republic of Bulgaria is a parliamentary republic in which state power is divided into legislative, executive, and judicial branches, operating under a unified legal framework that applies across the entire territory of the country. In accordance with the Constitution of the Republic of Bulgaria, local self-government is exercised through municipalities, which are granted the right to own property and manage independent municipal budgets. As of 2026, Bulgaria

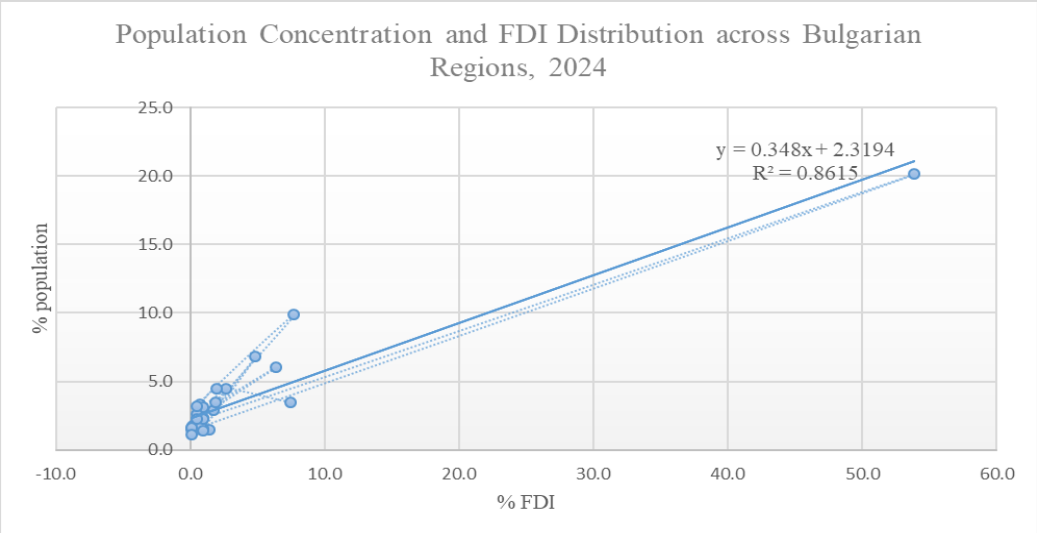
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consists of 265 municipalities with a total population of 6,423,207 inhabitants. Population distribution across Bulgarian municipalities varies considerably. The ability of a municipality to attract or retain residents depends on a combination of factors. Most notably that is economic prospects, employment opportunities, income levels, quality of public services, and overall standard of living. Equally important are the availability of quality education, healthcare and social services, as well as well-developed technical and transport infrastructure. Achieving these conditions largely depends on the financial capacity of municipalities to invest in infrastructure and continuously improve its economic and social environment. This capacity is closely linked not only to attracting new residents but also to attracting investment, both in the form of capital expenditure and through the establishment of companies that create employment, improve living standards, and generate Foreign Direct Investment (FDI).

As of 2024, the regions with the highest population shares are Sofia (20.2% of the national population), Plovdiv (10%), Varna (6.8%), and Burgas (6%). These regions also account for the highest levels of FDI in Bulgaria, suggesting a strong relationship between population concentration and the capacity to attract investment. Larger and economically stronger municipalities tend to generate more favourable conditions for investors, while investment itself further reinforces regional growth and population retention (Head & Mayer, 2004).

Figure 1. Population Concentration and FDI Distribution across Bulgarian Regions, 2024

The development of Bulgarian municipalities remains highly dependent on the central government, as most public policies are formulated at the national level and subsequently implemented by local authorities. This governance model is based on the principle of delegation of power from the central government to local authorities. While Bulgaria has made progress in political and administrative decentralisation, the same cannot be said about its fiscal decentralisation.



Municipal fiscal autonomy remains limited, restricting the ability of local

governments to formulate independent development policies and allocate financial resources according to local priorities and specific territorial needs.

Such a governance model is considerably less flexible than systems characterised by greater local autonomy. It limits municipalities' capacity to respond promptly to local challenges, invest strategically in infrastructure, and pursue long-term development objectives tailored to their own economic and social circumstances. Previous empirical studies also suggest that greater fiscal decentralization increases the incentives and capacity of local governments to improve the investment climate and attract FDI (Wang, 2013; Kim, 2018). Consequently, municipalities often lack the financial and institutional instruments necessary to fully exploit their development potential.

This conclusion is also supported by the Organisation for Economic Co-operation *and Development (OECD), which highlights the importance of decentralisation for regional development. According to OECD report (2019), “Another potential benefit of decentralisation is the ability to carry out more effective regional development policies (Morgan, 2006), as local and regional actors are better able to design regional policies that respond to local needs.”

Given their functional dependence on the central government, Bulgarian municipalities have only limited instruments to stimulate investment flows within their territories. The objective of this paper is to examine and demonstrate that the restricted decision-making and financial autonomy of local governments constrains their economic development, particularly with regard to attracting capital. This hypothesis is assessed by analysing the financial capacity of municipalities to invest in infrastructure and improve the local business and living environment, factors that are increasingly recognised alongside labour availability as key determinants of FDI attraction. These findings are consistent with the broader international literature on decentralisation. The OECD-UCLG (2016) report (OECD – UCLG, 2016) shows that wealthier countries are generally more decentralised, revealing a positive correlation between GDP per capita and the degree of expenditure decentralisation. This evidence suggests that increasing the fiscal autonomy of local governments not only improves the efficiency of public spending but also strengthens the institutional and financial capacity of municipalities to foster regional development, create favourable conditions for business, and attract FDI.

The legislative framework governing investment promotion also plays an important role in this process. Bulgaria's Investment Promotion Act provides a range of incentives designed to encourage domestic and foreign investment. However, while municipalities are generally limited to providing administrative assistance, the central government is able to offer significantly stronger financial incentives, including the reimbursement of employers' social security contributions for newly employed workers for up to twelve months, financing of employee training, funding for the construction of connecting infrastructure, the

acquisition of land without a public tender under specific conditions, and various other support measures that are considerably more attractive to potential investors.

2. Materials and Methods

The study primarily employed a comparative analysis to examine the evolution of FDI levels in the biggest regions of the Republic of Bulgaria, including the municipalities within these regions, during the period 2017–2024. The analysis investigated whether changes in local public finances, particularly in terms of revenue autonomy, expenditure flexibility, and investment capacity for infrastructure development, had a positive impact on FDI inflows.

Given that municipal budgets in Bulgaria are highly dependent on transfers from the central government budget, these indicators were used to assess the extent to which centralisation constraints limit local development potential. The study calculated the degree of dependence of local governments on the central level and analysed how this dependence affected their ability to attract investment. The research primarily relied on data from the National Statistical Institute of the Republic of Bulgaria, Eurostat, and the OECD.

The main objective of the study was to demonstrate that centralised governance structures reduced the ability of local governments to respond effectively to investor needs, increased transaction costs, and limited the implementation of targeted, place-based development strategies. In contrast, regions characterised by higher administrative efficiency and stronger local government capacity were more successful in attracting and retaining FDI.

3. Results and Discussions

The level of decentralization is a fundamental determinant of a country's prosperity, attractiveness, and capacity to generate capital. The more flexible the management of public finances is, particularly through granting greater autonomy to local authorities, the better equipped they are to make timely and appropriate decisions corresponding to local needs and development opportunities. This is explained by the informational advantages of local governments, which are better able to match public policies and public expenditure to citizens' preferences and local economic conditions than central governments (Oates, 1999; Rodríguez-Pose et al., 2009; Rodríguez-Pose & Muštra, 2022).

Figure 2 indicate that Bulgaria ranks among the countries with a relatively low level of fiscal decentralization. Across all major indicators, the country remains below the average values observed in most OECD countries.

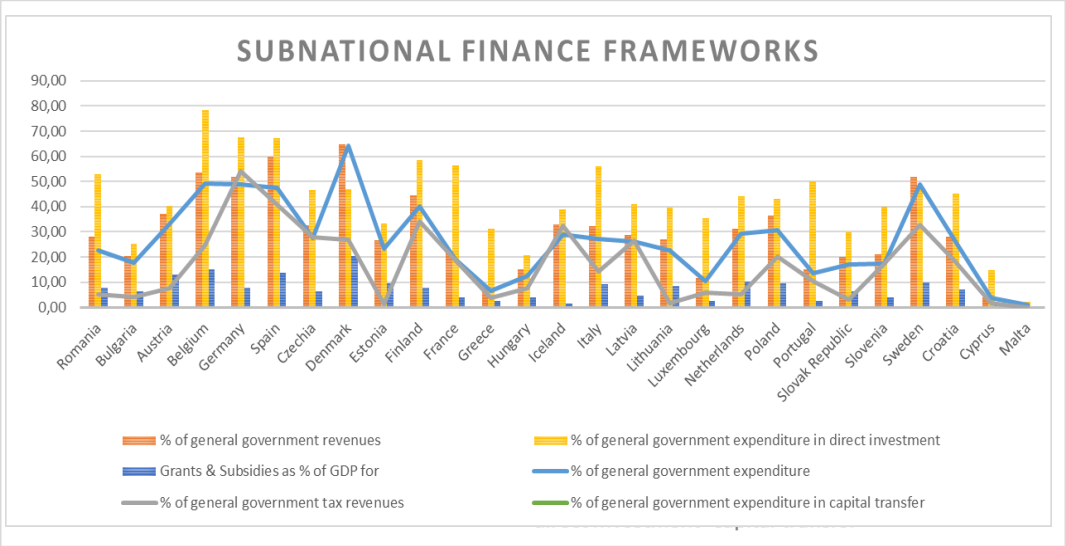


Figure 2. Fiscal Decentralization, Source: OECD

Regarding the share of local government expenditure in total public expenditure, Bulgaria records 17.78%, which is significantly lower than the levels observed in highly decentralized countries such as Denmark (64.40%), Germany (48.90%), Sweden (48.71%), and Belgium (49.04%). Even compared to several unitary states, including Spain, Finland, Poland, and the Czech Republic, the share of local government expenditure is considerably higher than that of Bulgaria, visible in figure 3.

Figure 3. Financial Framework, Source: OECD

A similar pattern can be observed in the share of local government revenues in total general government revenues, where Bulgaria records 20.40%, while in countries such as Denmark, Sweden, Germany, and Spain this indicator exceeds 50%. Particularly noteworthy is the share of local tax revenues, which in Bulgaria accounts for only 4.20% of total tax revenues. This is one of the lowest levels among the countries analysed and reflects the limited own-source tax base of Bulgarian municipalities. By comparison, local governments generate more than 54% of total tax revenues in Germany, 40.82% in Spain, 34.19% in Finland, and 32.65% in Sweden.

Regarding the share of local governments expenditures in public investment, Bulgaria also remains behind. The value of 25.20% is almost twice as low as that observed in many European countries, where local authorities account for between 40% and 70% of public capital investment. This indicates that investment policy in Bulgaria remains largely centralized, with a limited role for local governments in shaping and implementing investment priorities.

The indicator measuring grants and subsidies provided to local authorities as a share of GDP (6.38%) places Bulgaria in the middle range among the countries analysed. This suggests that, although the central government provides relatively substantial transfers to municipalities, these resources do not sufficiently offset the

limited own-source revenue capacity and the low level of fiscal autonomy of local governments.

Local governments are characterized by a high dependency of their local finances at the central level, which determines their limited autonomy and restricts their ability to independently invest in policies that could significantly contribute to their development.

Within the framework of the study, 265 municipalities are grouped into regions, which were classified into four quartiles based on their ranking according to the amount of attracted FDI (table 1). The quartile classification was obtained by ranking regions using the RANK.EQ function and dividing the ordered observations into four equal groups. This approach ensures an equal number of regions in each category and minimizes the distortion caused by extreme values in the distribution of FDI. The municipalities within the regions are classified into four groups based on their level of FDI: Very low FDI (Q1), Low FDI (Q2), Medium FDI (Q3), and High FDI (Q4).

Table 1. Regional Classification by FDI Level and Ranking

QUARTILES	RANKING	FDI RANGE, EUR MILLION	NUMBER OF REGIONS	NUMBER OF MUNICIPALITIES
Q1 – VERY LOW FDI	1–7	**31.67 – 75.18 million**	7 (Montana, Yambol, Haskovo, Silistra, Kustendil, Vidin, Smolyan)	64
Q2 – LOW FDI	8–14	**92.70 – 138.05 million**	7 (Lovech, Veliko Tarnovo, Shumen, Sliven, Dobrich, Vratsa, Razgrad)	57
Q3 – MEDIUM FDI	15–21	**143.95 – 385.75 million**	7 (Pleven, Gabrovo, Ruse, Targovishte, Pernik, Kardzhali, Blagoevgrad)	55
Q4 – HIGH FDI	22–28	**472.03 – 11,675.23 million**	7 (Burgas, Varna, Stara Zagora, Sofia (capital), Pazardzhik, Plovdiv, Sofia)	89

Source: Own calculations, NSI data

When examining the indicator of revenue autonomy, it can be observed that since 2017 municipalities have become increasingly dependent on the central government, gradually losing their ability to finance local activities through their own resources without government support. Their level of autonomy has declined

from 18.8% in 2017 to 14.8% in 2024. At the same time, revenue autonomy is approximately 10 percentage points higher among municipalities in quartile Q4, which represents municipalities with higher levels of attracted investment.

Figure 4 presents the development of local revenue autonomy across municipalities grouped into four FDI quartiles (Q1–Q4) over the period 2017–2024. The indicator is measured in percentage points and reflects the share of own-source revenues in total municipal revenues. The evidence presented in the figure 4 suggests that municipalities with the lowest levels of FDI attraction (Q1) face significant constraints in using their own-source revenues to implement policies that enhance the local business environment and improve their attractiveness as investment destinations. This suggests that municipalities with higher levels of FDI attraction may have greater fiscal flexibility to finance local policies.

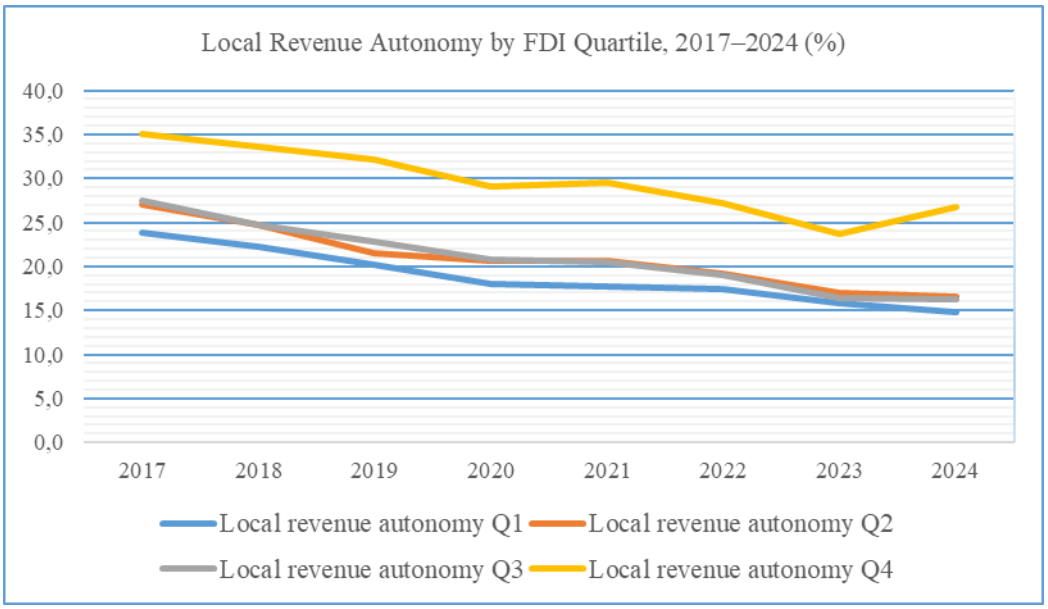


Figure 4. Local Revenue Autonomy by FDI Quartile, 2017–2024 (%), Own calculations, data from Ministry of Finance of the Republic of Bulgaria

A similar pattern can be observed in the indicator of expenditure flexibility (figure 5), which measures the proportion of municipal expenditure over which local authorities have greater discretion in allocating financial resources according to local priorities and needs. Throughout the analysed period, local expenditures accounted on average for around 38% of total municipal expenditures. The remaining share is allocated to delegated activities (such as education, healthcare, and social services), where municipalities primarily act as intermediaries for the implementation of state responsibilities rather than as independent decision-makers. This indicates that the limited expenditure autonomy of municipalities restricts their capacity to design and implement independent economic development policies. In practice, the discretionary resources available at the local level represent the main financial instrument through which municipal authorities

can respond to the requirements of potential foreign investors and create a more attractive investment environment.

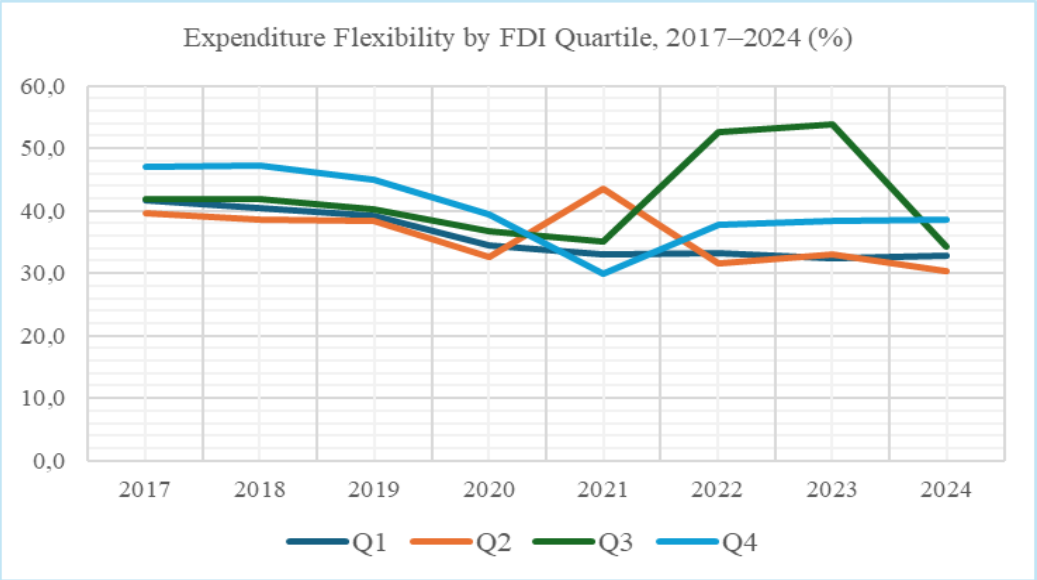


Figure 5. Expenditure Flexibility by FDI Quartile, 2017–2024 (%), Own calculations, NSI data

In order to allocate their production facilities, which in most cases involves expanding or diversifying their operations, investors seek locations that meet a wide range of criteria. One of the key factors is the availability of ready-to-use infrastructure. This infrastructure may include transport infrastructure, such as roads and connectivity, as well as social infrastructure, such as access to quality healthcare, and the availability of industrial zones equipped with the necessary technical infrastructure.

The indicator measuring the share of capital expenditure in total municipal expenditure, presented in figure 6, directly reflects the capacity of municipalities to provide such infrastructure and other long-term development assets. The indicator is expressed as the percentage of total municipal expenditure allocated to capital expenditure. By it, it is possible to assess the investment activity and development capacity of municipalities themselves. Municipalities with a consistently high share of capital expenditure would be expected to demonstrate a stronger correlation with growth in FDI inflows, as higher investment activity at the local level contributes to creating a more attractive business environment.

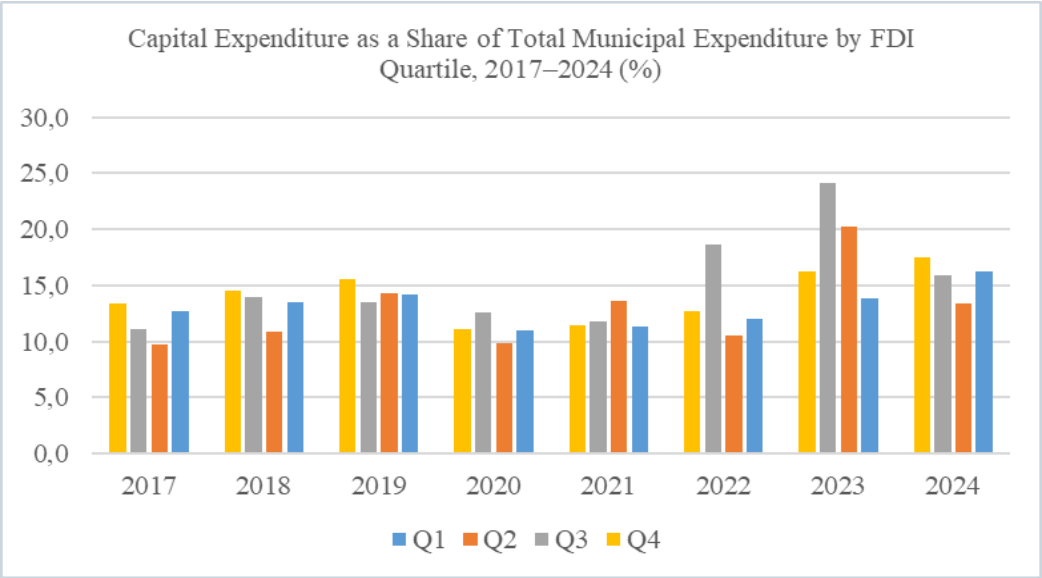


Figure 6. Capital Expenditure as a Share of Total Municipal Expenditure by FDI Quartile, 2017–2024 (%), Own calculations, NSI data

3. Conclusion

The analysis conducted allows the conclusion to be drawn that the higher the level of autonomy municipalities have in managing their public finances, the more attractive they become for potential investors. Greater financial autonomy also enables municipalities to invest more effectively in improving their local environment, making it more favourable for investment decisions and increasing their capacity to attract foreign direct investment.

The comparison of municipalities according to their FDI levels provides additional evidence for this relationship. Municipalities belonging to the higher FDI groups generally demonstrate stronger fiscal and investment capacities than municipalities characterised by lower levels of FDI. This supports the assumption that financial autonomy is not merely an administrative characteristic of local government, but an important component of its economic capacity and investment attractiveness.

However, the findings should not be interpreted as demonstrating that fiscal autonomy alone determines the location of FDI. Investment decisions are influenced by a broader set of factors, including market size, human capital, infrastructure, accessibility, institutional quality, business environment and national economic conditions. Fiscal autonomy should therefore be understood as one of the enabling conditions through which municipalities can improve their investment environment and respond more effectively to investor requirements.

Overall, the study supports the hypothesis that stronger local fiscal capacity is associated with greater potential for attracting FDI. Consequently, decentralisation of public finances should be viewed not only as a matter of administrative

efficiency, but also as a potential instrument of local economic development and investment promotion.

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THE FISCAL MULTIPLIER OF TOURISM TAXATION IN BULGARIA

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Abstract

Tourism serves as a vital economic engine for regional development, and its impact on local level depends on the mechanisms of municipal fiscal policies. This article examines the fiscal efficiency of tourism taxation in Bulgarian municipalities through the prism of the multiplier theory and the processes of fiscal decentralization. The main focus is on the empirical comparison between the efficiency of locally generated revenues from the tourism tax and transfers from the central budget for all 265 local governments in Bulgaria. The current legislative framework related to the local taxation is evaluated, as well as the impact of digital tourist registration systems on overall tax collection. The empirical results show a significant efficiency gap: 1 euro of tourism tax generates 5.44 euro of total own revenues for local budgets, compared to 18 cents in revenue if subsidies are used. In conclusion, the study argues for the urgent need to strengthen municipal tax autonomy as a key instrument for sustainable economic growth at the regional level.

Keywords: Fiscal multiplier, Tourist tax, Local finances, Bulgarian municipalities, Tourism economics.

1. Introduction

Over the past two decades, Bulgaria has faced the challenge of balancing centralized management of public resources with the need for genuine fiscal decentralization. Despite strategic objectives to strengthen local autonomy, the share of local tax revenues relative to total municipal receipts varies drastically – ranging from 22-25% for the capital city to a mere 4-5% for small municipalities with populations under 10,000 (Mutafov, 2025). This negative trend highlights the critical importance of identifying highly efficient local tax instruments, such as the tourism tax. Tourism taxation is an integral part of the decentralization process, having undergone a fundamental legislative transformation after 2011 when the tourist fee was converted into a tourist tax (Doneva, 2021); (Opinion of the Council of Ministers, 2012).

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Tourism holds a strategic position in the national economy. In the pre-crisis year of 2019, the sector's total contribution to Bulgaria's GDP reached 10.7% (BGN 13.1 billion), securing over 341,000 jobs (Doneva, 2021). According to data from the Bulgarian Chamber of Commerce and Industry (BCCI), following the downturn in 2020, the sector has demonstrated a steady recovery. By 2024, foreign tourist arrivals in Bulgaria reached 7.19 million, with international tourism revenues amounting to nearly EUR 3.986 billion (BCCI, 2025). The sector's contribution to gross domestic product (GDP) reached 6.7% in 2024, while international revenues from the sector exceeded USD 4.3 billion.

In this context, the tourist tax, regulated under Art. 61r. – 61t. of the Local Taxes and Fees Act (LTFA, 2026), operates not merely as a source of fiscal revenue but as a powerful economic lever. The theoretical framework of this study is rooted in the concept of the multiplier effect, which posits that autonomous expenditures or revenues trigger a chain reaction of economic transactions within the regional economy (Bozkurt & Bayri, 2026). Rusu (2011) states that the multiplier effect occurs when money spent by tourists circulates multiple times through a country's economy.

The research problem under consideration stems from the inefficiency of state-led redistribution of funds. While state subsidies to municipalities are often characterized by the "flypaper effect" – where transfers fail to stimulate broader economic activity – tourism taxation demonstrates an organic link to local consumption (Muir & Weber, 2013). This study aims to evaluate the fiscal efficiency of the tourist tax in Bulgarian municipalities compared to that of state subsidies by analyzing their respective fiscal multipliers.

The object of this study is local revenue in Bulgarian municipalities, with a specific focus on local tourism taxation. The subject focuses on the multiplier effects that the tourist tax generates within municipal budgets.

2. Literature Review

2.1 Evolution and Legal Framework of Tourism Taxation in Bulgaria

To evaluate the fiscal potential of the tourist tax, it is necessary to clarify its legal nature. Prior to 2011, municipalities collected a tourist fee, which was a compensatory payment for a specifically provided service. With the introduction of the tourist tax (Art. 61r – 61t of the LTFA), the taxation assumed a new character (Opinion of the Council of Ministers, 2012).

According to Art. 61r of the LTFA (2026), the tourist tax applies to overnight stays in accommodation establishments as defined by the Tourism Act (2026). It is important to note the interpretation of the Constitutional Court, which established that the tourist tax is a property tax rather than an income tax (Opinion of the Council of Ministers, 2012). Its amount depends on the number of actual overnight stays and the capacity (number of beds) of the accommodation and lodging facilities, rather than the income realized by the hotelier (Opinion of the Council of Ministers, 2012).

The law sets the tax limits between BGN 0.20 and BGN 3.00 per overnight stay. In the context of macroeconomic comparability and the conversion of financial datasets

into a single European currency, this equates to a range of approximately EUR 0.10 to EUR 1.53 per night, with the specific rate voted on by municipal councils (Doneva, 2021) (Opinion of the Council of Ministers, 2012). Additionally, the hotel accommodation sector benefits from a preferential Value Added Tax (VAT) rate of 9%, compared to the standard national rate of 20% (Opinion of the Council of Ministers, 2012), (BCCI, 2025), (PricewaterhouseCoopers, 2017).

Table 1. Key Parameters of the Tourist Tax in Bulgaria

Tax Parameter	Regulatory Framework and Details
Legal Basis	Art. 61r - 61t of the Local Taxes and Fees Act (LTFA)
Taxpayers	Providers of overnight stays (hoteliers, guest house owners)
Tax Bearer	The recipient of the tourist service (the tourist)
Control Mechanism	Unified Tourist Information System (UTIS)

Sours: Author's own elaboration

The administration of the tax is closely tied to digitalization via the UTIS system, maintained by the Ministry of Tourism. This tool allows municipal officials to calculate the tax due based on the actual overnight stays recorded for the month, with payments due by the 15th of the following month (Ministry of Finance, n.d.). To ensure predictability for municipal budgets, Art. 61s, para. 4 of the LTFA introduces a safeguarding mechanism: a minimum annual tourist tax liability calculated at a minimum of 30 percent full occupancy (capacity) of the establishment. Collection is strictly monitored through UTIS, and pursuant to Art. 61t of the LTFA, tax revenues are earmarked and must be spent explicitly on tourism infrastructure, green spaces, tourist information centers, and destination marketing (Opinion of the Council of Ministers, 2012).

2.2 Theoretical Concept of the Tourism Multiplier

In economic literature, the multiplier measures the change in total economic output in response to a change in autonomous expenditures or revenues (Muir & Weber, 2013). In the context of local finances, it reflects how initial tourist expenditures generate additional income, employment, and tax revenues.

The multiplier mechanism can be described through the interaction between "injections" (incoming cash flows from tourists) and "leakages" (Bozkurt & Bayri, 2026). Injections consist of tourist spending on accommodation, food, entertainment, and transport. Leakages occur when these funds exit the local economy through the purchase of imported goods, savings, or tax payments to the central budget (Rusu, 2011).

Based on Keynesian principles, the tourism multiplier measures how an initial influx of funds (e.g., tourism spending) triggers a chain reaction of economic activity, expanding income across both tourism-related and non-tourism industries (Zainullina & Kedrova, 2023).

Studies by international organizations such as the IMF show that in small, open economies like Bulgaria's, aggregate fiscal multipliers are often modest –

ranging between 0.3 and 0.8 (Zainullina & Kedrova, 2023), (Muir & Weber, 2013). However, the microeconomic and sectoral multiplier of the tourist tax in Bulgaria exhibits a value of 5.44. This phenomenon occurs because tourism is deeply integrated with other local activities, thereby minimizing the leakage of funds outside the municipality.

3. Research Methodology

The study adopts a combined qualitative and quantitative approach, merging a deductive analysis of the Local Taxes and Fees Act (LTFA) with statistical data from the National Statistical Institute (NSI) and UTIS. The theoretical framework relies on the concept of the Keynesian multiplier (Zainullina & Kedrova, 2023), adapted to the specificities of local taxation. To quantitatively assess the fiscal effects and calculate specific multiplier values, a Two-Way Fixed Effects panel econometric model was utilized. To ensure maximum reliability of statistical inferences and to overcome potential heteroskedasticity and intra-group autocorrelation, robust standard errors clustered at the municipal level were applied across all regressions.

The empirical analysis utilizes a baseline econometric model to test the impact of tourism on local budgets, formatted analytically as:

$$Y_{it}=\beta_0+\beta_1\,(Tourism_{it})+\sum\gamma(Controls_{it})+\alpha_i+\delta_t+\epsilon_{it} \quad (1)$$

Where:

$Y_{\{it\}}$ represents the targeted local tax revenues or aggregate own revenues for municipality {i} in year {t};

$Tourism_{\{it\}}$ is the primary independent variable (tourism expenditures or direct receipts from the tourist tax);

$Controls_{\{it\}}$ is a vector of control variables accounting for the scale and wealth of the municipality (population, income);

α_i represents the unobserved time-invariant municipality-specific fixed effects;

δ_t represents time dummy variables (year dummies) that control for macroeconomic shocks (e.g., inflation or the Covid-19 pandemic) affecting all municipalities uniformly in a given year {t};

ϵ_{it} is the standard idiosyncratic error term of the model.

The empirical study is based on a panel dataset spanning a 10-year period (2015-2024) across all 265 municipalities in Bulgaria, with regression modeling focusing heavily on the 49 leading tourist destinations. For the purposes of the model, these destinations are divided into three primary clusters based on their geographic, infrastructural, and seasonal profiles: coastal/maritime, mountain/spa, and urban/business destinations. This approach ensures the robustness of the

results and allows for the precise isolation of fiscal effects unique to developed tourism regions.

4. Results and Discussion

Based on the described methodology, Table 2 systematizes the results of the developed Two-Way Fixed Effects panel econometric model, evaluating the efficiency of local revenue sources.

Table 2. Panel Regression Model (Two-Way Fixed Effects) of the Fiscal Multiplier

	Own Revenues
Tourist Tax (EUR million)	5.442***
	(0.000)
State Subsidies (EUR million)	0.182***
	(0.000)
Population	-0.000
	(0.139)
Average Income	-0.001
	(0.768)
Constant	13.778***
	(0.005)
R^2 (within)	0.811
R^2 (overall)	0.236
Number of observations	343

p-values in parentheses
* p < 0.10, ** p < 0.05, *** p < 0.01
Sours: Author's own research

The model demonstrates exceptionally high statistical reliability (Prob> F=0.0000) and explains over 81% of the internal dynamics of aggregate own revenues in the studied municipalities (within R^2=0.811).The results conclusively prove the existence of a powerful fiscal tourism multiplier. The strongly positive coefficient of 5.442 indicates that for every EUR 1 that enters the local treasury directly from the tourist tax, the municipality's total own revenues increase by an average of EUR 5.44. This outcome transcends a simple accounting correlation; it mathematically confirms that tourism consumption acts as a catalyst for a massive volume of secondary revenues (property taxes, waste management fees, sidewalk commercial permits, etc.). The finding that EUR 1 of tourist tax generates EUR 5.44 in own revenue for the local budget is a key finding derived mathematically through the Two-Way Fixed Effects panel model described above. This multiplier is not a direct receipt from overnight stays, but an aggregate effect across the entire spectrum of local taxes and fees, driven by the synergy of direct, indirect, and induced effects. It is important to clarify terminologically that the tax rate itself does not mechanically multiply funds. The value of 5.44 actually measures the fiscal return on tourism consumption itself (accommodation, dining, services) captured through the lens of collected tourist tax. In this sense, the paid tax serves as a quantitative metric of tourist flow, which in turn stimulates a chain reaction in the local economy.

In sharp contrast, the coefficient for state subsidies stands at just 0.182. This means that every EUR 1 from the central budget generates a mere 18 cents of secondary own revenue at the local level. This result empirically confirms the presence of the "flypaper effect" – guaranteed subsidies function as inert capital and disincentivize local authorities from optimizing their own revenue collection.

Further proof of the exogenous nature of local budgets in these destinations is the lack of statistical significance for the average income control variable (p-value=0.768); municipal treasuries are fueled entirely by the purchasing power of external visitors rather than the wages of the local population. In conclusion, the empirical model proves that one euro from tourism creates over 30 times more secondary fiscal wealth compared to one euro of state subsidy.

When a destination attracts tourists, the direct revenue is the tourist tax itself. This activates a series of economic transactions that feed into the municipal budget through various channels, classified as direct, indirect, and induced effects (Rusu, 2011), (Bozkurt & Bayri, 2026). Indirect revenues stem from the fact that tourism infrastructure increases property tax assessments (higher real estate tax) and generates waste management demands (higher solid waste fees) (Doneva, 2021). Induced effects manifest by stimulating local small businesses (taxis, dining, markets) that pay patent taxes and fees for utilizing public sidewalks. For comparison, in absolute values for 2019, direct revenues from the tourist tax exceeded BGN 2.2 million for Sofia Municipality, BGN 675,000 for Varna, and BGN 380,000 for Plovdiv (Doneva, 2021) – and these are direct receipts alone, excluding indirect and induced contributions.

Table 3. Impact of Tourism on Municipal Revenues: Channels of Influence

Type of Effect	Fiscal Channel	Impact on Own Revenues
Direct	Tourist tax	Immediate revenue injection into the budget.
Indirect	Solid Waste Fee (SWF)	Hotels and restaurants generate larger waste volumes, increasing SWF revenues.
Indirect	Real estate tax	Tourism development stimulates investment in new facilities, raising tax assessments and property taxes.
Induced	Patent tax	Increased tourist numbers boost small businesses (taxis, retail) that pay patent taxes to the municipality.
Induced	Public space/sidewalk fees	Restaurants expand outdoor seating during the peak season, paying sidewalk usage fees.
Induced	Property transfer tax	Tourist interest drives up property prices and transaction volumes within the municipality.

Sours: Author's own research

The combined contribution of these channels yields the total value of EUR 5.44. A crucial element here is that the tourist tax acts as a "fiscal lever." While it

is the easiest to administer via UTIS, its collection serves as an indicator of actual establishment occupancy, enabling municipal administrations to verify and control other related payments (Mutafov, 2025).

The low efficiency of subsidies (0.18) can be analyzed through several economic phenomena:

1. The Flypaper Effect: Theory suggests that subsidy money "sticks where it hits" – meaning it is frequently used to expand administrative expenditures and current maintenance rather than to stimulate economic activity that could generate autonomous revenue (Muir & Weber, 2013).
2. Reduction of Tax Effort: When a municipality receives a guaranteed equalization subsidy from the state, it loses the incentive to optimize its own tax system and collect local taxes efficiently. This creates a dependency where the municipality relies on transfers instead of expanding its own economic potential (Mutafov, 2025).
3. Inefficient Allocation: State subsidies are often distributed via administrative formulas that fail to account for the unique needs of local businesses. Unlike the tourist tax, which is market-oriented (paid only when economic activity occurs), the subsidy is unconditional and frequently spent on low-value-added projects.

To ensure a precise analysis of state transfers, a distinction must be made between their types. The 0.18 coefficient reflects aggregate fiscal efficiency, driven primarily by general equalization subsidies for local activities and administration where the flypaper effect is pronounced. However, when examining targeted capital subsidies, the dynamic shifts dramatically, even turning negative over the long term.

Table 4. Efficiency of Revenue Sources in Local Budgets

Comparative Indicator	Tourist Tax	State Subsidy
Multiplier	5.44	0.18 (General subsidies) / -0.019 (Capital subsidies, Lag 2)
Primary Source	External consumption (Tourists)	Central budget (Taxpayers)
Flexibility	Determined by the local council	Determined by the State Budget Act
Targeting	Earmarked strictly for tourism	General maintenance and delegated activities
Management Incentive	High (More tourists = More funds)	Low (Guaranteed revenue)

Sours: Author's own research

As shown in Table 4, while the tourist tax maintains a high positive multiplier due to its targeted alignment, state transfers show marginal efficiency (0.18 for general subsidies) or even a negative fiscal footprint (-0.019 for capital subsidies with a time lag).

Economic Impact: The tourist tax has a significantly higher multiplier (5.44), meaning each collected unit generates far greater economic activity compared to a subsidy (0.18).

Autonomy: Local authorities enjoy greater freedom ("Flexibility") with the tourist tax, whereas subsidies are strictly regulated by the central government.

Motivation: The tax-driven model incentivizes municipalities to improve their local environment to attract more visitors, whereas the subsidy represents passive revenue.

Data from IMF and BNB research confirm that government transfers in Bulgaria exert a much weaker effect on growth compared to direct investments and capital expenditures (Muir & Weber, 2013). A EUR 1 subsidy yields only EUR 0.18 in growth because it often serves as a social safety net to "plug holes" rather than building economic infrastructure.

5. Conclusion

The empirical and theoretical analysis strongly suggests that a model built on own revenues from tourism taxation is fiscally and economically far more sustainable and efficient than centralized subsidization. The comparison between the microeconomic multiplier of 5.44 for the tourist tax and the aggregate fiscal multiplier of just 0.18 for state transfers demonstrates the urgent need for genuine fiscal decentralization. The modest impact of state subsidies is explained by their tendency to serve as passive social stopgaps rather than structural investments capable of generating regional value.

Conversely, the high multiplier of the tourist tax offers undeniable proof of tourism's power as a key economic driver at the local level. In this sense, choosing between an 18-cent return from state subsidies and a EUR 5.44 return from own tax revenues is not merely a mathematical choice, but a matter of political will for modern and effective local self-governance. As macroeconomic studies for Bulgaria show, given the small fiscal multipliers of government spending, future fiscal strategies should focus on improving the quality of public expenditures—by curbing inefficient spending, promoting growth-stimulating investments, and reinforcing the role of cost-benefit analyses.

To maximize tax potential and strengthen the financial independence of local authorities, the following expanded recommendations are proposed:

1. **Enhancing Tax Autonomy and Rate Optimization:** Empirical data reveal that many Bulgarian municipalities do not attempt to realize their full revenue potential (e.g., only 9 municipalities have adopted the maximum legal rates for property taxes). Municipalities should regularly assess their tax capacity and differentiate tourist tax rates relative to establishment categories. Simulations indicate that adopting maximum permissible rates alongside full collection enforcement could **significantly** increase municipal own revenues..
2. **Improving Monitoring and Data-Driven Assessments:** There is a notable lack of comparable data, systematic monitoring, and rigorous impact assessments regarding tourism-related taxes at the regional level. Bulgarian tourist destinations should implement detailed and regular self-assessment systems to objectively track and build upon achieved economic outcomes.
3. **Integrated Destination Management through Targeted Investments:** Municipalities must strictly adhere to the earmarked nature of the

tourist tax, reinvesting collected funds explicitly into tourism infrastructure to sustain the high multiplier effect of 5.44. An enhanced local environment directly increases regional attractiveness for new businesses, triggering chain effects (such as higher tax assessments and fees) that close the loop of positive fiscal feedback.

4. **Mitigating the Shadow Economy and Improving Organization:** Local authorities need to actively leverage the capacity of the Unified Tourist Information System (UTIS) to bring the shared economy (such as short-term rental platforms like Airbnb) into the light. Establishing better organization and transparency in local tax policy will expand the tax base and unlock massive, untapped fiscal reserves for municipalities.

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INNOVATIVE MODELS IN RURAL TOURISM: THE SHARING ECONOMY AND DIGITAL NOMADISM

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Abstract

This paper analyzes the interplay between the sharing economy and the concept of socialfarming as strategic mechanisms for rural revitalization in Bulgaria. Against the backdrop ofan accelerating demographic crisis, 2024 data from the National Statistical Institute (NSI)reveal profound structural imbalances in rural areas, where the age dependency ratio hasreached a critical 71.3% (compared to 57.6% in urban areas), compounded by adisproportionately high share of the population aged 65 and older. To mitigate thesethreats, this study proposes an innovative hybrid model for rural tourism development. Theconceptual framework is anchored in resource utility optimization, demonstrating howsocial farming can generate an authentic tourism product. Empirical evidence fromsuccessful practices illustrates how integrative, educational, and therapeutic modelsfacilitate the inclusion of vulnerable groups. Concurrently, the paper examines theattraction of digital nomads and young professionals by leveraging the potential of urban-to-rural domestic migration, which reached 22.8% in 2024. Case studies such as the globalhub in Bansko and Burgas Coliving demonstrate how modern coworking and colivinginfrastructures foster symbiosis and knowledge sharing between local communities andnew residents. Ultimately, strategic recommendations for sustainable development areformulated, emphasizing state investments in digital infrastructure, the streamlining ofregulatory frameworks for social enterprises, business guidelines for community building,the branding of social causes, and the integration of interdisciplinary academic training.

Keywords: Rural tourism, Sharing economy, Digital nomads.

1. Introduction

Rural areas within Bulgaria and the European Union are at a critical crossroads,necessitated by a radical shift in economic models to ensure survival and sustainabledevelopment. Demographic shifts in these regions no longer represent a mere challengebut pose an existential threat to the social fabric of local

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communities. Data from theNational Statistical Institute (NSI) (2025) for Bulgaria at the end of 2024 corroboratealarming trends of population decline and structural aging, with rural territories bearing theheaviest burden of these transformations. Within this context, traditional approaches toagriculture and conventional rural tourism are no longer sufficient to generate sustainableemployment or retain youth (Gospodinova, 2023).

Consequently, it is imperative to implement the sharing economy model, which ispredicated on maximizing the utility of underutilized assets, including vacant buildings,guesthouses, local knowledge, and social capital (Alloh et al., 2025; Malcheva, 2018). Aprimary catalyst in this process is the attraction of digital nomads – a rapidly expandingwave of mobile professionals seeking a "slow life" ethos and rural authenticity, whilesimultaneously demanding advanced digital infrastructure and a robust sense ofcommunity (NOMAZINE: No-mad-is-m & Social entrepreneurship, 2022).

Social entrepreneurship serves as the nexus that enables economic initiatives to pursuesocietal objectives while ensuring financial viability (Ilieva-Koleva & Dobreva, 2021). Socialfarming, in turn, provides a mechanism for farm multifunctionality, transforming agriculturalspaces into venues for therapy, inclusion, and education. This complements the stay ofremote workers and establishes a highly authentic, sought-after tourism product (Nicolosi et al., 2021). Integrating these segments within hospitality management redefines ruraltourism as an industry of shared experiences capable of reversing demographic decline byattracting highly qualified human capital (Hospitality and Tourism Management, n.d.).

2. Theoretical Framework

Developing an innovative rural tourism model requires the synthesis of severalcontemporary economic and social paradigms.

2.1 The Concept of the Sharing Economy in Tourism

The sharing economy, alternatively termed the collaborative or platform economy, fundamentally alters how services are consumed and supplied within rural destinations (Malcheva, 2018; Ianeva & Georgieva, 2018). It is defined as an economic ecosystemwherein assets or services are shared among private individuals, either peer-to-peer orcommercially, typically facilitated by online platforms. In the context of digital nomadism, this encompasses not only peer-to-peer accommodation but also shared workspaces (coworking), collaborative living arrangements (coliving), and the transfer of digital skills inexchange for authentic local experiences.

The core pillars of the sharing economy comprise the provider (asset owner), the user, andthe digital platform that facilitates transactions and builds trust via reputation systems (Alloh et al., 2025; Malcheva, 2018). For declining rural areas, this model is uniquelyvaluable, as underutilized real estate can be converted into shared spaces with minimalcapital expenditure, enabling rural residents to generate additional income (Ianeva &Georgieva, 2018).

2.2 Coliving as a New Paradigm of Hospitality

Coliving represents a contemporary form of intentional shared housing for individuals whoshare similar interests, values, and professional profiles (NOMAZINE: No-mad-is-m & Socialentrepreneurship, 2022). In contrast to conventional hotels or guesthouses, the emphasis isplaced entirely on community, collaboration, and shared daily life (COLIVING – OURFUTURE – PLANONLINE, 2024; Coliving 2022 & Beyond, n.d.).

Hospitality management within coliving spaces necessitates a shift from purelytransactional services toward facilitating human relationships and generating social capital (Hospitality and Tourism Management, n.d.). Entrepreneurship within this digitalizedecosystem demands a specialized mindset geared toward designing exceptional customerexperiences through innovative spatial design and modern technology integration.

2.3 Social Entrepreneurship and the Supporting Rural Ecosystem

While coliving establishes the economic and infrastructural foundations, socialentrepreneurship provides the destination with a purpose and social cohesion (Ilieva-Koleva & Dobreva, 2021). In Bulgaria, this is legislated by the Law on Enterprises of theSocial and Solidarity Economy (2020) as an activity dedicated to improving the livingstandards of vulnerable groups.

In this context, social innovations serve as instruments for the "regeneration of a positiverural identity" (Costantini & Pastorelli, 2021). For digital nomads, the presence of sociallyresponsible projects within a destination offers genuine contact with nature, volunteeropportunities, and access to clean, locally sourced food, aligning with the sustainablemanagement principles of the European Green Deal (Nicolosi et al., 2021; Kamenova, 2026).

3. Research Methodology

This study utilizes an integrated research approach combining quantitative and qualitativeanalyses. The primary methodologies include:

Secondary Statistical Data Analysis:

- Official datasets from the National StatisticalInstitute of Bulgaria for 2023 and 2024 were examined, alongside Eurostat dataconcerning demographic shifts and digitalization in rural territories (NSI, 2024; NSI, 2025; Eurostat, 2024).Comprehensive Literature Review: An academic analysis was conducted coveringscientific publications on digital nomadism, coliving, the sharing economy, and social entrepreneurship (Gospodinova, 2023).
- Case Study Method: Best practices of coliving and coworking projects in Bulgaria ("Coliving Semkovo", "Burgas Coliving" [Creativehubs | Burgas Coliving, 2020], and Bansko) and abroad were investigated.

- Comparative Analysis: A structural comparison was drawn between the traditionalrural tourism framework and the proposed nomad-centric model.

4. Results and Discussion

4.1 Demographic Profile of Bulgarian Rural Areas in 2024

The analysis of NSI data underscores the magnitude of the demographic challenges. As of December 31, 2024, the population of Bulgaria stood at 6,437,360 individuals, representinga 0.13% decline compared to 2023 (NSI, 2025). However, the situation in rural areas issubstantially more critical.

Table 1. Key Demographic Indicators of the Bulgarian Population by Place ofResidence (as of December 31, 2024)

Indicator (31.12.2024)	Urban Population	Rural Population	Total
Total Population	4,744,111 (73.7%)	1,693,249 (26.3%)	6,437,360
Average Age (Years)	44.5	47.6	45.3
Mortality Rate (‰)	13.8	20.7	15.6
Natural Increase (‰)	-5.5	-12.5	-9.2

Sours: NSI, 2025

A critical metric of depopulation is the age dependency ratio, which expresses the ratio ofdependent individuals (under 15 and over 65 years old) to the working-age population (15-64 years old). The age dependency ratio is mathematically formulated as follows (NSI,2025):

$$\text{Age Dependency Ratio} = \frac{\text{Population } (0-14) + \text{Population } (65+)}{\text{Population } (15-64)} * 100 \quad (1)$$

In Bulgarian rural areas, this ratio has climbed to a critical 71.3%, whereas in urbanenvironments it stands at 57.6%. This implies that for every 100 working-age individuals inrural areas, there are more than 71 dependents requiring care. This structural aging trend isfurther evidenced by the share of the population over 65, which reaches 31.4% in specificprovinces such as Vidin (NSI, 2024; NSI, 2025).

Conversely, migration statistics present a viable window of opportunity. In 2024, 22.8% ofinternal migrants relocated from urban to rural settings (NSI, 2025). This specificdemographic influx is paramount for implementing novel economic models.

4.2 Attracting Digital Nomads: Successful Coliving Models in Bulgaria

Digital nomads are highly skilled, location-independent professionals. They selectdestinations based on work-life balance, high-speed connectivity, and

strong communityframeworks (NOMAZINE: No-mad-is-m & Social entrepreneurship, 2022; COLIVING – OURFUTURE – PLANONLINE, 2024; Coliving 2022 & Beyond, n.d.).

An analysis of the Bulgarian nomad ecosystem outlines three prominent models thatsuccessfully revitalize local economies:

Mountain Destination Revitalization Model (Case Study: "Coliving Semkovo"): Located in the Semkovo mountain resort (Rila Mountains), this project represents apioneering global example of converting abandoned tourism real estate. It involvestransforming a massive, defunct Soviet-era hotel into a cooperative coliving assetcontaining over 200 apartments and expansive communal workspaces. This modelrelies on fractional ownership and attracts nomads intending year-round mountainresidency. The economic spillover for the nearby town of Belitsa and the broaderregion is substantial, generating service, restoration, and maintenance employment,while offering direct market access to local farmers.

Regeneration & Wellness Model (Case Study: "Burgas Coliving"): Situated near theBurgas Mineral Springs in a renovated 1954 structure (formerly a balneotherapycenter), this project fuses wellness services, natural seclusion, and coastal access.The operators actively pursue integration with the local population by hostingcultural events, festivals, and volunteer programs, thereby generating robust socialcapital (Creativehubs | Burgas Coliving, 2020).

Rural Coliving and Authenticity Model (e.g., Pavelsko Village, Rhodope Mountains): This micro-model utilizes traditional rural real estate (older Rhodopean guesthouses)to accommodate small groups of remote workers. The operational focus centersentirely on the "slow life" philosophy and deep cultural immersion. Nomads consumelocal produce and frequently support local entrepreneurs with digital services (webdesign, social media marketing), resulting in a direct, non-monetary knowledgeexchange.

Table 2. Classification of Coliving Models in Bulgaria and Their DestinationImpact

Coliving Model	Location / Example	Core Destination Asset	Economic and Impact
Revitalization of large resorts	Semkovo / Bansko	Unused building stock (hotels), mountain	Year-round employment, attracting large-scale foreign capital, events
Wellness and mineral resources	Burgas Coliving	Thermal springs, proximity to a coastal city	Preservation of historical heritage, wellness tourism (Creativehubs, 2020)
Authentic rural coliving	Rhodope Mountains (Pavelsko village)	Traditional houses, nature, local cuisine	Micro-economic support, direct transfer of digital skills to locals

Sours: Author's own research

Despite the clear opportunities, rural coliving investments face critical challenges:

- Infrastructure Deficits: The absence of reliable, high-speed internet connectivity (fiber-optic or 5G) in remote villages remains a primary impediment (NOMAZINE: No-mad-is-m & Social entrepreneurship, 2022; Costantini & Pastorelli, 2021).
- Risk of Rural "Disneylandisation": There is an inherent danger of isolating the nomadcommunity inside a "luxury bubble" that fails to engage with locals, which couldartificially inflate local real estate prices (Metta, 2023).
- Regulatory Gaps: Bulgarian legislation does not recognize "coliving" as a distinct legalcategory, forcing these properties to register under ill-fitting hospitality classifications (Alloh et al., 2025; Ianeva & Georgieva, 2018).

4.3 Discussion: Symbiosis Between Local Communities and NewResidents

The foundational question remains how to achieve a functional symbiosis between agingrural populations and incoming digital nomads. Social entrepreneurship offers the bridgefor this interaction. Rural residents possess profound knowledge regarding traditions, crafts, and land cultivation, which are highly valued by authenticity-seeking remoteworkers. Conversely, young professionals bring digital literacies and global perspectivescapable of modernizing local enterprises (NOMAZINE: No-mad-is-m & Socialentrepreneurship, 2022; Creativehubs | Burgas Coliving, 2020).

This process of "knowledge sharing" constitutes the core of the sharing economy beyondmere financial transactions. It cultivates social capital, which serves as the strongestdefensive mechanism against the abandonment of mountainous and rural regions (Sgroi,2022).

5. Proposed Framework for Rural Revitalization

Based on the empirical findings, an Integrated Model for Rural Revitalization via Coliving Ecosystems and the Sharing Economy has been developed (see Figure 1). This model unifiesdigital nomadism, the sharing economy, and social entrepreneurship to transformdepopulating regions into attractive destinations by generating economic and socialadded value.

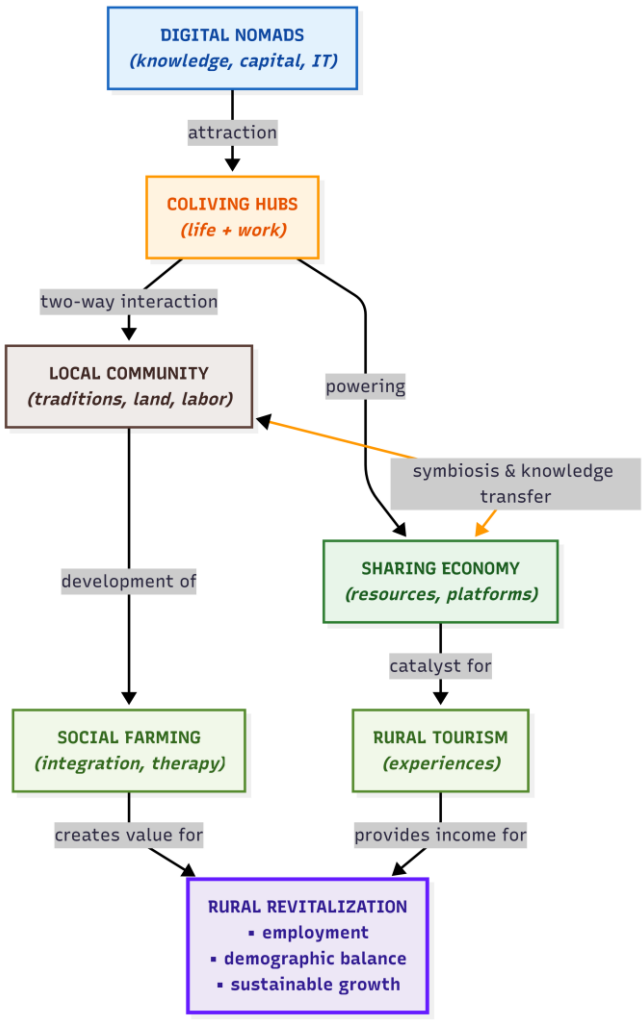


Figure 1. Integrated Model for Revitalization

Source: Author's own elaboration

The framework is structured across four main operational vectors:

5.1 Structural Components of the Model

Coliving Infrastructure:

This serves as the primary entry point. Establishing modern,collaborative rural housing options attracts affluent digital nomads. Strategically,coliving hubs generate consistent commercial revenue through accommodation fees,coworking desk rentals, and ancillary services. This predictable cash flow forms thefinancial backbone of the model.

The Sharing Economy: This component relies on maximizing the utility of underutilizedlocal assets, such as vacant real estate, shared transit options, digital platforms, andlocalized knowledge. Through these mechanisms, coliving hubs stimulate the ruralentrepreneurial ecosystem, allowing residents to generate revenue with minor capitaloutlays.

Social Farming and Entrepreneurship: Developed directly by the local community, thisfunctions as a sustainable business model with a distinct social mission. Rather thanacting as an isolated economic activity, it is integrated as an experiential element,offering nomads authentic contact with the land, clean food access, and volunteeringoptions, while securing employment and support structures for vulnerable localgroups.

5.2 Interaction Mechanism (The Operational Engine)

5.3

The success of the framework relies on deep social and financial symbiosis between thelocal population and new residents:

Social Symbiosis and Knowledge Sharing: As illustrated in Figure 1, a bidirectionalknowledge-transfer relationship exists between the local community and the sharing economy. Residents offer heritage, authenticity, and agricultural expertise. In return,digital nomads contribute global outlooks and technical competencies (e.g., digitalmarketing and web development for local producers). This mutual exchangestrengthens regional social capital.

Financial Symbiosis (Cross-Subsidization Mechanism): To guarantee long-termviability and hedge against economic precarity in rural areas, an internal cross-subsidization business model is applied. Commercial revenues derived from nomad-funded coliving services are systematically reinvested into sustaining social farmingassets and community initiatives. Consequently, the commercial viability of thecoliving hub financially secures non-profit, high-utility social causes for the localcommunity.

5.4 Key Management Factors

To prevent phenomena like "Disneylandisation" (the creation of artificial, superficialattractions) or economic instability, operators must possess specific managementcapacities:

Innovation and Experience Design: Developing coliving services that satisfy stringentprofessional requirements (high-speed connectivity, ergonomic workstations) whileseamlessly blending them with authentic environmental experiences.

Ethical Leadership and Sustainability: Navigating the balance between commercialprofitability and the fulfillment of the social mission to support local populations.

Digital Competence: Utilizing modern software platforms for sharing economylogistics, data analytics, and digital destination marketing.

5.5 Implementation Framework

State and Municipal Authorities: Prioritizing public investment in digital infrastructure(high-speed fiber and 5G deployment) in rural areas, simplifying

registrationcompliance for coliving assets, and allocating regional development funding throughLocal Action Groups (LAGs).

Tourism Entrepreneurs: Retrofitting vacant rural properties into contemporarycoliving spaces, forging strategic alliances with local farmers and artisans, and activelybranding the social impact of the destination.

Academia: Implementing interdisciplinary curricula combining hospitalitymanagement, digital entrepreneurship, and sustainable development to train the nextgeneration of managers for these innovative spaces.

6. Conclusion

The structural shift of Bulgarian rural tourism toward digital nomadism and colivingframeworks represents a critical step in addressing regional disparities and thedemographic crisis. Rural territories must be re-imagined as "spaces for shared life and knowledge." Attracting highly qualified remote professionals through large-scaledevelopments like "Coliving Semkovo" or targeted micro-projects injects fresh economicmomentum and intellectual capital into declining regions, validating the practicalapplication of the sharing economy.

Based on this research, the following strategic recommendations are directed toward keystakeholders:

For State and Local Government Authorities:

- Digital Infrastructure Investments: Ensuring high-speed broadband and cellularcoverage in rural zones as an absolute prerequisite for remote worker attraction.
- Regulatory Streamlining: Fostering an administrative environment conducive to socialenterprise registration, including tax incentives under the Law on Enterprises of theSocial and Solidarity Economy.
- Support for Local Action Groups (LAGs): Prioritizing funding for LEADER/CLLDprojects that integrate social farming with tourism initiatives.

For Tourism Entrepreneurs:

- Coliving Space Development: Re-purposing underutilized real estate assets intocommunity-focused, modern remote work hubs.
- Social Cause Branding: Integrating the social impact of connected farms intomarketing strategies to appeal to socially conscious consumers.
- Ecosystem Partnerships: Collaborating closely with local producers to deliverauthentic regional gastronomy and craft experiences.

For Academic Institutions and Organizations (e.g., EBSiDE):

- Interdisciplinary Curricula: Constructing specialized courses blending hospitalitymanagement, digital entrepreneurship, and sustainable development.
- Applied Research Initiatives: Conducting continuous monitoring of demographictrends and sharing economy outcomes within pilot rural territories.

- Startup Incubation: Establishing social innovation incubators in rural environments toconnect university students with active field practices

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DIGITAL TRANSFORMATION IN THE INSURANCE INDUSTRY: CHALLENGES AND OPPORTUNITIES FOR THE DEVELOPMENT OF INSURANCE MARKETS IN DEVELOPING ECONOMIES

Halit Shabani[1], Ibish Mazreku[2]

Abstract

Digital transformation is profoundly changing the global insurance industry by creating new business models, more efficient processes, and products that are increasingly tailored to customers. The use of artificial intelligence (AI), big-data analytics, online platforms, automation, and InsurTech solutions is affecting risk assessment, underwriting, claims management, fraud detection, and customer service. For developing markets, this technological wave creates opportunities to reduce distribution costs and increase financial inclusion, while simultaneously exposing weaknesses in infrastructure, skills, data protection, and cybersecurity. The purpose of this paper is to analyse the impact of digital transformation on the insurance industry, fo-cusing on Kosovo as a small developing market and comparing it with international trends. The methodology combines theoretical analysis, institutional analysis, and descriptive statistical analysis of secondary data for the period 2021–2025. The key indicators are gross written premiums, claims paid, assets, insurance density and penetration, the life/non-life structure, and indicators of digital use. Because of the absence of a harmonised series on insurers' digital investments in Kosovo, the correlation results are interpreted as associations rather than causality. The results show continuous growth in Kosovo's market: premiums increased from EUR 117.4 million in 2021 to EUR 179.0 million in 2025, while assets rose from EUR 240.6 million to EUR 356.9 million. The compound annual growth rate of premiums was approximately 11.1%, while paid claims grew by approximately 9.1% per year. Nevertheless, insurance penetration remained at 1.6% of GDP and life insurance represented only 4.7% of premiums, indicating considerable room for voluntary products, microinsurance, and digital channels. The paper concludes that technology is a necessary but insufficient condition: outcomes depend on data governance, proportionate supervision, human capital, interoperability, and consumer trust.

Keywords: digital transformation, insurance industry, InsurTech, developing markets, artificial intelligence, financial inclusion.

1. Introduction

The insurance industry is based on information: the insurer collects data, assesses the probability and magnitude of loss, determines the premium, administers the contract, and pays the claim. Consequently, every improvement in the production, transmission, and analysis of information directly affects the economic model of insurance. Digital transformation is not merely the conversion of a physical document into an electronic one; it is a reconfiguration of processes, decision-making, customer relationships, and the control architecture.

Across the value chain, online platforms reduce selling costs, application programming interfaces enable insurance to be embedded in other products, sensors and telematics generate more frequent data, while AI can rank risks and claims. The OECD (2026) emphasizes that new data sources and analytical tools provide the sector with better opportunities for risk assessment and risk reduction. EIOPA (2021), on the other hand, observes that the benefits of accuracy, automation, and cost reduction must be balanced against fairness, transparency, explainability, and human oversight.

The topic is especially important in developing economies. These markets are commonly characterised by low insurance penetration, the dominance of compulsory insurance, informality, lower incomes, and less consolidated institutional infrastructure. At the same time, the spread of mobile phones and digital payments creates the possibility of technological leapfrogging: services can reach customers without the costly expansion of physical networks.

Kosovo represents an appropriate case for analysis. In 2025, gross written premiums reached EUR 179.0 million, but insurance penetration remained only 1.6% of GDP and life insurance accounted for 4.7% of premiums (CBK, 2025). This structure indicates market growth, but also dependence on traditional products and considerable room for expansion.

1.1. Research *problem*

The main problem is the gap between the potential of technology and the actual capacity of developing markets to convert it into efficiency, inclusion, and better consumer protection. Digitalization can reduce transaction costs, but it can also exclude people with limited digital skills. AI can improve risk segmentation, but it may reproduce hidden biases in data. Online service can accelerate payments, but it increases dependence on ICT systems and external providers.

1.2. Purpose and objectives

The purpose is to assess the role of digital transformation in modernizing insurance in developing markets and to determine the institutional conditions for its safe adoption in Kosovo. The objectives are:

1. to systematise the technologies and their uses in the value chain;
2. to analyse the economic benefits and the operational, ethical, and regulatory risks;
3. to measure the dynamics of Kosovo's market during 2021–2025;
4. to assess the ecosystem's readiness for digital distribution and service;
5. to formulate recommendations for insurers, the CBK, and policymakers.

1.3. Research questions and hypotheses

RQ1: How does digitalisation affect operational efficiency and customer experience?
RQ2: What are the main obstacles to adoption in developing markets?
RQ3: Do the dynamics of Kosovo's market indicate capacity for expansion through digital channels?
RQ4: Which regulatory and governance measures are required for trustworthy use of AI?
The hypotheses are:

- **H1:** The adoption of digital technologies is positively associated with operational efficiency and speed of service.
- **H2:** Infrastructure, skills, trust, and the regulatory framework significantly affect the level of adoption.
- **H3:** Increased use of digital payments and connectivity creates conditions for greater access to insurance, but does not by itself guarantee increased penetration.
- **H4:** Proportionate AI governance and cyber resilience are prerequisites for sustainable benefits.

2. Literature review and conceptual framework

2.1. From digitisation to digital transformation

Technical digitisation means converting analogue information into digital format. Digitalisation of processes means using technology to improve an existing process. Digital transformation goes further: it changes the way an organisation creates and distributes value. In insurance, this may mean moving from

compensation after an event towards risk prevention, from a standard product towards usage-based cover, and from episodic interaction towards a continuous relationship with the customer.

The OECD (2017) defines Insurtech as the use of new technologies with the potential to innovate the sector and affect regulatory practices. The term includes technology start-ups, but also the transformation of traditional insurers and partnerships with banks, mobile operators, trading platforms, and cloud providers.

2.2. Key technologies

Artificial intelligence and machine learning. Algorithms can classify applicants, predict claims frequency, identify anomalies, and assist with the automation of simple claims. In the European market, EIOPA (2025) data showed the use of AI by 50% of surveyed non-life undertakings and 24% of life undertakings; additional substantial shares planned to use it within three years.

Big Data and analytics. Transactional, geospatial, device, image, and behavioral data can improve accuracy. However, a correlation between a characteristic and a claim is not necessarily a causal relationship, and the use of proxy variables may produce indirect discrimination (OECD, 2020).

Cloud computing and APIs. Cloud infrastructure makes computing capacity more flexible, while APIs enable the controlled exchange of data. For small markets, this model reduces initial investment, but creates concentration risk and dependence on third-party providers.

Telematics, IoT, and images. Sensors can support pay-how-you-drive insurance, property monitoring, or health parameters. More frequent data allow more dynamic pricing and preventive interventions, but require understandable consent and device security.

Blockchain and smart contracts. Distributed ledgers may assist verification and parametric products, especially when payment is linked to an external index. Practical use depends on the quality of the data source and legal recognition of automated execution.

2.3. Impact on the value chain

Function	Digital use	Expected benefit	Main risk
Marketing and sales	platforms, comparison tools, embedded insurance	wider access and lower cost	unsuitable selling, manipulation
Underwriting	AI, alternative data, telematics	segmentation and speed	bias, lack of explanation
Administration	RPA, electronic signature, APIs	fewer errors and shorter time	technological dependence
Claims	online notification, OCR, image analysis	faster payment	unfair automated rejection
Fraud	anomaly detection, network analysis	lower losses	false-positive results
Risk management	predictive models, dashboards	earlier response	model and data risk

Source: authors' compilation based on OECD and EIOPA.

2.4. Efficiency, inclusion, and trust

Transaction-cost theory suggests that automation and online channels can reduce the costs of searching, verification, contracting, and administration. This is

particularly important for products with small premiums, where traditional distribution makes the product uneconomical. Mobile microinsurance or embedded insurance can reduce this barrier.

However, inclusion requires more than an application. Global Findex 2025 shows that 40% of adults in developing economies saved in a financial account in 2024, an increase of 16 percentage points from 2021 (WB, 2025). This indicates an expansion of the digital financial ecosystem, but the use of insurance also depends on income, perceived value, trust in the payment of claims, and financial literacy.

Trust is economic capital. An automated process may be faster, but if the consumer does not understand the reason for a price or a rejected claim, it may be perceived as arbitrary. Transformation must therefore combine simple interfaces, explanations, a right of appeal, and human intervention for high-impact decisions.

3. Methodology

3.1. Research design

The study is applied, exploratory, and descriptive research. It combines: (i) analysis of literature and regulatory documents; (ii) analysis of Kosovo as a case study; and (iii) statistical analysis of annual series for 2021–2025. The unit of analysis is the insurance sector at market level.

3.2. Sources and variables

The main source is the CBK Annual Report 2025, which presents comparable series for premiums, claims, and assets (CBK, 2025). Official CBK and World Bank data are used for connectivity and financial inclusion. The international framework is based on OECD, IAIS, EIOPA, and EU legislation.

Variable	Operational definition	Unit
GWP	gross written premiums	EUR million
Claims	claims paid by insurers and KIB	EUR million
Assets	sector assets	EUR million
Simplified loss ratio	claims paid / GWP	%
Penetration	GWP / GDP	%
Density	GWP / population	EUR per inhabitant
Life share	life premiums / GWP	%

3.3. Statistical techniques

The analysis uses absolute change, annual growth rate, compound annual growth rate (CAGR), mean, standard deviation, coefficient of variation, and Pearson correlation between premiums, claims, and assets. The CAGR formula is:

$$CAGR = \left(\frac{X_{2025}}{X_{2021}}\right)^{1/4} - 1$$

The simplified claims-to-premiums ratio is calculated as follows:

$$LR_t = \frac{Claims_t}{GWP_t} \times 100$$

Because the sample contains only five annual observations and all series have a trend, correlations are used only to describe co-movement. No causal inference is performed, and it is not claimed that growth was caused by digitalisation.

3.4. Limitations

The principal limitation is the absence of harmonised public data on ICT expenditure, the percentage of policies sold online, average claims-handling time, and the use of AI by each insurer. In addition, the short series does not permit a robust econometric model. The paper therefore identifies the potential and conditions of impact, rather than the measured causal effect of a particular technology.

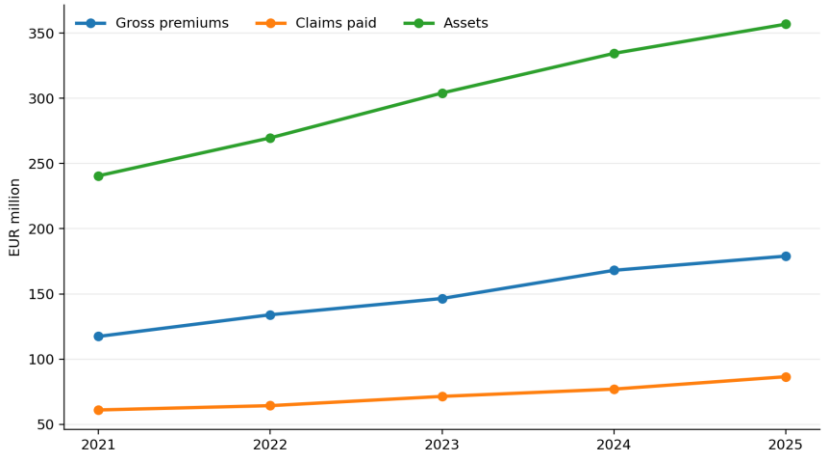
4. Statistical analysis of Kosovo's insurance market

4.1. Dynamics, 2021–2025

The data show a sustained expansion of activity. Premiums increased by EUR 61.6 million or 52.5% over the period; claims by EUR 25.5 million or 41.8%; and assets by EUR 116.3 million or 48.3%.1

Year	Gross premiums	Claims paid	Assets	Claims/premiums
2021	117.4	61.0	240.6	52.0%
2022	134.0	64.3	269.7	48.0%
2023	146.5	71.4	304.1	48.8%
2024	168.1	77.0	334.5	45.8%
2025	179.0	86.5	356.9	48.4%

Source: CBK (2026); authors' calculations.2



Premiums, claims, and insurance-sector assets, 2021–2025

Premium growth was faster in 2022 and 2024, while it slowed to 6.5% in 2025. In the same year, the number of policies fell from 2.0 million to 1.9 million, or by

1 Ibid., pp. 50–53.
2 Ibid., Chart 31, Tables 9–10, and Chart 32.

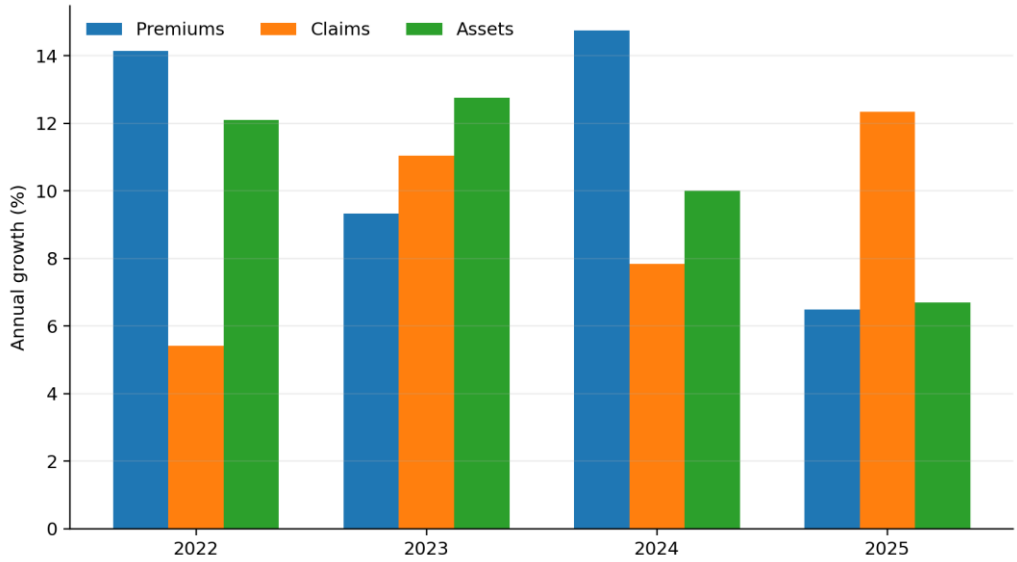
4.8%, suggesting that the increase in premium value was not solely the result of a larger number of contracts.3

4.2. Summary statistics

Indicator	Premiums	Claims	Assets
Mean, 2021–2025	149.0	72.0	301.2
Minimum	117.4	61.0	240.6
Maximum	179.0	86.5	356.9
Standard deviation	24.9	10.1	47.0
CAGR	11.1%	9.1%	10.4%

Source: authors' calculations based on CBK data.

The correlation coefficient between premiums and claims is approximately 0.98, while that between premiums and assets is approximately 1.00. This co-movement is expected: portfolio expansion increases premiums, reserves, assets, and exposure to claims. It is not evidence of the impact of digitalisation, because the series contain trends and do not control for inflation, tariff changes, product structure, or macroeconomic factors.



Annual growth rates

4.3. Market structure in 2025

Non-life insurance reached EUR 170.6 million or 95.3% of premiums, while life insurance reached EUR 8.4 million or 4.7%. Compulsory insurance accounted for 56.4% of non-life premiums; MTPL alone represented 45.8% of total premiums.4 This functional concentration leads to two conclusions.

First, digital channels can deliver immediate efficiency in high-volume products through online renewal, automated verification, and digital claims notification. Second, the transformational impact will be greater if technology is used to develop demand for voluntary insurance—property, agriculture, health, life, and products for small enterprises.

3 Ibid., p. 52.
4 Ibid., pp. 52–53.

Penetration of 1.6% and density of EUR 112.9 per inhabitant show that nominal growth has not yet brought the market close to the level of more developed economies.5 Digitalisation can reduce service costs, but demand will depend on income, risk awareness, and trust in the contract.

4.4. The digital financial environment

At the end of 2024, Kosovo had approximately 1.7 million customer cards. The number of card transactions reached approximately 43 million, 33.8% more than in 2023 (CBK, 2025). This development signals consumer readiness for digital financial interaction and lowers the practical barrier to paying insurance premiums online.

Nevertheless, digital payment is not the same as the digital sale of insurance. The product requires an explanation of cover, exclusions, duration, obligations, and the claims procedure. A fully digital channel must preserve evidence of disclosure and verify suitability, particularly for complex products.

4.5. Evaluation of the hypotheses

Hypothesis	Assessment	Reasoning
H1	Strong theoretical support; no domestic causal test	Official sources document automation and speed, but insurers' KPIs are unavailable
H2	Supported	Literature and regulation identify infrastructure, skills, data, and trust as conditions
H3	Partially supported	Digital payments grew rapidly, while insurance penetration remained at 1.6%
H4	Supported	EIOPA, DORA, and IAIS require governance, control, security, and human oversight

The most important result is the distinction between **digital readiness** and the **insurance outcome**. The expansion of payments creates infrastructure, but low penetration shows that interventions are also needed in product design, distribution, education, and trust

.

5. Opportunities for developing markets

5.1. Cost reduction and automation

Processes with clear rules—registration, document verification, notifications, periodic payments, and small claims—are the best candidates for automation. The benefit should not be measured only by staff reductions, but by cycle time, number of errors, cost per policy, and customer satisfaction. Incorrect automation merely accelerates a poor process; it should therefore be preceded by process redesign.

5.2. Expanding access

Mobile telephony, digital payments, and partnerships with banks or platforms can reach customers outside urban centers. IAIS (2015) has emphasized

5 Ibid., p. 50.

that technological innovations may be used to overcome barriers to access in inclusive insurance, while preserving policyholder protection.
Simple products with clear cover, small premiums, and minimal documentary requirements are particularly suitable. Examples include parametric agricultural insurance, mobile-device cover, travel insurance embedded in a ticket, and simple accident insurance.

5.3. Claims and fraud management

Electronic claims notification, photo uploads, and automated verification can shorten processing time. For low-value claims with clear signals, a straight-through process can be completed without manual intervention. For complex cases, the algorithm should prioritize rather than make the final decision without control. Fraud detection is an area with potentially high returns. However, an algorithmic signal is an indicator, not proof. EIOPA (2025) recommends human oversight and appeal mechanisms, because fraud must be proven by the insurer.

5.4. Digital supervision

Transformation also affects the supervisory authority. Standardised, machine-readable reporting can enable early analysis of liquidity, reserves, complaints, and concentration. IAIS (2021) and the Financial Stability Institute observe that remote supervision depends on access to digitalized regulatory data and strong security protocols.
For the CBK, a gradual approach may begin with a common taxonomy, automated validations, and dashboards for key indicators before the use of complex models.

6. Challenges and risks

6.1. Infrastructure and legacy systems

Legacy systems often contain fragmented data, non-standardized codes, and manual integrations. Adding a new application on top of this foundation may create a modern façade without transforming the process. Data quality, modular architecture, and controlled APIs should be prioritized.

6.2. Human capital

Transformation requires a combination of actuarial, insurance, legal, data, and security knowledge. A shortage of specialists is particularly acute in small markets. Training should include not only programming, but also model governance, ethics, interpretation, and customer communication.

6.3. Privacy, fairness, and explainability

More data are not automatically better data. The insurer should document purpose, legal basis, origin, quality, retention period, and access. Sensitive variables or their proxies may create discrimination.
EIOPA (2025) formulates six pillars: proportionality; fairness and non-discrimination; transparency and explainability; human oversight; data governance and record-keeping; and robustness and performance. These

principles are appropriate even for a market outside the EU, because they create a standard of trustworthiness and facilitate harmonization.

6.4. Cybersecurity and third parties

Digitalization expands the attack surface. An incident may interrupt sales, claims payments, and reporting, while a data leak may harm customers and reputation. Management should include asset inventory, multi-factor authentication, segmentation, backups, testing, incident response, and control of providers.

The EU DORA Regulation (2022) establishes harmonized rules for ICT risk management, incident reporting, resilience testing, and third-party risk for financial entities, including insurers. Even without direct application in Kosovo, it provides a benchmark for alignment.

6.5. Model risk and generative AI

Models may fail because of poor data, behavioral change, or use outside their intended purpose. Generative AI adds the risk of inaccurate responses, information disclosure, and lack of traceability. Low-risk uses may include document summarization with human verification; decisions on price, rejection, or claims require much stronger controls. The EU AI Act (2025) classifies systems used for risk assessment and pricing in life and health insurance as high-risk. This risk-based approach is more appropriate than a general prohibition or unrestricted self-regulation.

7. Discussion

The analysis shows that Kosovo's market has an economic and digital foundation for transformation, but does not yet provide sufficient public evidence to measure the productivity of technology investments. Double-digit average growth in premiums and assets indicates investment capacity, while low penetration and the minimal weight of life insurance show that the business model remains narrow.

In this context, transformation should not begin with the most advanced technology, but with the most valuable problem. For one insurer, the priority may be reducing claims time; for another, digital renewal; and for the supervisor, reporting quality. Each project should have a baseline and indicators: average time, cost per transaction, abandonment rate, complaints, errors, payments within the deadline, and incidents.

H1 is supported by the mechanisms and international evidence, but requires domestic firm-level data. H2 and H4 are clearly supported by institutional literature. H3 is only partially supported: the growth of digital payments is rapid, but insurance penetration remains low. This result contradicts technological determinism. Infrastructure enables use, but products, income, risk culture, and trust determine actual adoption.

For developing markets, the principal advantage may be modularity. Rather than immediately replacing the entire system, insurers may create integration layers, digital identity, payments, and claims modules. However, modularity must be

accompanied by a data architecture and clear ownership of controls.

8. Recommendations

8.1. For insurance companies

1. Develop a three-year strategy linked to measurable business objectives, rather than a list of technologies.
2. Build a data inventory and dictionary, quality rules, and clear responsibilities.
3. First digitalise high-volume processes with controllable risk.
4. Apply an impact assessment to every AI model: purpose, data, fairness, explainability, human control, and monitoring.
5. Maintain an alternative channel for customers with limited digital skills.
6. Measure claims-payment time, cost per policy, complaints, and online usage.
7. Test resilience and continuity plans, including cloud providers and APIs.

8.2. For the Central Bank of the Republic of Kosovo

1. Develop a supervisory innovation strategy based on proportionality and technological neutrality.
2. Establish a consultation mechanism or regulatory sandbox with clear criteria, time limits, and consumer safeguards.
3. Standardise digital reporting and require indicators on online sales, digital claims, incidents, and AI use.
4. Align ICT-risk expectations with DORA and AI governance with EIOPA principles.
5. Require high-impact rejections or prices to be explainable and appealable.
6. Publish annual aggregate statistics on digital transformation while preserving confidentiality.

8.2. For policymakers and the ecosystem

Electronic identity and signatures, registry interoperability, financial education, and data protection should be improved. Universities may develop joint programmes in actuarial science, analytics, and security. Industry associations can standardise terminology, protocols, and educational campaigns.

8.4. Proposed roadmap, 2026–2029

Phase	Time frame	Main actions	Success indicator
Foundation	0-12 months	data inventory, KPIs, security, reporting	measured baseline and assigned responsibilities
Piloting	12-24 months	online renewal, e-claims, low-risk models	lower time and cost, without more complaints
Scaling	24-36 months	APIs, embedded products, SupTech	higher share of digital policies
Consolidation	36+ months	model audit, resilience testing, harmonisation	greater trustworthiness and penetration

9. Conclusions

Digital transformation can significantly improve the insurance industry in developing markets, but its effect depends on implementation. Digital technologies reduce transaction costs, accelerate underwriting and claims, improve fraud detection, and create opportunities for new products. At the same time, they create new risks related to privacy, algorithmic discrimination, provider concentration, and cyber disruption.

For Kosovo, the 2021–2025 data show a growing sector: a CAGR of 11.1% for premiums and 10.4% for assets. Nevertheless, penetration of 1.6%, the 4.7% share of life insurance, and the dominance of compulsory products indicate that the potential has not been fully utilised. The 33.8% growth in card transactions in 2024 demonstrates readiness for digital financial services, but does not replace the need for understandable products and trust.

The principal contribution of the paper is an integrated framework: transformation should be assessed through three outcomes—efficiency, inclusion, and trustworthiness. A project that reduces cost but increases exclusion or complaints cannot be regarded as a complete success. The most sustainable route is gradual, risk-based adoption with quality data, human control, resilience, and transparent measurement.

Future research should use company-level data and customer surveys. A panel containing indicators such as ICT investment, online policies, claims time, and productivity would enable regression and causal evaluation. Controlled experiments could also measure the effect of interfaces, explanations, and education on insurance purchases.

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THE ROLE OF AI TOOLS IN MODERN WEB DESIGN: A COMPARATIVE OVERVIEW

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Abstract

The rapid advancement of artificial intelligence (AI) is significantly transforming modern web design practices. This paper presents a structured overview of AI-powered tools and examines their role across different stages of the web design lifecycle, including user interface design, code generation, user experience personalization, and performance optimization. The study categorizes widely used AI tools based on their functionality and application domain. A comparative analysis is conducted to evaluate their capabilities, advantages, and limitations in real-world web development workflows. The findings suggest that AI tools primarily act as supportive technologies that enhance efficiency, automate repetitive tasks, and enable data-driven design decisions, rather than fully replacing human designers. Furthermore, the paper highlights key challenges, including limited creative control, dependency on automated systems, and ethical concerns related to data privacy and user manipulation.

In addition, the study emphasizes the growing importance of integrating AI tools within collaborative design environments, where human creativity and machine intelligence complement each other. The results also indicate that successful adoption of AI in web design depends on balancing automation with user-centered design principles. Finally, the paper outlines potential future directions, including more advanced personalization techniques and the development of explainable AI systems for transparent design decisions.

Keywords: artificial intelligence, web design, user interface design, code generation, performance optimization

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1. Introduction

Perhaps the most significant technological transformation of the last decade is the convergence of artificial intelligence and web design. Web-based products today constitute the primary interface between organizations and their users, and the quality of such an interface has a major impact on user engagement and brand perception. With the increasing development of information technologies, AI tools are no longer based on narrow automation that relies on strictly defined rules. These tools today enable solving complex design problems, from content generation to interface personalization.

Artificial intelligence platforms are already embedded into many web design tools. Typical examples of such tools are Figma AI and Adobe Sensei, which enable designers many benefits that will be presented in this paper. Also, large language model (LLM) such as GitHub Copilot enable the automation of routine programming tasks, offering relative code completion, which also reduces the costs of companies working in this area in terms of

It is also important to emphasize the significance of artificial intelligence as it relates to user behavior analysis and experience personalization. All of this is enabled by machine learning algorithms that are embedded in such AI platforms. This also means certain implications regarding the use of different web design methodologies and the role of humans in the decision-making process in web design.

In addition to the benefits offered by the application of artificial intelligence in the web design process, there are also certain problems that can be methodological, ethical, etc. Namely, there are certain problems around the interoperability of AI-designed solutions, issues around the algorithmic transparency of these models, problems regarding decision-making in web design, etc. Furthermore, the collection and processing of granular behavioral data underlying AI personalization systems engages complex regulatory and ethical obligations under contemporary data protection frameworks (European Commission, 2021). The creative and intellectual property implications of generative AI — whose outputs are derived from large corpora of existing human-authored design work — remain contested and are subject to ongoing legal and normative deliberation (Verganti et al., 2020).

The existing and available literature in this area exhibits significant gaps. The studies that have been published mostly address individual AI tools or even specific aspects of an application, in isolation. These studies do not provide an

adequate integrative analysis of AI deployment across the entire web design process. Furthermore, there is very little research that includes comparative analyses that systematically evaluate the performance of AI tools applied to web design. Also, very little attention is paid to theoretical frameworks that address the relationship between increasingly advanced AI tools and human creativity, which creates a relatively large gap in the researched issues.

In that context, this research will be aimed at three interrelated goals. First, it will provide a structured comparative overview of the leading artificial intelligence tools used in web design, categorized by application type and domain of functionality. It also synthesizes empirical and theoretical evidence regarding the benefits and limitations of these tools in terms of design productivity, quality, user experience, and development efficiency. Finally, this paper also identifies emerging challenges and trends that will emerge in the future.

2. Literature review

The emergence of large-scale generative AI systems — encompassing diffusion-based image synthesis models, multimodal generative architectures, and large language models adapted for visual and design tasks — has introduced qualitatively new capabilities into the web design toolkit. Platforms such as Adobe Firefly and Midjourney enable the synthesis of high-fidelity visual assets, conceptual illustrations, and design system components from natural language descriptions, substantially reducing the time and technical expertise required for original visual content production (Adobe, 2024).

Empirical studies on designer responses to AI-generated creative content have identified a phenomenon of "creative anchoring," in which exposure to AI-generated design options systematically influences the subsequent creative direction of human designers, even when the AI outputs are explicitly labeled as preliminary or illustrative (Nielsen Norman Group, 2023). This effect carries implications for design process governance and raises questions about the conditions under which AI-generated content should be introduced in ideation workflows to minimize undue anchoring while maximizing its exploratory value.

A further dimension of scholarly concern pertains to the intellectual property and attribution implications of generative AI systems trained on large corpora of human-authored creative work. The legal and normative frameworks governing the ownership of AI-assisted creative outputs remain unsettled across major jurisdictions, creating conditions of regulatory uncertainty that constrain organizational AI adoption strategies (Shneiderman, 2022). Research in this area is nascent and is developing in dynamic interaction with evolving regulatory environments.

The integration of AI into software development practice has been extensively studied in the context of LLM-based coding assistants, with GitHub Copilot attracting particular scholarly attention as the most widely deployed commercial system of its type. Bird et al. (2023) conducted a large-scale empirical study of Copilot adoption among professional software developers, reporting substantial productivity gains as measured by task completion time and code output volume. Their findings indicate that AI-assisted developers completed programming tasks an estimated 55% faster than unassisted counterparts under controlled experimental conditions, with particularly pronounced benefits for routine, syntactically stereotyped coding tasks.

Vaithilingam et al. (2022) complemented these findings with a qualitative investigation of developer experience, revealing a significant expectation-experience gap in Copilot usage. While developers anticipated AI assistance to be most valuable for complex algorithmic challenges, empirical observation indicated that the greatest realized benefits occurred in the domain of boilerplate code generation and API usage exemplification. These discrepancies have implications for the design of developer education programs and the user experience design of AI coding tools, suggesting the need for better calibrated transparency mechanisms to communicate AI capability boundaries to users.

The application of machine learning to web analytics and user behavior modeling has transformed the operational possibilities for evidence-based design. AI-powered analytics platforms employ supervised and unsupervised learning algorithms to identify statistically significant patterns in large-scale user interaction data, enabling the prediction of user behavior, the detection of usability deficiencies, and the automated optimization of content presentation strategies (Davenport & Mittal, 2022). These capabilities represent a qualitative extension of traditional web analytics, which was largely confined to descriptive reporting of aggregate behavioral metrics.

The ethical dimensions of AI deployment in web design have emerged as a substantive research domain, reflecting broader societal concerns regarding the social consequences of algorithmic systems. Dwivedi et al. (2023) provide a comprehensive synthesis of AI ethics literature as applied to digital design contexts, identifying data privacy, algorithmic bias, transparency, accountability, and the potential for manipulative design as principal areas of ethical concern. Their analysis emphasizes that ethical risks are not uniformly distributed across application domains but vary systematically with the nature of AI intervention, the vulnerability of affected user populations, and the regulatory context of deployment.

The above reveals several gaps in the existing literature that we will try to partially address in this paper. First, previous research has examined AI tools without placing them within a comprehensive overview of the web design

lifecycle. This inclusion of AI within the web design lifecycle is necessary to understand the impact of AI in different phases of design, but also to assess the implications of AI on the quality of the design process. Furthermore, comparative studies that systematically evaluate competing AI platforms based on realistic criteria are very rare. Most of these evaluations are conducted by commercial entities that often have conflicts of interest or by researchers working with samples that are not of serious scale. This paper will strive to provide methodologically rigorous comparative assessments that will provide reliable evidence that will benefit practitioners in the decision-making process.

3. Use of AI tools in web design

The application of artificial intelligence in web design allows designers to speed up the web design process, but also makes this process more efficient and user focused. AI tools help designers generate layouts, suggest color palettes, create images, write website content, and even optimize user experiences based on visitor behavior. In this way, web designers can become more creative and solve real problems while spending less time on repetitive tasks.

Today artificial intelligence tools offer great advantages in ensuring the quality of websites. In this way, simulations can be performed regarding user interactions, predicting the movement of users through the website, and thus identifying usability problems on the website before it is published or hosted. With the help of these tools, this way of working eliminates assumptions and enables continuous improvement of the website, before publication and after its launch.

Artificial intelligence can also provide another great advantage related to personalization. With AI tools, it is possible to analyze user characteristics and thus define content adapted to the user's preferences, recommendations for certain products, and adjustments to the interface. In this way, user satisfaction can be improved, and this is especially important for those websites that are in the field of business and e-commerce. Beyond personalization, AI tools are transforming the way designers can improve the accessibility and inclusivity of websites. Such tools can now scan websites for accessibility issues, such as insufficient color contrast, missing text, or poor navigation structures for screen readers, and suggest immediate corrections. This will allow designers to create websites that are usable by people with visual, auditory, or motor impairments. As a result of this accessibility and inclusivity, the web design process encompasses these aspects as an integral part of it.

Artificial intelligence offers a number of benefits, but despite those benefits, it can never be a complete replacement for humans. Creativity and critical thinking remain essential skills that AI cannot fully replicate. However,

these AI tools applied to web design can be a powerful assistant that can improve productivity and make faster and better design decisions. It is expected that with the development of new technologies such as artificial intelligence, they will play an even greater role in creating innovative, efficient, and user-friendly websites.

Looking ahead, with the increasing development of information technologies and artificial intelligence, the role of these tools will expand even further. This expanded use will enable the emergence of more intuitive design tools capable of understanding context and user intent with greater precision. The development of these technologies will contribute to deepening the cooperation between humans and artificial intelligence systems, and as a result, websites will be created that will be not only more visually appealing but also smarter and better aligned with user expectations.

4. Methodology

This paper uses a qualitative research approach through which is conducted analysis of the role and impact of AI tools in web design. The methodology is based on a comparative analysis of AI platforms, focusing on their functionalities, applications, advantages, and limitations across different stages of the web development lifecycle. Also, representative artificial intelligence tools that are most commonly used in practice were selected in this research. These tools were chosen because they cover different phases of the web design process, including design, development, and analysis.

A comparative analysis of AI tools applied in web design was made based on pre-defined precise criteria. These criteria are: functionality and purpose, level of automation, impact on productivity and contribution to user experience. The analysis was done by examining the characteristics of each tool, but also all of it was supported by appropriate documentation and relevant literature. The main aim of this analysis was to identify the similarities, differences and contribution of each of these tools to contemporary practices in the web design process.

This methodological approach implies a comprehensive understanding of how artificial intelligence technologies are integrated into the web design process and how they affect the efficiency of that process. Also, this analysis includes the quality of the user experience, on which special emphasis is placed. Although, due to the allowed size of this paper, only a limited number of tools are included, this research nevertheless provides a representative overview of current trends and is a basis for future research.

5. Comparative analysis of AI platform for web design

This paper presents a structured comparative analysis of ten of the most commonly used artificial intelligence tools used in the web design process. This analysis stems directly from the methodological framework that was previously defined, applying a qualitative, comparative approach to the analysis of artificial intelligence platforms. Several aspects were covered, such as their functionality, level of automation, usability, impact on productivity, and contribution to user experience.

Table 1, summarizes the evaluation criteria for comparative analysis of AI tools. Contribution to user experience is treated separately in Table 2, since it depends heavily on context of use and benefits from a more discursive treatment.

Table 1. Comparative analysis of most used AI platform for web design

AI Tool	Lifecycle Phase / Category	Functionality and Purpose	Level of Automation	Impact on Productivity
Figma AI	Design & Prototyping	Smart layout suggestions, auto-tidying of components, variant generation for responsive breakpoints, design-consistency checks	Semi-automated – AI proposes options, designer selects/refines	High – reduces wireframing and iteration time substantially
Adobe Sensei	Design & Brand Systems	ML-driven asset tagging, automated colour-palette and contrast/accessibility checks, content-aware editing	Semi-automated – automates routine checks, human approves final output	Moderate to High – accelerates accessibility compliance and brand consistency
Adobe Firefly	Visual Asset Generation	Generative creation of images, illustrations, and design-system components from	High – full asset generation from natural-language input	High – drastically cuts original asset-production

		text prompts		time
Midjourney	Visual Asset Generation	Text-to-image synthesis for hero imagery, concept art, and mood-board exploration	High – near-autonomous image generation	Moderate to High – valuable for ideation, but outputs need curation and integration
GitHub Copilot	Development & Coding	LLM-based code completion, boilerplate generation, and API-usage examples within the IDE	Semi-automated – suggests code, developer reviews and accepts	High – reported task completion up to ~55% faster for routine coding
Framer AI	Design & Development (No-Code)	Generates complete, publish-ready web layouts (hero, pricing, navigation) from text prompts, including motion effects	High – can produce a deployable site from a single prompt	High – collapses concept-to-prototype timelines from days to hours
Wix AI Website Builder	Full-Site Generation	Chat-based intake of style and content preferences leading to a complete generated website with layout, imagery, and starter copy	High – end-to-end automated site assembly	High for simple sites; limited for highly customized projects
Uizard	UI/UX Prototyping	Converts text descriptions or hand-drawn	Semi-automated – generates mockups that	Moderate – speeds up early-stage

		sketches into multi-screen interactive mockups	designers subsequently refine	prototyping rather than final production
Webflow AI	Development & No-Code Web Building	AI-assisted layout generation paired with visual, code-aware web building and CMS integration	Semi-automated – AI scaffolds structure, designer controls styling and logic	Moderate to High – reduces front-end build time while preserving code control
Hotjar (AI-enhanced analytics)	UX Personalization & Analytics	ML analysis of behavioral data (heatmaps, session recordings, surveys) to detect usability issues and inform redesign	Semi-automated – surfaces patterns and recommendations; humans interpret and act	Moderate – indirect productivity gains through evidence-based design decisions

Table 1 presents the most commonly used and well-known AI tools used in the web design process. Each of these tools is compared in terms of automation, productivity, ease of learning, etc. In this table, the tools are divided into several groups. For example, Figma AI helps with design and prototyping by suggesting layouts and checking consistency. Adobe Sensei supports brand systems by automatically tagging assets and checking accessibility. Adobe Firefly and Midjourney both create images from text prompts, but Firefly makes ready-to-use design pieces while Midjourney is better for early ideas. GitHub Copilot helps write code inside the IDE. Framer AI and Wix AI Website Builder can build an entire website from a single prompt. Uizard turns sketches or text into interactive mockups. Webflow AI generates layouts while still letting developers control the code. Hotjar studies user behavior to find usability problems.

When it comes to the level of automation, each tool has a different degree of automation of the processes. Platforms such as Figma AI, Adobe Sensei, GitHub Copilot, Uizard, Webflow AI, and Hotjar require human intervention to review and adjust the solutions generated by these tools. This would mean that using these tools requires relatively high human participation in the final decision

in the web design process. In contrast, tools such as Adobe Firefly, Midjourney, Framer AI, and Wix AI Website Builder offer a ready-made result with just one prompt. This does not mean that human influence is completely excluded, but they have greater automation in building websites.

Perhaps the greatest contribution of AI tools is in improving productivity. Tasks from the entire web design process that once took days are now reduced to hours with the help of these tools. For example, Framer AI can turn an idea into a working prototype in hours instead of days, and GitHub Copilot can speed up routine coding by about 55%. Hotjar's benefit is less direct, since it helps teams make better decisions. Instead of dealing with routine and repetitive tasks, these tools allow designers to have more time to devote to creative and innovative tasks.

Today, with the development of new information technologies, there is an increasing effort to make these artificial intelligence platforms easy to use. This especially applies to those tools that are part of well-known platforms like Adobe and GitHub. These tools are intended for users with little knowledge of web design, so they are precisely designed to be easy to use. However, some tools such as Midjourney, Webflow AI, and Hotjar take a bit more effort, since they need some skill in prompting, web design, or user research.

Table 2 shows the same ten tools as in Table 1, but here they are considered from a different perspective: how much each one affects the end user's experience, not just the designer's work.

Table 2. Contribution to the user experience

Tool(s)	Contribution to User Experience
Figma AI / Adobe Sensei	Indirect but meaningful: faster, more consistent layouts and accessibility-compliant colour systems translate into more usable, visually coherent end products.
Adobe Firefly / Midjourney	Enhance the perceived quality and originality of visual storytelling; risk of “creative anchoring” toward AI-suggested aesthetics if not curated critically.
GitHub Copilot	Indirect contribution – faster, more reliable code shortens the path from design to a functioning interface, but has no direct bearing on end-user experience.
Framer AI / Wix AI Website Builder	Strong for rapid delivery of clean, conventional layouts; weaker for highly differentiated, brand-specific experiences that benefit from human creative

	judgement.
Uizard / Webflow AI	Improve UX indirectly by shortening prototyping and build cycles, allowing more design iterations to be tested with real users before launch.
Hotjar (AI-enhanced analytics)	Most direct contributor among the ten tools – converts real user behavior into concrete redesign recommendations, closing the feedback loop highlighted in the source paper.

According to the findings presented in table 2, it can be noted that Figma AI and Adobe Sensei have an indirect effect — their consistent, accessible output eventually makes products easier to use. On the other hand, tools such as Adobe Firefly and Midjourney make visuals look better and more original, but there is a certain risk that the designs that these tools will offer will look similar. Therefore, designers need to be careful to review these designs in order to avoid such problems. The platform, GitHub Copilot, starting from the fact that it helps developers to develop products faster, its effect on the user experience is very small or it can be said that it has no direct effect.

AI tools such as Framer AI and Wix AI Website Builder presented in Table 2 are great for quickly building websites, but they have problems creating unique designs specific to a brand, and this is where human intervention is largely required. When it comes to building prototypes that can be tested by multiple users and building multiple different versions of the website before launching, tools such as Uizard and Webflow AI come to the fore. This model of website creation has advantages in terms of testing the website by real users by building different versions, but this process can take a relatively long time and be very expensive. Finally, Hotjar has the most direct impact of all ten tools, since it turns real user behavior into specific suggestions for improving the design.

6. Discussion

Analyzing the tools covered in this paper, it can be concluded that automation is grouped into two broad tiers. Tools such as Adobe Firefly, Midjourney, Framer AI, Wix AI Website Builder exhibit high levels of automation and direct productivity gains. However, when using these tools, there is a risk that they will direct designers towards adopting the suggestions of artificial intelligence and eliminating human creativity. On the other hand, other tools (Figma AI, Adobe Sensei, GitHub Copilot, Webflow AI, Uizard, Hotjar), are semi-automated and here human creativity comes to the fore, i.e., the symbiosis between man and machine is more pronounced. In these semi-automated tools, the

influence of man on the design of websites is far greater than in fully automated platforms.

The tools with the highest reported productivity impact (Framer AI, GitHub Copilot, Adobe Firefly) are not necessarily the tools with the deepest contribution to bespoke user experience; conversely, the tool with the most direct UX contribution in this sample, Hotjar, shows only moderate productivity impact because its value is realised through interpretation rather than generation. This mirrors the source paper's central argument that productivity and design quality are related but distinct dimensions of AI's impact on the web design lifecycle.

There are certain limitations to the results obtained from the research in this paper. Namely, the analysis conducted in this paper is based primarily on documentation, materials provided by service providers, and secondary sources offered by the industry in the field of artificial intelligence and web design. This indicates that the findings obtained in this pap-er were not made through the direct and immediate use of these tools. Also, the number of AI tools is growing exponentially, so the analysis in this research reflects the state of the market at the time of writing. Finally, the selection of ten tools, while representative of the major lifecycle phases identified in the literature review, is not exhaustive and necessarily omits other widely used platforms. However, the size of the paper does not allow for an analysis of the vast number of AI tools available on the market, but it is a good basis for further research in this area.

7. Conclusion

This paper shows that artificial intelligence systems are already structurally embedded in the web design process, although their impact is neither uniform nor unconditionally positive. The comparative analysis, which is the main aim of this paper, reveals a fundamental difference in the way AI tools mediate between process automation and human creativity. Fully automated tools such as Adobe Firefly, Midjourney, Framer AI, Wix AI Website Builder allow for increased productivity, but on the other hand this efficiency comes at the cost of eliminating human creativity and innovation. Such artificial intelligence systems perform the generative action themselves, limiting the human factor to the eventual organization and modification of content after the initial creation of the website.

Semi-automated tools such as Figma AI, Adobe Sensei, GitHub Copilot, Webflow AI, Uizard, Hotjar enable a situation where artificial intelligence provides design suggestions, and the human is the one who decides on all elements of the proposed design. In this way, the human-machine symbiosis is maintained where human creativity is far more important than the automation capacities of AI tools.

This separation of artificial intelligence tools applied in web design is the most significant analytical discovery of this paper, since it is often considered that greater automation is desirable because it increases productivity. However, it should be taken into account that at the expense of increased productivity, the innovation and creative potential that designers have when creating websites is reduced. This would mean that productivity and creativity are moving in partially opposite directions, so the strategic choice will be up to web design companies to decide which of these directions to choose.

The contribution of this paper can also be seen in the fact that it does not only consider the technical advantages of artificial intelligence tools, but also analyzes the ethical and legal issues associated with them. These include the lack of transparency of algorithms (since it is often unclear how the AI makes decisions), the protection of personal data, the copyright of content created with AI, and the danger of users becoming too dependent on the suggestions provided by the tool. This research shows that the more an AI tool automates the work (fully automated tools), the greater the risk of limiting the designer's creativity. Users are often inclined to choose the first suggestion the tool offers, rather than exploring and developing new ideas. Therefore, the benefits of automation and the risks it brings cannot be considered separately – they are directly related. The same automation that increases efficiency can also reduce creativity and reduce transparency in the work process.

Therefore, the main conclusion of the paper is that artificial intelligence should not completely replace the web designer, but rather assist him in his work and thus relatively facilitate the web design process. The best results are achieved when a human and AI work together. That means the AI takes over the routine tasks, and the human retains control over the creative decisions and the final design. Accordingly, the real challenge today is not whether to use artificial intelligence tools in web design, but how to organize the work process in such a way as to take advantage of the benefits of automation, without losing human creativity, critical thinking and authorship.

However, this research also has certain limitations because instead of its own experimental testing, it relies on an analysis of existing literature and other secondary sources. Also, due to the limited size of the paper, only ten artificial intelligence tools were analyzed, so the results cannot be fully applied to all such tools. Therefore, the findings should be understood as general directions and trends, and not as final and universally applicable conclusions. Also, today artificial intelligence is developing very rapidly, the classification of tools presented in this paper represents the state of the art at the time of the research and may change with the emergence of new tools and new functionalities. This paper would be a basis for some future research in which it would be useful to conduct practical tests of the tools themselves to compare their usability and the quality of

the results. It would also be good to examine how the long-term use of AI affects the creativity of designers. However, the results of this research show that, despite the increasing role of artificial intelligence, humans remain crucial for making creative and ethical decisions in the web design process.

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E-COMMERCE TRENDS: NORTH MACEDONIA VIS-À-VIS OTHER EUROPEAN COUNTRIES

Marjan Angeleski[1], Olivera Kostoska[2]

Abstract

According to the latest published data from the State Statistical Office of the Republic of North Macedonia, but also according to Eurostat, the number of Internet users aged 15–74 in North Macedonia was 92.1% for the first quarter of 2025. This figure is close to the EU27 average which, according to the Eurostat, was 93.79% in 2025. However, if we make a comparison between individuals, i.e. Macedonian citizens who used the Internet to purchase goods or services in the last 12 months and the average of the EU27 citizens, the data show significant differences between Macedonian and EU27 citizens. Namely, according to the State Statistical Office, the percentage of individuals having ordered/bought goods or services via Internet in the last 12 months was 60.3% in 2025 (according to Eurostat, this value for North Macedonia in the same year was 55.91%), while according to Eurostat, the EU27 average of all individuals who made a last online purchase in the 12 months was 78% in 2025. Taking into account such data, this paper aims to make a comparative analysis of the trends of Internet users and their connection with the volume of purchasing goods or services via Internet among the citizens of North Macedonia and other European countries. Moreover, the paper will also make an analysis of the trends of purchasing goods or services via Internet by the Macedonian citizens over a time series of several years.

Keywords: e-commerce, Internet, online purchase

1. Introduction: e-commerce concept, pros and cons, and new trends

Technological innovations have increased the use of the Internet, and modern information and communication technologies are causing changes in business processes and affecting the competitive advantage of companies. The

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rapid development of both information technologies and economic globalization have caused e-commerce to play a significant role in economic activities around the world (Kao et al., 2019). In general, "e-commerce refers to conducting sales and purchasing activities in an electronic environment" (Özdemir and Nacar, 2022) or "e-commerce is the pursuit of commercial activity through electronic tools. It is based on the electronic processing and transmission of information (text, video, audio)" (Išoraitė and Miniotienė, 2018). Dave Chaffey (2015) stated that electronic commerce or e-commerce refers to "all types of electronic transactions between organisations and stakeholders, whether they are financial transactions or exchanges of information or other services". He also points out that e-commerce transactions are either buy-side e-commerce, i.e. "e-commerce transactions between an organisation and its suppliers and other partners" or sell-side e-commerce, that is "e-commerce transactions between an organisation and its customers" (Chaffey, 2015). E-commerce is an instrument for furthering new shape and dimensions of businesses. In essence, virtual markets and stores that do not involve physical space have enabled access to different types of markets and the carrying out of business transactions anywhere in the world (Nanehkaran, 2013). The main advantage of e-commerce is that it abolishes time and space limits and hurdles when obtaining goods and services, and provides the users with possibility to purchase anywhere and anytime (goods and services are 24x7 accessible through a website) as long as they have access to the Internet. In addition to details and reviews for each item in e-shop, consumers benefit from a wider choice of goods and services and the bulk of information that allow them to easily compare price and quality of the offer across various traders in short time. Users can personalize their purchases and refrain from subjective criteria when determining product selection, such as salespeople's persuasion, alleged discounts, or promotions (Išoraitė and Miniotienė, 2018). On the other hand, organizations benefit from the ability to reach more customers, including easier access to international markets. They also benefit from lower costs, supply chain improvements, and reduced time and cost of purchasing raw materials thanks to e-procurement (Ramanathan et al., n.d.). However, it is also important to note that e-commerce has certain limitations. One of the disadvantages is the possibility of fraud, i.e. when ordering online there is a possibility that customer will not receive the same product as the one displayed in the photo. In addition, when buying online, it frequently takes a long time before the product is delivered, and shipping charges can sometimes be higher than the price itself. It goes without saying, but when buying online, it is important to check the reliability of the website in order to protect credit card and banking data (Išoraitė and Miniotienė, 2018). After all, this industry is relatively new, so governing regulations are either unclear or non-existent. Finally, "while operational costs are minimal, setup costs are high, especially because of the need for costly infrastructure such as dedicated computer servers. Highly talented and specialised workers are required for setup and maintenance of the IT resources required to run such enterprises" (Ramanathan et al., n.d.). In recent decades, the new technologies such as machine learning and artificial intelligence have caused e-commerce to experience major changes in terms of customer relationships management, operations management, and service

delivery (Attar et al., 2022). These technologies can increase the potential for new business models, primarily through the growing platforms on the Internet, specifically social media, and integration of their elements with e-commerce platforms, leading to s-commerce (social commerce) platforms (Hajli, 2015). Moreover, m-commerce (mobile commerce) have augmented the availability of commerce applications and boosted online sales. Smartphones are becoming more powerful and have the ability to manage numerous complex applications. Businesses, especially banking, are increasingly shifting towards the mobile space, and consumers are frequently shopping via mobile (Ramanathan et al., n.d.). Given the salience of this topic, this paper aims to examine the e-commerce trends in North Macedonia versus other European countries. Namely, in addition to the introduction, the rest of the paper provides an analysis of Internet use and e-commerce trends of the Macedonian citizens over a longer period of time based on data from the State Statistical Office of North Macedonia, as well as a comparative analysis of the e-commerce acttivities of the Macedonian citizens vis-à-vis other European Countries individuals, mainly based on the Eurostat data.

2. Internet use and e-commerce trends of the Macedonian citizens

Although the first commercial use of the Internet in North Macedonia began about 30 years ago, when the first web-based e-commerce stores began to appear in the world (especially in the USA), the first Internet transaction with a credit card in North Macedonia, which represents one of the basic infrastructural prerequisites for using the possibilities of e-commerce, was realized only in 2007. (Methamorphosis, 2007). However, in addition to the infrastructural prerequisites, the Internet users are considered a basic determinant in the development of e-commerce. In general, the State Statistical Office (SSO) of the Republic of North Macedonia has been recording data related to the information society since 2006, when the number of Internet users aged 15-74 who regularly used the Internet, i.e. on average at least once a week, was 21.1%. In the same year, people aged 15-74 who ordered or purchased products or services via Internet in the last 12 months amounted to 1.8%, which indicates an expectedly extremely small number of individuals who ordered or purchased a product or service online, based on the small number of Internet users (SSO). In 2025, this share is far higher (92.1%, Internet users aged 15-74 and 60.3% of individuals having ordered/bought goods or services via the Internet in the last 12 months), which clearly shows the dynamics of the development of e-commerce in North Macedonia, i.e. in 20 years there has been a 33.5-fold increase in individuals who have ordered or bought a product or service online, and about a 4.4-fold increase in the number of Internet users. For comparison, according to Eurostat (2006), the percentage of Internet users in the EU25 was 47% in 2006 (according to Buchow, H. (2006) it is 57%), and the percentage of those who have ordered or purchased online in the last 12 months was 27% (Buchow, H., 2006). According to the same source, out of 95% of Internet users aged 16-74 in the EU, which is the average number of individuals who used the Internet within the last 12 months in 2025, users who bought or ordered goods or services for private use is 78% in 2025 (Eurostat, 2026).

Namely, the average number of Internet users in the EU27 has increased 2 times during this period, and the number of all individuals who made a last online purchase in the 12 months has increased 2.9 times in these 20 years. Such comparisons show an almost even growth of Internet buyers and Internet users in the EU27 countries, and a drastic jump in both Internet usage and ordering/purchasing among Macedonian citizens.

The analysis of data from the State Statistical Office of the Republic of North Macedonia from 2012 to 2025 shows a continuous growth trend of order/purchase via Internet in the last years and, understandably, a decrease over the years of people who have never ordered or bought a product or service via the Internet. So, in 2012, only 7.84% of individuals in North Macedonia ordered/bought goods or services via Internet in the last 12 months, while the peak was reached in 2024 with a value of 63.5%, followed by a decrease in 2025 of 3.2 percentage points and a value of 60.3%. In any case, from 2012 to 2025, the percentage of online buyers increased several times, and the largest share in these values falls on the order or purchase in the last 3 months (4.26% in 2012 and 45.3% in 2025) (Fig. 1). People who have never purchased a product or service via Internet in 2012 accounted for as much as 88.59%, while at the end of the analyzed period, in 2024, this percentage was 27.5%, with a few percentage increases in 2025 when it was 31.6%.

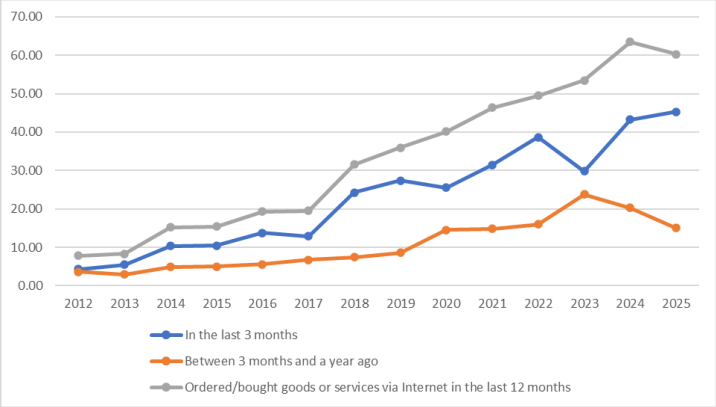


Figure 1. Period of order/purchase via Internet (2012-2025)

Based on data from the State Statistical Office of the Republic of North Macedonia, the percentage of individuals who have ever ordered/purchased products or services via Internet is higher for the first time in 2021 than those who have never ordered or purchased a product/service online. Fig. 2 shows that this trend of growth or decline continues in the following years.

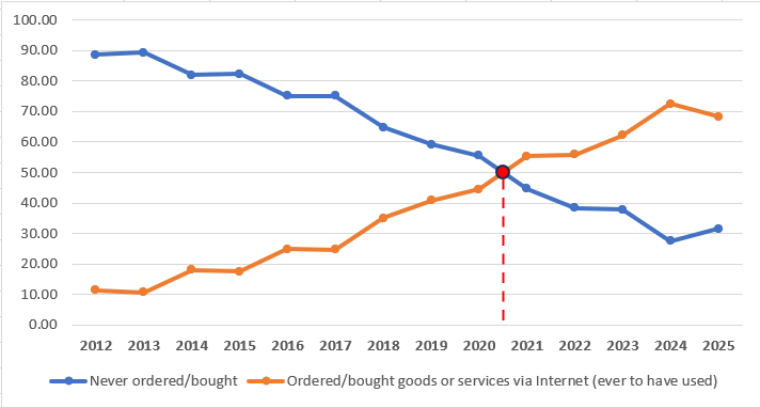


Figure 1. Ordered/bought goods or services via Internet (ever to have used) Vs Never ordered/bought

The trends in the percentage of individuals who have ever ordered/purchased products or services via Internet and the percentage of Internet users from 2012 to 2025 (Table 1), show a linear growth in both values (Fig. 3), with an expected almost twice as high slope, which indicates the rate of change from year to year in the percentage of individuals who have ever ordered/purchased products.

Table 1. Internet users Vs Ordered/bought goods or services via Internet (ever to have used) according to the State Statistical Office of the Republic of North Macedonia

	Year	Internet users	Ordered/bought goods or services via Internet (ever to have used)	Never ordered/bought
1	2012	57.5	11.41	88.59
2	2013	65.4	10.72	89.28
3	2014	68.1	17.98	82.02
4	2015	70.4	17.59	82.41
5	2016	72.2	24.84	75.16
6	2017	74.5	24.78	75.22
7	2018	79.2	35.10	64.89
8	2019	81.4	40.73	59.27
9	2020	81.4	44.4	55.6
10	2021	86.4	55.3	44.7
11	2022	88.3	55.9	38.4
12	2023	85.3	62.1	37.8
13	2024	91.2	72.5	27.5
14	2025	92.1	68.4	31.6

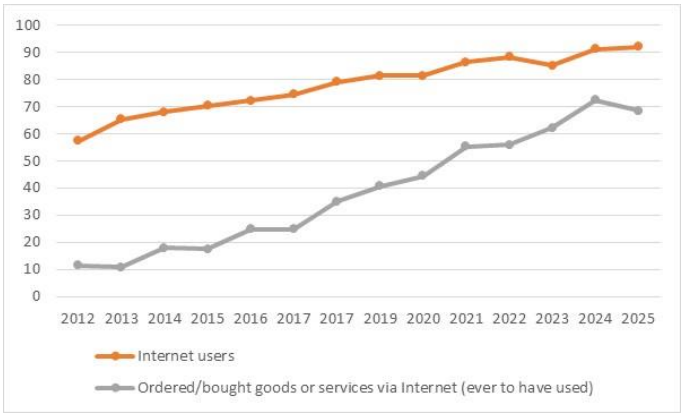


Figure 2. Ordered/bought goods or services via Internet (ever to have used) Vs Internet users

Fig. 4 shows a comparison of Internet users and the proportion of them who have ever ordered or purchased a product or service via Internet.

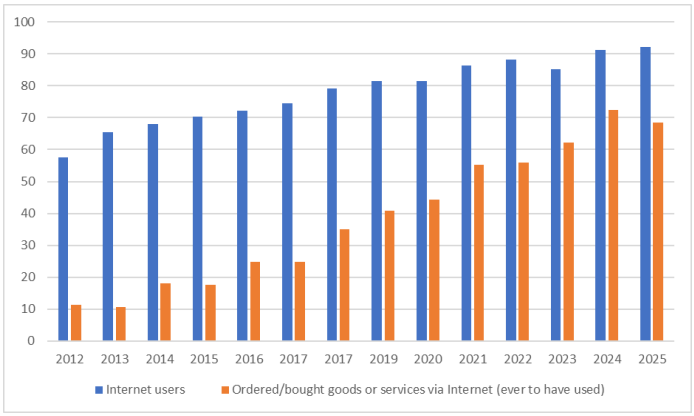


Figure 3. Internet users and online purchases in North Macedonia

Comparing the values of individuals who have ever ordered/purchased products or services via Internet and the percentage of Internet users from 2012 to 2025, a very high positive correlation coefficient of 0.958 is recorded, which would mean that with the increase in Internet users, the values of individuals who have ever ordered/purchased products or services via Internet also increase accordingly (Fig. 5).

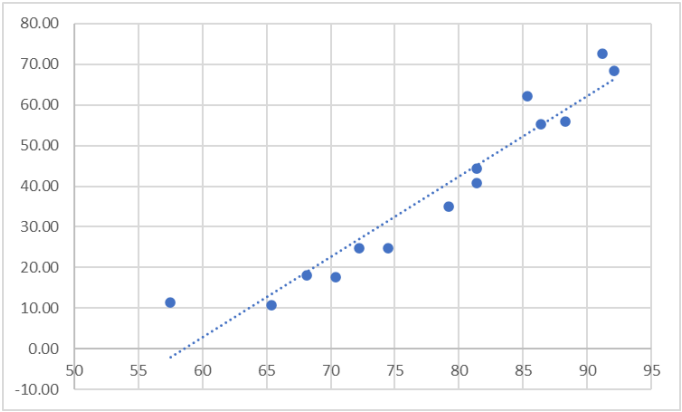


Figure 4. Correlation - Internet users (x-axis) Vs Ordered/bought goods or services via Internet (ever to have used) (y-axis)

Of course, considering that such values for Internet users, according to the dynamics, would soon reach a certain saturation threshold close to 100%, it is to be expected that the percentage of individuals who have ever ordered/purchased products or services via Internet would grow over the years, even though the percentage of Internet users would, as expected, stagnate.

The analysis of the SSO data showing on Table 2 and Fig. 6 where Macedonian citizens bought the most from in the period from 2012 to 2023 (no data on origin/residence of the seller is available for the last two years) shows that from 2014 to 2017 sellers from the rest of the world dominated (which is most likely due to the possibilities of buying from the Chinese brand Aliexpress), but from 2021 to 2023, the dominance was taken over by national sellers. The data for the last two years will likely change this picture and the dominance will again be taken over by sellers from the rest of the world thanks to the large expansion of the Temu e-commerce store, which began delivering products to North Macedonia in late 2024.

Table 1. Buying or ordering goods or services by country of origin/residence of the seller

Origin/residence of the seller	National sellers	Sellers from other EU countries	Sellers from the rest of the world	Country of origin of sellers is not known
2012	54.77	36.22	24.88	5.31
2013	64.54	31.11	22.68	5.51
2014	35.70	41.92	41.62	4.42
2015	47.12	36.32	56.15	3.34
2016	40.80	20.66	58.64	0.56
2017	31.68	26.52	58.85	2.89
2018	52.32	18.83	36.22	3.43
2019	38.81	11.54	20.01	0.69
2020	48.18	9.97	13.48	1.68
2021	84.17	12.50	17.86	1.41
2022	89.82	20.42	11.13	2.67
2023	87.82	18.08	13.32	2.25

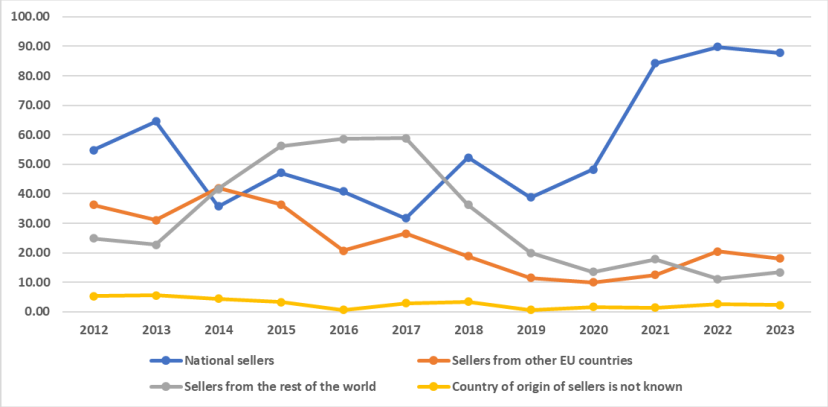


Figure 5. Buying or ordering goods or services by country of origin/residence of the seller

3. E-commerce comparative analysis: North Macedonia vis-à-vis other European Countries

The comparative analysis for 2025 shows that for Internet purchases by individuals who made a last online purchase in the 12 months, the highest percentage of European countries is observed in Ireland (95.26%) and the Netherlands (94.42%), followed by the Scandinavian countries, Norway (93.44%) and Sweden (90.44%), while at the bottom are Bulgaria (57.01%), Italy (61.72%) and Romania (63.57%). Of the countries in the Western Balkans, the primacy is held by Serbia (65.88%), followed by North Macedonia (60.33%) and Kosovo (59.19%), while the lowest number of Internet buyers in the last 12 months have Albania (45.44%) and Montenegro (46.65%). (Eurostat, 2026) However, it is interesting to note that over the 10 years (from 2016 to 2025), the highest growth of all countries in Europe was recorded in Romania, at almost 254%, followed by North Macedonia with a growth of more than 205%, while at the EU27 level, such growth during the same period amounted to 24.43%. As expected, the growth in the last 10 years in the countries with the highest percentage of individuals who ordered or purchased a product or service in 2025 was relatively small (Ireland recorded a growth of around 33.87%, the Netherlands of 20.13%, Norway 17.82% and Sweden 13.36%), because, ever since 2016, almost all of the above have had a higher percentage of individuals who ordered or purchased a product or service than the EU27 average in 2025. In 2020, when the latest data is available, the United Kingdom, among the European countries, recorded a penetration of 92.29%, which is higher than the more than 90% of the other European countries for which data is available in 2025. (Eurostat, 2024, 2026)

Fig. 7 shows a comparison of Internet users and the proportion of those who have ever ordered or purchased a product or service via Internet.

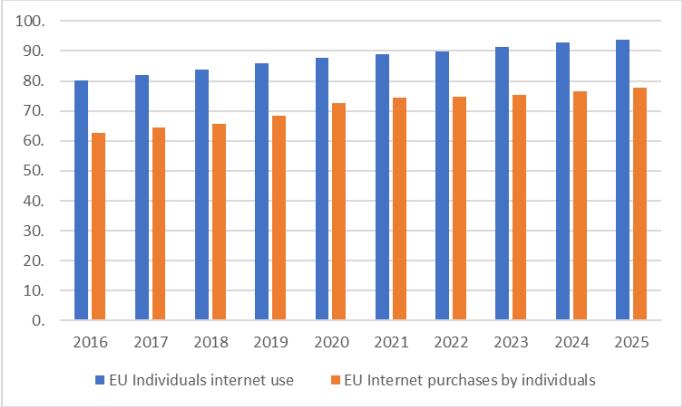


Figure 6. Internet use and online purchases EU average

Based on the analysis of EU Individuals Internet use and EU Internet purchases by individuals from 2016 to 2025, as for North Macedonia, a very high correlation coefficient of 0.986 is observed (Fig. 8).

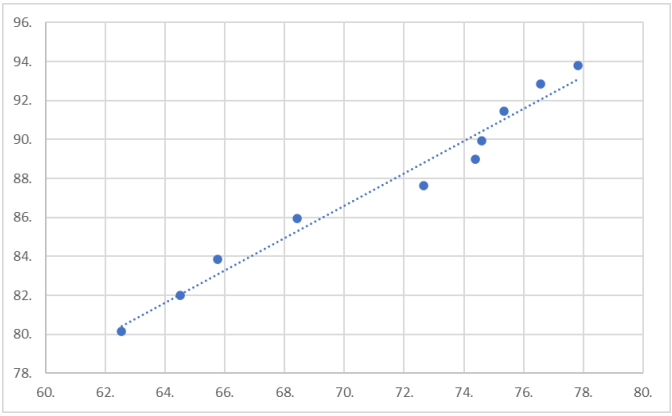


Figure 7. Correlation - Internet use (y-axis) and online purchases EU average (x-axes)

In the case of EU countries, linear growth is observed in both values (Fig. 9), but the slope that shows the rate of change from year to year in both Internet users and the percentage of individuals who have ever ordered/purchased products or services online is almost identical, indicating a steady growth in Internet use and online purchases EU average.

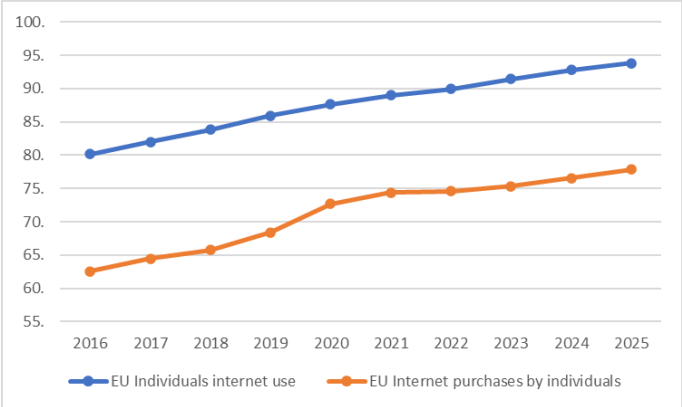


Figure 8. Trend - Internet use vs online purchases EU average

4. Conclusion

E-commerce has undoubtedly become an integral and indispensable part of people's daily activities, especially due to the large percentage of internet users, the changing shopping habits and the use of the convenience of buying products and services from any place and at any time. North Macedonia, especially in recent years, has noted a significant increase in the number of internet users who shop online and according to data from the State Statistical Office of the Republic of North Macedonia, in 2021 the percentage of individuals who have ever ordered or purchased a product or service online for the first time is higher than those who have never ordered or purchased a product/service online. According to available data until 2023, ordered or purchased a product/service online by National sellers dominates.

According to Eurostat data for 2025, the highest percentage of European countries is observed in Ireland (95.26%) and the Netherlands (94.42%), while the lowest number of Internet buyers in the last 12 months have Albania (45.44%) and Montenegro (46.65%). According to the same source, the percentage of online buyers in Europe increased from 62% in 2015 to 78% in 2025, which represents an increase of 16 percentage points in a period of 10 years. Despite the fact that in 2025 the percentage of Macedonian citizens who in the last 12 months ordered or purchased a product/service online is lower even than the EU average from 10 years ago (60.3%), the high percentage of Internet users and the dynamics of growth, especially in recent years, show that the interest in online purchase will continue to grow in the future.

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INNOVATIONS IN DIGITAL BANKING SERVICES

Marina Blazhekovikj Toshevski[1], Stevcho Dimeski[2]

Abstract

The development of information and communication technologies in recent decades has significantly transformed the way the banking sector operates. Modern banks are facing increasing customer demands for fast, accessible, and secure services, which creates a need for the continuous introduction of digital innovations. Digital banking represents one of the key segments of this transformation, enabling more efficient management of financial services and an improved user experience.The subject of research in this paper is innovations in digital banking services, with special emphasis on their implementation in the banking sector of the Republic of North Macedonia. Faced with competition from global FinTech companies and changing user habits, domestic banks are forced to invest in new technological solutions – from mobile applications and electronic banking to the implementation of artificial intelligence and Blockchain technologies.

The main objective of this paper is to conduct a comparative analysis of the digital solutions offered by the leading commercial banks in the country and to examine their functionality, security, and acceptance by users.

Keywords: Digital banking, Financial technologies, Innovations

1. Introduction

Digital transformation in the banking sector can no longer be viewed merely as the migration of existing services from branch counters to electronic channels. It represents a fundamental change in how banks organize processes, communicate with customers, manage data, and create new value. Skinner (2014) argues that a digital bank must redesign its services around the capabilities of the

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mobile Internet, while Chishti and Barberis (2016) emphasize the role of the FinTech ecosystem in accelerating innovation.

In the Republic of North Macedonia, digital banking is developing amid rising customer expectations, regulatory changes, and growing competition from FinTech companies. The National Bank of the Republic of North Macedonia (NBRNM) emphasizes the need for secure, innovative, and efficient payment systems, while the Law on Payment Services and Payment Systems provides a basis for the further development of payment services (NBRNM, 2024; NBRNM, 2025).

The paper examines innovations in digital banking services, focusing on mobile and Internet banking, digital identity, digital wallets, instant payments, automation, artificial intelligence (AI), Big Data, Blockchain, and Open Banking. Its objective is to assess the extent to which the domestic banking sector is moving beyond the digitization of existing services toward broader digital transformation.

The research combines an analysis of official banking and regulatory sources, a comparative analysis of five banks, and a descriptive analysis of the results of a questionnaire administered to 100 respondents.

2. Theoretical Aspects of Digital Banking

Electronic banking has traditionally been associated with the delivery of banking services through electronic channels, whereas digital banking encompasses a broader transformation of processes, data, and customer experience. Laudon and Traver (2021) associate e-banking with electronic channels, while Skinner (2014) views the digital bank as an organization that redesigns the customer relationship through technology.

The evolution of banking can be analytically represented through Bank 1.0 as traditional banking, Bank 2.0 as the era of self-service channels and ATMs, Bank 3.0 as mobile banking, and Bank 4.0 as contextual and integrated banking. The final stage is not a formal regulatory standard, but rather a framework for understanding the transition toward services that are automated and embedded in broader digital ecosystems.

The benefits include 24/7 availability, faster execution, automation, lower operating costs, and opportunities for personalization. The risks include cyberattacks, fraud, identity theft, IT system disruptions, and dependence on third-party providers. The ECB (2025) emphasizes that digital business models foster efficiency and competition, but also create new operational and financial-stability risks.

FinTech is reshaping the financial ecosystem through specialized services, faster experimentation, and new business models (Chishti & Barberis, 2016). Competition is therefore shifting away from price alone toward customer experience, speed, digital onboarding, personalization, and service integration.

3. Technological Foundations and Key Innovations

The Core Banking System (CBS) remains the central component of banking infrastructure. Application and integration layers are built on top of it, enabling mobile and web channels to communicate with core banking functions. Service-oriented architecture (SOA), API gateways, and microservices support modularity and integration, while cloud technologies provide scalability. In the financial sector, these benefits must be balanced against third-party risk management and operational resilience requirements (BCBS, 2024).

Mobile banking is becoming the primary customer touchpoint. Modern applications provide account access, payments, transfers, card management, notifications, loan applications, and digital account opening. Digital wallets additionally rely on tokenization and biometric authentication.

Artificial intelligence can be applied to fraud detection, credit scoring, customer analytics, chatbots, and document processing. The ECB (2026) reports that almost 90% of significant banks in the euro area use AI, with particularly widespread application in fraud and cybercrime detection, marketing, chatbots, and credit scoring.

Big Data enables segmentation, forecasting, and personalized offers, but requires privacy protection and transparency. Blockchain can support distributed ledgers and smart contracts, although its application depends on regulatory and economic feasibility (Tapscott & Tapscott, 2016). Open Banking enables data sharing and service initiation through APIs with customer consent, and the European PSD2 framework represents an important example of this development (European Commission, 2015).

Cybersecurity is a prerequisite for every digital innovation. TLS, encryption, multi-factor authentication (MFA), biometrics, tokenization, monitoring, and fraud-detection systems form part of a multilayered security architecture. The ECB (2026) notes that artificial intelligence can help banks detect and prevent cyber threats more rapidly, while at the same time it can be misused by attackers to carry out more sophisticated attacks. Banks must therefore continuously strengthen both their cybersecurity and their ability to maintain critical operations during technological or cyber incidents.

4. Comparative Analysis of Digital Innovations in Commercial Banks in the Republic of North Macedonia

The analysis includes Komercijalna Banka, NLB Banka, and Stopanska Banka as large and systemically relevant institutions, while ProCredit Bank and Halkbank are included to capture different models of digitalization. In addition, each selected bank represents a distinct digitalization profile, thereby broadening the analytical scope.

Table 1. List of Banks

Bank	Rationale for selection	Focus
Komercijalna Banka	Systemically relevant; digital identity	OneID, mBanka, digital wallets
NLB Banka	Systemically relevant; strong mobile ecosystem	NLB Pay, onboarding, Apple/Google Pay
Stopanska Banka	Systemically relevant; P2P innovation	TOPSI Pay, m-banking
ProCredit Bank	Distinct self-service model	24/7 zones, OneID, assistant
Halkbank	E-commerce and business digitalization	vPOS/e-commerce and digital channels

Komercijalna Banka stands out for OneID, mBanka, mToken, and digital wallets. The bank enables fully online activation of payment accounts and services through digital identification and electronic signatures (Komercijalna Banka, 2026). This case is particularly relevant for analyzing digital identity and onboarding.

NLB Banka has a broad mobile ecosystem comprising mKlik, NLB Pay, Apple Pay, Google Pay, and Garmin Pay. NLB Pay enables mobile payments and cash withdrawals using a digitized card, while tokenization reduces the need to transmit the actual card number (NLB Banka, 2026). NLB also offers online payment-account opening and digital loan applications.

Stopanska Banka is particularly relevant because of TOPSI Pay, which enables instant peer-to-peer (P2P) transfers through a contact list without entering the recipient's account number. The service operates 24/7, while m-banking also includes payments, notifications, product information, and applications for credit products (Stopanska Banka, 2026).

ProCredit Bank represents a different model, with 24/7 zones, digital account opening through OneID, and a digital banking assistant. Its 2024 Annual Report confirms that the bank operates 12 locations comprising branches, service points, and 24/7 zones, and that it continues to develop fully digital services (ProCredit Bank, 2024).

Halkbank is included to capture e-commerce and business digitalization, ensuring that the comparative sample is not limited to retail mobile banking. Including a

bank with this profile is important because banking digital transformation also encompasses merchant infrastructure, API integrations, and digital payments.
Accordingly, the banks should not be ranked using a single one-dimensional score. One bank may be stronger in digital identity, another in mobile wallets, a third in P2P payments, a fourth in self-service banking, and a fifth in e-commerce. The purpose of the analysis is to identify the different approaches to digital transformation adopted by the banks under review.

4.1. Criteria for Comparative Analysis

Following the individual analysis of the banks, a direct comparison (benchmarking) is conducted across technical capabilities, customer experience, security, and innovativeness. Two complementary tools are used for this purpose: a comparison of digital functionalities and ratings, and a digital-functionality matrix. The interpretation does not seek to designate one bank as the absolute leader; rather, it identifies the segments in which each bank holds a relative advantage.

4.2. Comparison of Digital Functionalities and Ratings

Table 2. Comparison of Digital Functionalities and Ratings

Feature	Komercijalna	NLB	Stopanska	ProCredit	Halkbank
Google/Apple Pay	✓	✓	✓	✓	✓
Digital Onboarding (OneID)	✓ (Full)	⚠ (Partial)	✗	✓ (Full)	✗
P2P (via contacts)	✗	✗	✓ (TOPSI)	✗	✗
Smart ATMs (recycling)	✓	✓	✓	✓ (Leader)	⚠
E-commerce (vPOS)	⚠	⚠	⚠	✗	✓ (Leader)
Average store rating	4.6 ★	4.7 ★	4.5 ★	3.8 ★	4.2 ★
Authentication	mToken / FaceID	Soft-Token	PIN / Bio	USB PKI	SMS / Bio

Note: ✓ = fully implemented; ⚠ = partially implemented/limited; ✗ = unavailable. The ratings are taken from the analyzed material and refer to the status reported therein.

4.3. Digital Functionality Matrix (Status: 2026)

The digital maturity matrix presents the presence or absence of functionalities treated in the analyzed material as relevant to contemporary digital banking. This approach enables a concise comparison of the banks' different strategic orientations.

Table 3. Digital Functionality Matrix (Status: 2026)

Feature	Komercijalna	NLB	Stopanska	ProCredit	Halkbank
Digital Onboarding (OneID)	✓ (Full)	⚠ (Partial)	✗	✓ (Full)	✗
NFC Wallet (Google/Apple Pay)	✓	✓	✓	✓	✓
P2P payments (phone contacts)	✗	✗	✓ (TOPSI)	✗	✗
Cardless cash withdrawal	✗	✓ (m-Cash)	✓ (m-Cash)	✗	✗
Hardware security (token)	✓	✗	✗	✓	✗
AI/chatbot support	✗	✓ (Viber Bot)	✗	✗	✗
24/7 zones (recycling ATMs)	✓	✓	✓	✓ (Leader)	⚠

Legend: ✓ – fully implemented; ⚠ – partially implemented/under development; ✗ – unavailable.

4.4. Comparative Overview: Customer Experience and Security

In terms of customer experience, the analyzed material highlights NLB Banka and Stopanska Banka as institutions with modern mobile applications and straightforward navigation. Komercijalna Banka offers a broad range of functionalities, although its interface, particularly the web version, is more

complex. ProCredit Bank adopts a functional, minimalist approach with a strong emphasis on self-service.

In terms of security, Komercijalna Banka and ProCredit Bank stand out for their use of hardware tokens and PKI solutions, while NLB and Stopanska Banka apply a more balanced approach based on soft tokens and biometrics. These different approaches illustrate the typical trade-off between stronger control and ease of use.

According to the segmentation in the analyzed material, NLB and Stopanska Banka are particularly relevant for users seeking fast mobile and P2P services; Komercijalna and ProCredit are more suitable for business users and customers who prioritize functionality and security; while Halkbank stands out in the e-commerce segment. The results should therefore be interpreted as profiles of digital specialization rather than as a single overall ranking.

5. Empirical Research on Digital Banking Services in the Republic of North Macedonia

5.1. Research Methodology

The empirical research aims to examine the actual use, perceptions, and satisfaction of users of digital banking services in the Republic of North Macedonia. The study is quantitative and was conducted using a structured questionnaire administered to 100 users of digital banking services. The questionnaire covers demographic characteristics, use of digital services, level of satisfaction, perceptions of innovativeness, and technologies perceived as lacking.

5.2. Research Questions and Hypotheses

1. Which digital innovations and technologies are most prevalent among commercial banks in the Republic of North Macedonia?
2. To what extent does the use of digital banking services contribute to improving the efficiency and quality of banking services?
3. What is the impact of digital innovations on user experience and customer satisfaction in commercial banks?
4. What are the main challenges and constraints faced by banks when implementing advanced digital solutions?
5. Which digital technologies and innovations are lacking in the Macedonian banking sector compared with global trends in digital banking?

Based on the research questions and the theoretical framework, the following research hypotheses were formulated. Their descriptive assessment is conducted using the questionnaire results and the comparative analysis.

Research Hypotheses

• H1: Greater use of digital banking services is associated with a higher level of user satisfaction.

• H2: Mobile banking is the most important digital channel for customers' day-to-day interaction with banks.
• H3: Users perceive a high level of digitalization, but consider AI and personalized recommendations to remain insufficiently represented.

5.3. Demographic Structure and Results

Of the respondents, 48% are aged 18–25, 32% are aged 26–35, 15% are aged 36–45, and 5% are over 46 years of age. By gender, 54% are male and 46% female.
Ninety-two percent use digital banking, while 8% do not. The most frequently used services are mobile banking (85%), Internet banking (72%), digital payments (68%), and online loans (21%).
Regarding satisfaction, 34% are very satisfied, 41% satisfied, 19% partially satisfied, and 6% dissatisfied. Thus, 75% provide a positive assessment of the services.
Regarding innovativeness, 22% consider the services highly innovative, 49% partially innovative, and 29% insufficiently innovative. The most frequently identified missing technology is an AI assistant (52%), followed by personalized recommendations (44%), Open Banking (29%), and advanced security (25%).

Table 4. Questionnaire Results (N=100)

Questionnaire	Result
Use of digital banking	Yes 92%; No 8%
Most frequently used services	Mobile 85%; Internet 72%; Digital payments 68%; Online loans 21%
Satisfaction	Very satisfied 34%; Satisfied 41%; Partially satisfied 19%; Dissatisfied 6%
Perception of innovativeness	Highly innovative 22%; Partially innovative 49%; Insufficiently innovative 29%
Technologies perceived as lacking	AI 52%; Personalization 44%; Open Banking 29%; Advanced security 25%

Table 5. Descriptive Assessment of the Hypotheses

Hypothesis	Finding	Assessment
H1	75% are satisfied or very satisfied	Consistent, but not statistically tested
H2	Mobile banking 85%	Descriptively supported

H3	71% rate the services as highly/partially innovative; AI 52%; personalization 44%	Descriptively supported

5.4. Analysis and Descriptive Assessment of the Research Hypotheses

H1 concerns the association between the use of digital banking services and user satisfaction. In the sample, 92% of respondents use digital banking, while 75% are satisfied or very satisfied. These indicators are consistent with the hypothesized positive relationship; however, because no test of association between usage and satisfaction was conducted using the available aggregate data, H1 is assessed as descriptively consistent rather than statistically confirmed.

H2 proposes that mobile banking is the most important digital channel for customers' day-to-day interaction with banks. The results show that mobile banking is used by 85% of respondents, ahead of Internet banking (72%), digital payments (68%), and online loans (21%). H2 is therefore descriptively supported by the questionnaire results.

H3 proposes that users perceive a relatively high level of digitalization while simultaneously considering AI and personalized recommendations to be insufficiently represented. The results show that 22% of respondents rate the services as highly innovative and 49% as partially innovative, meaning that 71% recognize at least some degree of innovativeness. At the same time, 52% identify an AI assistant as a missing technology, while 44% identify personalized recommendations. H3 is therefore descriptively supported. This finding is also relevant in the broader European context: the ECB (2026) reports that almost 90% of significant banks in the euro area already use AI, particularly for fraud and cybercrime detection, marketing, chatbots, and credit scoring. This suggests that AI is moving from an experimental technology toward widespread banking adoption, and respondents' expectations for greater use of AI and personalization are consistent with contemporary trends (ECB, 2026).

6. Discussion

The principal finding is that the domestic banking sector is relatively mature in terms of basic digitalization, while users increasingly expect a next generation of personalized digital services. Mobile banking is the dominant channel, consistent with the development of mobile ecosystems across all analyzed banks.

The differences among the banks lie not only in the number of services offered, but also in their strategic orientation. Komercijalna Banka emphasizes digital identity and a broad service portfolio; NLB focuses on mobile experience and digital wallets; Stopanska Banka on P2P payments; ProCredit on self-service and a 24/7 model; and Halkbank on e-commerce. This argues against simply designating a single bank as the "most digital."

In the international context, AI, personalization, API integration, and the automation of complex processes offer the greatest potential. The ECB (2026) shows that AI is already widely used by significant European banks, particularly for fraud detection, marketing, chatbots, and credit scoring. Domestic banks can use these trends as benchmarks, but implementation must be adapted to the domestic regulatory framework, infrastructure, and market size. The questionnaire finding that 52% identify an AI assistant and 44% personalized recommendations as insufficiently represented directly supports H3 and indicates a gap between basic digitalization and the next stage of intelligent, personalized services.

Security remains a prerequisite for trust. New services should be designed according to security-by-design principles, incorporating strong authentication, monitoring, and recovery plans. Digital transformation without operational resilience creates new risks rather than sustainable competitive advantage. The finding that 25% of respondents identify advanced security as a need indicates the importance users attach to this area. Recent empirical research shows that perceived security and digital literacy influence the intention to use digital banking (Kovačević et al., 2025), while the ECB (2026) emphasizes the importance of security and operational resilience in digital services.

7. Recommendations for Improvement

First, a secure Open Banking ecosystem should be developed gradually through standardized APIs, customer consent, and strong authentication. Second, AI assistants with human oversight should be developed, particularly for navigation and customer support. Third, Big Data and machine learning should be used to provide personalized financial recommendations under clear privacy and transparency rules.

Fourth, digital onboarding should be as comprehensive as possible, incorporating digital identification, electronic signatures, and automated checks. Fifth, cybersecurity should be integrated into the design of every new service. Sixth, banks should invest in digital and financial literacy through clear guidance, phishing warnings, and educational content.

It is advisable to establish a framework for measuring digital maturity across several dimensions: service availability, automation, channel integration, security, and personalization. Such a framework would enable more systematic comparison.

A useful direction for future research would be to develop a digital maturity index and compare domestic banks with banks in the Western Balkans and the European Union, particularly in the areas of Open Banking, AI, digital identity, and operational resilience.

8. Conclusion

Digital transformation is one of the most significant drivers of the contemporary banking sector. The analysis shows that banks in the Republic of North Macedonia have developed a substantial range of digital services, particularly in mobile and Internet banking, digital payments, digital identity, and self-service channels.

The selection of the five banks is justified by their institutional relevance and differing technological strategies. The questionnaire results show that 92% of respondents use digital banking, mobile banking is the most widely used channel at 85%, and 75% are satisfied or very satisfied. At the same time, 52% identify an AI assistant and 44% personalized recommendations as technologies that are currently lacking.

The main challenge for the next phase is not merely the introduction of new functionalities, but their integration into a secure, simple, and personalized customer experience. Priorities should include secure Open Banking, AI with human oversight, personalization, digital onboarding, and the continuous strengthening of cyber resilience.

In conclusion, the Macedonian banking sector has a solid foundation for further transition toward a more advanced digital banking model. The key challenge is to translate technology into measurable customer value while preserving trust, privacy, and the stability of the banking system.

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ACCESSIBILITY IN CULTURAL TOURISM: INCLUSIVE EDUCATIONAL PRACTICES IN GREEK MUSEUMS FOR DEAF AND HARD OF HEARING VISITORS

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Abstract

Accessibility in cultural tourism provides the basis for the equal participation of all individuals in the cultural experience. Museums, as spaces of education, culture and social interaction, must, through targeted inclusive practices, listen to and address the needs of deaf and hard of hearing visitors. This paper examines the importance of accessibility and inclusive educational practices in Greek museums, focusing on the possibilities of enhancing the participation of deaf and hard of hearing people in cultural tourism. A separate discussion is made of issues such as the use of sign language, visual communication, digital technologies, accessible educational programs and multimodal forms of presentation of cultural information. At the same time, the challenges faced by Greek museums in terms of developing inclusive cultural policies and accessible communication practices are analyzed. Through a bibliographic approach and by studying contemporary theoretical and practical approaches to accessibility in museum education and cultural tourism, an overall picture of the subject under study is recorded. The aim is to highlight the importance of inclusion in the formation of sustainable and socially responsible cultural experiences, as well as to formulate proposals for improving accessibility in Greek museums.

Keywords: *cultural tourism, museum accessibility, deaf and hard of hearing visitors, inclusive education, Greek museums, cultural inclusion.*

1. Introduction

Accessibility is one of the key factors in modern cultural policy and sustainable cultural tourism (United Nations, 2006; UNESCO, 2015). The concept of accessibility is no longer limited to physical access to cultural spaces, but also includes equal access to information, communication, knowledge and learning experience (UNESCO, 2015). In this light, museums are a category that must

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function as open and inclusive organizations, always positively approaching the needs of all visitors, regardless of their sensory, motor or cognitive peculiarities.

Cultural tourism plays a key role in the tourism industry, as it brings cultural heritage into a common context with education, local development and the preservation of cultural identity (United Nations World Tourism Organization [UN Tourism], 2018). Museums, as actors of cultural tourism, aim to bring visitors closer to history, art and culture by utilizing organized educational and experiential experiences (International Council of Museums [ICOM], 2022). At the same time, they contribute substantially to the development of intercultural understanding, strengthening social cohesion and the active participation of citizens in cultural life. The accessibility of museums is considered important for deaf and hard of hearing people, who often encounter obstacles when visiting cultural spaces. In addition, the provision of information in Greek Sign Language remains limited, while the availability of subtitled audiovisual material is also limited. At the same time, in several cases there is a lack of properly trained staff, while alternative ways of presenting information are insufficient. As a result, a set of difficulties accumulate that limit their equal participation in the museum experience. To overcome the above issues, inclusive educational practices based on visual communication, digital technologies, multimodal presentation of knowledge and Universal Design need to be implemented (Story et al., 1998). In recent years, Greece has shown a growing interest in developing accessible cultural services and enhancing the social inclusion of people with disabilities. Many museums have followed strategic actions that included guided tours in Greek Sign Language, digital applications, educational programs and interactive media, aiming to improve the experience of deaf and hard of hearing visitors (Mayer, 2021). However, the main issue that arises is that the country's initiatives are not consistently implemented, as a result of issues of insufficient funding, insufficient staff training and limited use of new technologies. The purpose of this paper is to explore the role of accessibility in cultural tourism in relation to inclusive educational practices implemented in Greek museums for the benefit of deaf and hard of hearing visitors. The basic principles of museum accessibility, educational and technological approaches as well as the challenges that cultural organizations continue to face are analyzed in the light of contemporary Greek and international literature aiming at equal participation.

The ultimate goal of this study is to formulate proposals that promote the formation of more inclusive museums, guided by equal access to culture and promoting the sustainable development of cultural tourism.

2. Accessibility and Inclusive Cultural Tourism

In recent decades, the concept of accessibility has undergone significant development, highlighting its value and necessity (United Nations, 2006; Story et al., 1998). The role of accessibility does not only concern the physical access of people with disabilities to buildings and public spaces. In the modern context, accessibility is understood as the ability of all people to participate equally in social, educational and cultural life, without exclusion or discrimination. This is a

concept that stems from the principles of Universal Design, where products, services and environments are designed with their broad use by the largest group of citizens, regardless of their age or special abilities. In the field of culture, accessibility is one of the most basic components of the democratic functioning of cultural organizations (ICOM, 2022). Museums, as institutions for the preservation and promotion of cultural heritage, must respond to the needs of visitors and offer a comprehensive cultural content (UNESCO, 2015). Therefore, the content of the concept of accessibility refers to physical access to facilities as well as accessible communication, the provision of understandable information, the use of appropriate technological tools and the development of educational programs that respond to the different needs of the public.

Cultural tourism is defined as a form of tourism activity that begins with cultural experiences and contact with the history, art, traditions and identity of a place (McKercher & Du Cros, 2002; UN Tourism, 2018). Typically, museums are considered the most important point of cultural tourism, as they function as places of learning, entertainment and social interaction. At the same time, they contribute to the protection and promotion of cultural heritage, strengthening both the local economy and the international visibility of a destination.

In recent years, the concept of inclusive cultural tourism has emerged, in the context of promoting and creating experiences that are accessible to all visitors (Buhalis & Darcy, 2011; Richards, 2021). In this context, accessibility is not simply seen as a special service that concerns exclusively people with disabilities, but is considered a key feature that supports the quality of cultural services. For example, a museum that designs its services oriented and based on the principles of inclusion defends and responds not only to the needs of people with disabilities, but also to elderly visitors, families with young children, foreign visitors and people with different educational or linguistic backgrounds. At the same time, the rapid development of digital technologies has created new possibilities for enhancing accessibility in cultural tourism. Interactive applications, digital guides, subtitled audiovisual material, mobile applications, virtual tours and augmented reality technologies are typical examples of innovative and more personalized and accessible experiences for different groups of visitors (Mayer, 2021; Falk & Dierking, 2016). The use of these technologies allows museums to reach a wider audience and strengthen their educational role, promoting participation and the dissemination of cultural knowledge. Accessibility in cultural tourism is no longer just a social or moral obligation but also a strategic choice that enables the sustainable development of cultural organizations (Black, 2012; ICOM, 2022). Museums that have inclusion and the removal of barriers as their starting point immediately affirm their social mission, while broadening their audience and contributing to the creation of a cultural environment that promotes equality, respect for diversity, and the active participation of all citizens.

3. Deaf and Hard of Hearing Visitors in Museums

Deaf and hard of hearing individuals are a particularly heterogeneous population group, and they are not all the same in terms of the degree of hearing

loss, the way they communicate, the age at which hearing loss occurs, and their social and cultural background. For many deaf people, especially those born or raised without functional hearing, sign language is their first language and primary means of communication, while written or spoken language functions as a second language (World Health Organization [WHO], 2021). In another case, there are hard of hearing individuals who mainly use spoken language with the help of technological aids, such as hearing aids or cochlear implants. This differentiation imperatively dictates the development of multiple forms of communication in museums, so as to meet the needs of all visitors.

In modern times, the term disability does not follow the traditional medical model, which treated hearing loss exclusively as an individual problem (Oliver, 2018; United Nations, 2006). On the contrary, disability today adopts a more social model. According to this model, disability is determined more by the barriers created by the social and physical environment itself and is not interpreted so much by the functional state of the individual. Therefore, the limited participation of deaf and hard of hearing visitors in the museum experience is largely due to the lack of accessible services, appropriate means of communication and inclusive design.

More specifically, by visiting a museum, the individual enters a complex educational process, which is based on his interaction with the exhibits, information and museum staff. This fact is not self-evident for deaf and hard of hearing people, as their experience in a museum is often limited when information is provided exclusively through oral tours or audio applications, without alternative means of communication (Falk & Dierking, 2016; Hooper-Greenhill, 2007). The lack of interpretation in Greek Sign Language, the absence of subtitling in videos, difficult-to-understand information signs and the limited familiarity of staff with the needs of visitors with hearing loss dictate the main causes of limiting the quality of the museum experience. At the same time, access to cultural information is not only based on the existence of appropriate technological tools, but also on the way in which the educational process is shaped within the museum. More specifically, the use of simple and understandable language, the use of high-quality visual material, the provision of information through videos in Greek Sign Language, the development of interactive applications and the integration of multimodal forms of communication serve the understanding of cultural content and offer a quality experience to all visitors (Mayer, 2021; Story et al., 1998).

The project of developing inclusive museums requires the active participation of the deaf community in the design of services and educational activities. Collaboration with deaf organizations, sign language interpreters, special educators and museum education professionals constitute a set of factors that support the development of services that respond to the real needs of the public and not to theoretical approaches alone (UNESCO, 2015; ICOM, 2022). This participatory process also results in the social acceptance of museums, while truly integrating the deaf and hard of hearing into cultural life.

It becomes clear that accessibility does not function as a complement to the issue, nor should it be interpreted as a special service for a limited number of

visitors. On the contrary, it is an indicator that ensures the quality of museum services and is directly linked to modern museum education. The creation of appropriate conditions for the visitor ensures proper communication, learning and equal participation, strengthening the social role of museums. Finally and most importantly, the creation of a cultural climate that advocates respect for diversity and equal access for all to cultural heritage.

4. Inclusive Educational Practices in Greek Museums

An inclusive museum environment requires the adoption of educational practices that support the equal participation of all those who wish to visit museum exhibits for the benefit of the learning and cultural experience. In modern museum education, accessibility is defined as a fundamental principle and not as a complementary function that will serve only people with disabilities (UNESCO, 2015; ICOM, 2022; Chatterjee & Noble, 2016). The implementation of inclusive practices removes any communication barriers, enhances the active participation of visitors and promotes equal access to cultural knowledge.

For deaf and hard of hearing visitors, the development of multimodal forms of communication that do not rely exclusively on spoken language is of particular importance. The use of Greek Sign Language, the subtitling of audiovisual material, the use of visual symbols, the use of simple and understandable language and the provision of information through multiple means of communication are some of the most basic strategies that contribute to the understanding of museum content and enhance the autonomy of visitors (Marschark & Spencer, 2011; World Health Organization [WHO], 2021). The above practices support the principles of universal design and inclusive education. These principles understand cultural content to be accessible to the widest possible audience. At the same time, digital technologies play an important role in improving accessibility. The use of applications for mobile devices, interactive screens, digital guides, QR codes, multimedia applications and virtual tours opens the way to new possibilities for presenting cultural information, creating unprecedented personalized learning experiences. In fact, these technologies create an environment for autonomous navigation for visitors, contributing to their interaction with the exhibits and transforming the museum from a place of passive observation to a place of active participation and learning.

Inclusive practices also include accessible educational programs. Typically, thematic tours, workshops, interactive activities and museum pedagogical programs that mainly utilize visual media, collaborative methods and experiential approaches respond positively to the needs of deaf and hard of hearing visitors (Mayer, 2021; Shehade & Stylianou-Lambert, 2024). Of course, the importance of the active participation of the visitors themselves in the learning process should not be ignored. In this way, the understanding of the cultural content is strengthened, critical thinking is cultivated and their deeper connection with the cultural heritage is deepened.

In order to successfully implement the above practices, continuous training of museum staff and collaboration with Greek Sign Language interpreters, special

educators, researchers and representatives of the deaf community are needed. The participation of people with hearing loss themselves in the design and evaluation of educational activities is a basic prerequisite for the development of services that respond to the real needs of visitors and enhance the quality of the museum experience (Hooper-Greenhill, 2007; Falk & Dierking, 2016). In modern times, there are many Greek museums that have followed actions aimed at accessibility and inclusion. For example, the Acropolis Museum includes accessibility services, such as infrastructure for people with disabilities, printed material in Braille and digital applications that offer visitors a wealth of experience. Furthermore, the Museum of Byzantine Culture is one of the modern museums that adopts digital applications, virtual tours and interactive audiovisual material. Finally, the Archaeological Museum of Thessaloniki develops educational actions aimed at the participation of all social groups, promoting the principle of a "museum for all". The initiatives may reveal that accessibility is a priority for several Greek cultural organizations, but their implementation continues to be a significant challenge with variations in its extent and systematicity. The formation of a comprehensive national accessibility framework, the exchange of good practices and the exploitation of the possibilities offered by new technologies give depth to the issue of inclusive museum education. As a result, a sustainable development of cultural tourism in Greece is taking place.

4.1 International Good Practices and Innovative Approaches to Museum Accessibility

Museums are increasingly recognized as inclusive cultural spaces that should ensure equal access for all visitors, and accessibility has become a central issue in international cultural policy. In recent decades, major cultural organizations and museums have adopted and implemented practices aimed at the equal participation of all visitors in the cultural experience, regardless of sensory, motor or cognitive specificities. The current perception of accessibility includes not only strategies for removing physical barriers, but also access to information, communication, learning and the overall visitor experience (UNESCO, 2015; ICOM, 2022). As a result, museums follow a policy oriented towards social inclusion and the participation of all citizens in cultural life.

There are many countries that have developed models of accessible museums, which serve as reference points for the development of inclusive cultural services. For example, in the United States, the Smithsonian Institution has an accessibility framework with sign language tours, subtitled audiovisual material, digital applications and adapted educational programs for visitors with disabilities. In addition, the Museum of Modern Art (MoMA) in New York, through educational activities for deaf visitors, utilizes sign language and interactive learning methods to ensure participation and interaction with the exhibits (Mayer, 2021; Falk & Dierking, 2016).

Similarly, in the United Kingdom, the British Museum offers accessibility services with videos in British Sign Language, subtitled presentations, digital guides and accessible online content. In this way, visitors choose how they will approach cultural information. This offers them autonomy and quality in their

experience. Similarly, the Louvre Museum in France has taken initiatives with specially designed tours for deaf visitors, as well as multimedia material that facilitates the understanding of exhibits through visual and interactive means (ICOM, 2022; Chatterjee & Noble, 2016).

The case of the Rijksmuseum in the Netherlands, which has made significant use of digital technologies to improve accessibility, should not be ignored. Through mobile applications, interactive tours and personalized information systems, visitors are ensured an experience tailored to their personal needs and preferences (Mayer, 2021; Falk & Dierking, 2016). In this light, it becomes clear that technology is an important means of enhancing cultural participation and the educational dimension of museums.

At the same time, examining the issue at an international level, it is proven that the cooperation of museums with deaf organizations, research institutions and experts enhances special education and accessibility. In many cases, deaf people themselves participate in the design, implementation and evaluation of services addressed to them. This participatory approach strengthens all interventions made for the benefit of the real needs of visitors as well as the sustainability of accessibility policies (UNESCO, 2015; World Health Organization [WHO], 2021).

The use of digital technologies is also a common feature of most international examples. Digital guides, augmented reality applications, virtual tours, interactive screens and multimedia presentations are shaping new possibilities for accessing cultural information (Mayer, 2021; Shehade & Stylianou-Lambert, 2024). Through the above technologies, understanding the content becomes easier and visitor participation is enhanced, shaping more personalized learning experiences.

The study of international good practices shows that accessibility is not a matter of social obligation, but a practice aimed at strengthening the educational and social role of museums. At the same time, it contributes to broadening the audience, improving the quality of the services provided and promoting sustainable cultural development. The use of international experience in Greek museums ends up being an important means for designing more comprehensive accessibility policies, with the aim of creating a truly inclusive cultural environment for all visitors.

5. Challenges and Future Perspectives

Modern reality has made significant progress in the field of accessibility, the full integration of deaf and hard of hearing visitors in Greek museums. However, significant challenges remain. The development of inclusive policies beyond the implementation of individual technological solutions or educational actions requires a comprehensive strategic plan based on accessibility in all museum functions. The most important thing in the whole project is not to simply take piecemeal initiatives but to implement a systematic inclusion policy that is launched based on the principles of equality and social justice (UNESCO, 2015; ICOM, 2022). Initially, the main issue arises as the limitation in the financial and

human resources available to many Greek museums, especially the smaller regional institutions. The development of accessible digital applications, the production of audiovisual material in Greek Sign Language, the provision of modern technological equipment and the continuous training of staff require investments that are often not considered self-evident. As a result, there are considerable differences in the field of services provided between museums in the country (European Commission, 2020; Darcy & Buhalis, 2011).

An additional key priority is the need to strengthen the professional training of museum workers. Knowledge of the principles of inclusive education, accessible communication and the special needs of deaf and hard of hearing visitors is a prerequisite for the provision of quality services (Hooper-Greenhill, 2007; ICOM, 2022). Staff need to be trained in direct collaboration with Greek Sign Language interpreters, specialist scientists and representatives of the deaf community, thus promoting the improvement of the museum experience and the development of services that respond to the real needs of visitors. At the same time, new technological conditions are also the starting point for new perspectives on enhancing accessibility in cultural tourism. More specifically, the use of artificial intelligence applications, interactive digital guides, augmented and virtual reality, as well as personalized information delivery systems, is revolutionizing the way deaf and hard of hearing people interact in the cultural space. However, to be effective, technology needs to be designed with the real needs of users in mind and with the participation of people with hearing loss themselves in the process of developing and evaluating relevant applications (UNESCO, 2023; Mayer, 2021). In recent years, artificial intelligence has become a major tool for improving accessibility in cultural institutions. Its applications foster innovative tools that facilitate communication, understanding of information and active participation of visitors with sensory disabilities. In particular, for deaf and hard of hearing visitors, artificial intelligence manages to automatically convert spoken language into written text in real time, to create automatic subtitles, as well as to develop sign language translation systems through digital characters (avatars). These capabilities reduce communication barriers and enhance the autonomy of visitors during the museum experience. At the same time, the use of intelligent digital guides and virtual assistants offers personalized information that responds positively to the needs and preferences of each visitor. Through artificial intelligence algorithms, museums can suggest tour routes, adapt the content of information to the user's level of knowledge and offer multimodal forms of presentation of cultural content. In addition, the combined use of artificial intelligence, augmented reality and virtual reality creates new perspectives for the development of interactive and more inclusive cultural experiences. Overall, the above technologies, in addition to access to information, contribute to the overall upgrade of the educational role of museums. The creation of personalized learning experiences, the enhancement of interaction with exhibits and the possibility of active participation of visitors make artificial intelligence a particularly important tool for the formation of accessible and sustainable cultural services in the future.

In this light, strengthening cooperation between the Ministry of Culture, museums, universities, research institutions and deaf organizations activates a unified national strategy for accessibility in cultural tourism (United Nations, 2006; Ministry of Culture of Greece, 2024). The development of common standards, the exchange of good practices and the use of European funding programs mark a positive sign in the sustainability of interventions and ensure that accessibility will be an integral element of the operation of all Greek museums.

Inclusive museums are not a luxury but a basic obligation arising from the current institutional framework for the rights of people with disabilities. At the same time, they are a basic investment in the quality of cultural services and the sustainable development of cultural tourism. In culture, when equal access opportunities are provided, citizen participation is simultaneously strengthened, respect for diversity is cultivated and an inclusive society is formed.

6. Proposed Framework for Future Empirical Research

This literature review highlighted the importance of accessibility and inclusive educational practices in museums for deaf and hard of hearing visitors. Further empirical investigation of the issue is also considered important, in order to record the real experiences, needs and expectations of the visitors themselves. In addition, it is important to investigate the degree of readiness of Greek museums to meet the requirements of modern accessible cultural education (UNESCO, 2015; ICOM, 2022).

A future study could examine the experiences of deaf and hard of hearing people during their visit to Greek museums. In particular, issues such as access to information, the adequacy of the services provided, the use of digital technologies, as well as the degree of satisfaction of visitors with existing accessibility practices could be investigated.

The research could be implemented with a quantitative or mixed methodological approach. Data collection could utilize questionnaires or semi-structured interviews with deaf and hard of hearing visitors, representatives of deaf organizations, as well as museum professionals involved in the design and implementation of educational activities. It would be particularly important to study specific cases of Greek museums that follow accessibility practices and in this way identify effective strategies and possible areas for improvement.

Furthermore, the role of new technologies and artificial intelligence in enhancing accessibility would be a major issue. Future research could assess the effectiveness of tools such as automatic subtitles, digital tour guides, sign language applications and personalized information systems in improving the museum experience (Mayer, 2021; Shehade & Stylianou-Lambert, 2024).

In this specific area, the collection of empirical data offers a complete picture of the formulation of evidence-based accessibility policies, but also of the evolution of the services provided and the creation of a more inclusive and sustainable cultural tourism framework in Greece.

7. Conclusion

Accessibility to cultural tourism lays the foundations for shaping cultural experiences characterized by equality, participation and social responsibility. Museums must function as institutions that support the preservation and dissemination of cultural heritage. Their role is to respond to the needs of all visitors, ensuring that access to knowledge and culture does not only concern sensory or communication barriers. For the transition from a traditional museum to a modern, participatory and inclusive one, it is a necessary condition for strengthening its social role and promoting cultural democracy.

This study analyzes the challenges that deaf and hard of hearing visitors encounter when accessing museum services, despite the development of recent years at the international and national level. The use of Greek Sign Language, the use of subtitled audiovisual material, digital applications, interactive technologies and accessible educational programs are some of the basic strategies for cultivating an equal participation of people with hearing loss in the museum environment. However, in order to put the above interventions into practice, a comprehensive strategic plan needs to be launched, which will support the continuous training of staff and the systematic cooperation of museums with the deaf community and the competent scientific and social bodies. The role of digital technology operates as a catalyst, offering new possibilities for the redesign of museum services with universal accessibility in mind. The implementation of new technological applications revises the experience of all visitors, enhancing active participation, autonomy and lifelong learning. Accessibility should not operate in a fragmented or complementary manner, but should be an integral element of the strategic planning of cultural organizations and the overall quality of the services provided. In conclusion, the strengthening of inclusive educational practices in Greek museums revises the data by shaping a more accessible and sustainable cultural tourism framework. The adoption of policies that promote equal access, the use of modern technologies, the development of partnerships with representative bodies of people with disabilities and the continuous evaluation of the services provided are some key actions for the formation of a social and educational museum environment. In this way, Greek museums become important correspondents for high-quality cultural experiences based on principles of inclusion, equality and sustainable development.

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THE IMPACT OF ARTIFICIAL INTELLIGENCE ON INNOVATION PERFORMANCE IN GLOBAL PHARMACEUTICAL COMPANIES

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Abstract

Based on an analysis of the available scientific literature, the paper examines how the application of artificial intelligence affects the innovation performance of global pharmaceutical companies. The review is a narrative critical synthesis built around three primary sources, selected by stated criteria and supplemented through the literature they cite. Since innovation in this industry is measured by the speed of development, research costs and the share of candidate molecules reaching the market, as well as the repeatability of that result, attention is focused on the three channels through which the technology acts on these indicators: accelerating the early stages of drug discovery, better selection and prioritization of candidates and reducing uncertainty in clinical trials. The analysis shows that technical capability alone does not provide an innovation result. It depends on organizational readiness, the quality and structure of data and the professional profile of employees. The digital technologies that accompany production and supply are also discussed, and the limitations brought by model uncertainty, data bias and regulatory requirements are considered. The review of sources reveals literature that describes the potential in more details than it measures the actual effect on the innovation outcome. None of the reviewed sources reports an outcome indicator, and the evidence rests on intermediate measures, such as algorithm accuracy, and on financial proxies.

Keywords: artificial intelligence, pharmaceutical industry, innovation performance, drug discovery, machine learning, organizational readiness.

1. Introduction

Few industries convert scientific knowledge into products as quickly as pharmaceuticals. It combines research, biotechnology development, and manufacturing processes aimed at producing drugs, vaccines, and other therapeutics, making it one of the fastest-growing industries (Stamenović, 2019).

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Its importance is seen in improving public health, extending lifespan, and improving quality of life. At the same time, few industries are regulated so strictly, as products are directly related to human life and health, requiring high levels of safety, quality, and efficiency (Klimenkova et al., 2021). It is precisely this connection to health that makes the industry expensive and slow. It takes an average of ten years from a molecule to a registered drug, with total costs estimated at $2.6 billion (DiMasi et al., 2016). Of all candidates that enter the first phase of clinical trials, only about one tenth reaches the market as drugs that can be offered to patients, and the cost of failures is then compensated through higher prices for registered drugs (Stamenović, 2023). The question of innovation performance is therefore not abstract, but comes down to how much time, how much money and how many unsuccessful attempts a new drug takes. In this picture, artificial intelligence has entered as a technology with transformative potential in all sectors, from supply chain management (Chi et al., 2020; Nissen & Sengupta, 2006) to medicine and the automotive industry (Lugano, 2017). The literature attributes its potential to transform business models (Duan et al., 2019), change the future of work (Schwartz et al., 2019), improve performance (Wilson & Daugherty, 2018), and expand human capabilities (Dwivedi et al., 2021; Collins et al., 2021). Interest in it has grown for several reasons that act simultaneously: advances in basic methods and their opening to the wider community, cheaper hardware and dedicated chips, and the COVID-19 pandemic, which has accustomed the public to a smaller human role in work processes (Von Krogh, 2018; Coombs, 2020; Sipior, 2020). In pharmacy, such approaches are not new. Predictive toxicology, biochemical modeling, and bioinformatics have relied on computational methods for a long time (Duch et al., 2007). The last decade has brought advances in machine learning that, combined with increased computing power and the availability of large data sets, have led to a renewed interest in the field (Henstock, 2019). Today, the technology is encountered at four main points in the development cycle: identification of biological targets, screening of compounds, optimization of candidate molecules, and design and execution of clinical trials. With each new introduction, competitive pressure on laggards increases, and this also changes the way management evaluates technology. In parallel, solutions are entering manufacturing and supply chain that directly support the innovation process through traceability, quality control, and reduced waste (Zdravić et al., 2025).

The relationship between technology and innovation output is not linear either. The available literature more often describes what artificial intelligence can do than it measures how much it has actually changed the way companies operate. The gap between the described potential and the confirmed effect is among the topics discussed in the paper.

The paper includes a theoretical part, a synthesis of the results of the literature review, a discussion and a conclusion. The theoretical part deals with the methodological foundations of the technology, the digital transformation of operations, its application in drug discovery and development, innovation performance, organizational readiness, personalized medicine, manufacturing and supply chain solutions, as well as risks and limitations. The results section

systematizes the agreements and differences between the authors, while the discussion assesses the value of the available evidence.

The impact of artificial intelligence on the innovation performance of global pharmaceutical companies, reviewed on the basis of the available scientific literature, determines the subject of the paper. Innovation performance here refers to the speed of the development cycle, the costs of research and development, the probability of a candidate molecule reaching registration and the ability of the organization to repeat that result. These four instruments effectively serve as the indicators of innovative activities featured throughout the study. At the same time, they are distinguished from the intermediate indicators that undergo further analysis. Although an intermediate indicator may contribute to the final outcome, it does not, in itself, prove that the drug was developed more quickly, at a lower cost, or with a greater likelihood of registration.

Technologies that accompany the basic research activity are also included, since production, distribution and services to patients are part of the same value creation cycle (Zdravić et al., 2025).

The main goal is to determine how and through what mechanisms artificial intelligence acts on the innovation performance of large pharmaceutical companies. Several specific goals are derived from it:

• to describe the areas of the development cycle in which the technology is most often applied;

• to determine the organizational and technological conditions that determine the success of the application;

• to systematize the limitations, risks and ethical issues that accompany it;

• to assess the extent to which the available sources provide a basis for concluding about the actual effect on the innovation outcome.

2. Review method and source selection

This paper focuses largely on gathering critical literature rather than conducting a classic systematic literature review, a choice dictated by the study's specific objectives. Naturally, the primary goal is to identify and illustrate the link between artificial intelligence and innovation, and to determine whether evidence for this connection exists. The process of sourcing materials was carried out in two phases. The first phase involved searching various platforms for studies, books, and papers that addressed the research topic and offered relevant information. The second phase was evaluative, focusing on assessing which of these works would be most useful and contribute most significantly to the current study. Three papers were selected as primary sources: Stamenović (2023), Popović et al. (2024), and Zdravić et al. (2025). Four criteria guided this selection process. Each paper had to explicitly address artificial intelligence or related digital technologies within the pharmaceutical industry, rather than healthcare in general. All three papers originate from the regional scientific community and draw upon a broader body of international research, making them suitable starting points for citation tracking. During the evaluation, papers were excluded if they failed to explain a connection or provide significant results regarding the impact

of artificial intelligence on innovation in the specified industry or, more precisely, if no common points or instruments could be derived from them to demonstrate (or refute) a link between these two variables.

3. Methodological foundations of artificial intelligence and digital transformation of pharmaceutical operations

The field is defined as the creation of intelligent systems that perform tasks that require human intelligence, such as learning, problem solving, and decision-making, where humans and such systems work together (Popović et al., 2024). The breadth of the definition is intentional, as the field encompasses several layers of techniques of varying maturity and practical applicability. Machine learning is a subfield that predicts outcomes by performing a large number of permutations and combinations of datasets available for drug molecules, in order to determine the best combination without relying on traditional manual laboratory methods (Popović et al., 2024). According to the learning method, three groups are distinguished: supervised learning, which covers classification and regression, unsupervised learning, which covers association and clustering, and reinforcement learning (Wu et al., 2022). Neural networks and deep learning are located within machine learning and carry the greatest computational weight. Traditional model-based methods remain useful for analyzing biological data, but they are unable to process the large amounts of available data to discover relationships and predict data behavior (Popović et al., 2024).

The historical thread extends back to Turing (1950) who considered the possibility of an inanimate machine thinking like a human, and from there to the Turing test as the starting point of the field (Akman & Blackburn, 2000). The development of machine learning depends on the fusion of computer science, mathematics and statistics, and business knowledge. In the pharmaceutical industry, which is science-driven, such fusion is rarely found in the same people, which is an obstacle to the development of the field (Henstock, 2019).

The digital transformation in the pharmaceutical industry is changing the way medicines are developed, manufactured, distributed, and controlled after they are placed on the market. The change does not stop with technological innovation. It also encompasses organizational behavior, management style, and communication between departments within the company, as well as relationships with stakeholders (Mackey & Nayyar, 2017).

In the production sector, the use of smart factories is increasingly common, aiming to make it easier to monitor parameters during the process, automatically recognize problems, report them, and correct them. They rely on the Internet of Things, artificial intelligence, robots, and digital twins, and the result is flexible, agile, and high-quality production (Elbasani et al., 2020). The basic technical procedures, grinding, mixing, and granulation of raw materials, drying, and sterilization, require constant control of temperature, humidity, and pressure (Klimenkova et al., 2021; Pisano, 2010). In recent years, development has been

directed toward reducing costs and losses in production, while simultaneously increasing the safety and quality of medicines (Rantanen & Khinast, 2015).

The second part of the big picture is services. They encompass the intangible components that accompany the product and contribute to its safe and effective use: educational programs for doctors, digital applications for monitoring therapy, telemedicine, expert advisory services regarding regulatory standards and monitoring of side effects (Klimenkova et al., 2021; Pisano, 2010). The two parts differ in their focus. In manufacturing, this is on the physical creation of the product, while in services there is a large number of activities that ensure that the product reaches the end user in the right condition and on time (Zdravić et al., 2025).

3.1 Application in drug discovery and development and impact on innovation performance

The ability to analyze vast amounts of data and generate insights that would be difficult for humans to obtain shortens the time, cost, and risk of developing new drugs. Analyzing large datasets identifies the biological processes involved in disease, for example by comparing gene expression in diseased and healthy tissue, which gives researchers potential targets for drug development. BenevolentAI and Insilico Medicine are doing this work, searching for targets for Alzheimer's disease, Parkinson's disease, and cancer. After selecting a target, compound screening comes next. Large libraries of compounds are screened by analyzing their chemical structure and predicting their biological activity, which directs the work to the most promising candidates. This is how Atomwise and Exscientia work for cancer, COVID-19, and cystic fibrosis (Stamenović, 2023). Predicting its behavior in interaction with biological targets provides the basis for modifications that improve efficiency and reduce side effects, which is the practice of Numerate and XtalPi in diabetes, hepatitis B, and cancer (Stamenović, 2023). Identifying patients who are likely to respond to a particular therapy reduces the number of participants needed and increases the likelihood of success, and this is what Berg Health and Mendel.ai are doing in cancer, Alzheimer's disease, and heart disease. Among the most frequently cited examples is the Canadian company Deep Genomics, which in September 2019 announced that it had solved the problem of Wilson's disease with the help of artificial intelligence. The company has created a dataset of more than 200,000 gene mutations, which it has incorporated into training algorithms capable of cross-checking the connections in human DNA, and in the same year its value reached $575.2 million. Older computational approaches are also found in this field. Quantitative structure-activity relationship studies, known as QSAR, are used to create new effective drugs in a very short time using simulation tools. A model based on a radial basis function neural network, trained with particle swarm optimization, was used to predict the pKa values of 74 different types of drugs. The SPIDER technique determines the role of natural products in drug discovery, while the approach known as open target examines the relationship between targets and diseases, as well as the way in which certain genes are associated with diseases (Popović et al., 2024). Whether all this translates into better innovation outcomes

remains a separate question. The benchmark is familiar: about ten years and $2.6 billion per new drug (DiMasi et al., 2016), with only about ten percent of candidates entering the first phase reaching the market, and the cost of failures is passed on to the price of the drugs and to direct patient costs. The expected contribution of artificial intelligence is threefold. Time is shortened, as computational screening and prediction of activity replace parts of the manual laboratory work (Popović et al., 2024). Costs are reduced by earlier rejection of weak candidates and by a smaller number of patients needed for testing. The chances of success are improved because predicting toxicity based on molecular structure and biological activity reduces the need for animal testing and increases the safety of new drugs, as is the practice of Insilico Medicine and BioSymetrics.

3.2 Organizational readiness, personalized medicine and clinical trials

The strongest evidence on the state of readiness in the sources analyzed comes from a global survey conducted in 2019 by the DIA association, which examined analytical platforms and innovations in companies that are already implementing or planning to implement artificial intelligence. 402 responses were processed, including data from 217 organizations, and the most significant barriers to implementation were employee skills (55 percent), data structure (52 percent), and budgets (49 percent) (Lamberti et al., 2019). According to the original article, 634 questionnaires were received and 402 were kept for analysis after incomplete answers and respondents without enough knowledge of the topic had been excluded. Despite the aforementioned barriers, the same survey showed that most organizations are already implementing artificial intelligence to some extent and understand the importance of the workforce for success, and a large number of them expected to increase the number of employees as the application expands. The first place is not technology, but people, which coincides with the finding that the combination of computer science, mathematics and statistics, and business knowledge is rarely found in a science-driven industry (Henstock, 2019). When skills are a barrier for more than half of respondents, and technological application for about a third, the focus of the problem shifts from equipment to organization. Companies often respond to this limitation by partnering. AbbVie is collaborating with Insilico Medicine on the development of new drugs for diseases related to aging, with the goal of finding new biological targets and shortening discovery times through the partner’s platform. The company has similar agreements with Biocorpora and Cyclica, and is also working on optimizing clinical trials and improving patient outcomes. Collaboration between academia, industry, and regulatory bodies is cited as a requirement for the ethical application of technology in drug discovery and development, along with ongoing research and training programs (Singh et al., 2023).

The greatest expectations are attached to personalized medicine. Doctors know that metabolism, physical and physiological characteristics, and genome structure affect the body's response to a drug, but in practice, the approach that all patients receive the same drug regardless of their differences still prevails (Popović et al., 2024). Advances in artificial intelligence open the possibility of a new era, in

which pharmaceutical products adapt to the needs and adaptability of the body. The transition requires a large amount of data collection, processing, and clarification, as well as millions of analyses and predictions to find the best therapeutic approach for a particular case. The IBM Watson system, based on artificial intelligence, helps create an appropriate treatment plan depending on the patient's disease history and personal data, including genomic structure. This approach is expected to reduce treatment costs and side effects in patients (Popović et al., 2024). In diagnostics, the results are more specific. Computer algorithms detect breast cancer metastases in lymph node biopsies on whole-mount images with an accuracy of over 91%, rising to 99.5% when supplemented with physician input. The United States Food and Drug Administration has so far approved 29 medical devices and algorithms based on artificial intelligence in various areas of medical science (Ghaffar Nia et al., 2023). The first to be approved in the healthcare sector was a diagnostic model based on an autonomous system, trained on a diverse set of data from people of different ages, races, and sexes, in order to reduce the likelihood of errors across groups. A randomized controlled trial showed that patients who received an automated polyp detection system performed better than the control group in terms of adenoma detection rate and the average number of polyps detected after colonoscopy (Lam et al., 2022). AbbVie applies technology to clinical trials to analyze large amounts of data generated during trials, optimize design, and identify subgroups of patients who would benefit most from a particular therapy, leading to the development of personalized medicine. The company's platform relies on machine learning algorithms that predict the most promising biological targets and molecules, processing data from genetic, clinical, and scientific sources.

3.3 Digital technologies in production and supply chain, risks and ethical issue

The innovation cycle does not end with the registration of the drug. Three technologies stand out as the most significant in the pharmaceutical industry, as they improve data security, real-time tracking of drugs throughout the supply chain and control of storage and transportation conditions, while preventing counterfeiting (Al Sohan et al., 2022). The collected data is analyzed, and the most important ones are forwarded to devices that perform specific tasks (Perwej et al., 2019), with the technology relying on sensor technology, barcodes, radio frequency identification, short-range communication and cloud computing (Li et al., 2015). Pfizer has applied it to monitor temperature and environmental parameters during transportation and storage, with 17 sensors that update data in real time throughout the day. The temperature should remain between minus 80 and minus 60 degrees Celsius, and any deviation is automatically reported to the responsible person, which was of particular importance in the distribution of vaccines during the pandemic (Pfizer, 2021; Zdravić et al., 2025). Novartis, together with Amazon Web Services, installed sensors to monitor the condition of the equipment, temperature, humidity and pressure, and algorithms predict possible downtime, which has reduced interruptions in drug production and

increased the overall efficiency of the equipment. At AstraZeneca, the technology is used to monitor the weight and hardness of tablets in real time, while Eli Lilly has introduced it in the production of injections, where air quality, humidity and temperature determine sterility (Amazon, 2019). In the terms used in this paper, these are intermediate measures of process performance and not indicators of innovation performance.

Blockchain technology is a decentralized data management and verification system that relies on encryption, smart contracts, and negotiation between participants in the chain (Wang et al., 2021). Combined with the Internet of Things, it stores information about components, materials, and products throughout and after the production cycle. The advantage is the recognition of problems in real time, whether it is defects, downtime, or component quality (Lohmer & Lasch, 2020; Min, 2019; Zhang et al., 2023). Moderna, in collaboration with IBM, has applied it to track the distribution of vaccines, so that government agencies and healthcare institutions can know the status of a particular batch at any time as it moves through the chain (Ledger Insights, 2021; IBM, 2021b). At Pfizer, it is used to combat drug counterfeiting, and one application based on this technology allows individuals to store and control their own health data and share it securely (IBM, 2021a). Radio frequency identification (RFID) identifies and tracks products using radio waves. Each tag contains a microchip with a unique identification number and data such as the date of manufacture, expiration date, and batch number, as well as an antenna that transmits the information to a reader (Vaka, 2024; Casella et al., 2022). Sandoz has applied it to three critical drugs for expiration tracking and automated inventory management through its Kit Check software, which has proven particularly useful during the pandemic. At Hanmi Pharmaceutical, it has been implemented from manufacturing to distribution, reducing errors in deliveries and improving the control of drugs with limited expiration dates and special temperature conditions. Novartis uses it to track batches in warehouses and during transportation (Pharma Technology Focus, 2019; Avery Dennison, 2023).

Despite these capabilities, the literature is consistent in stating that the application also has serious limitations. The first of these concerns data. Training models requires large amounts of high-quality data, and in drug discovery, data is often proprietary and subject to intellectual property restrictions, making it difficult for researchers to access. Comparison between different sources is also hampered by the lack of standardization in collection and storage. The technology creates insights that are difficult for humans to access, but the path it takes to reach a conclusion often remains unclear, which reduces confidence in the results and slows down application (Stamenović, 2023). Systems represented by artificial neural networks are often criticized precisely for their black-box properties (Popović et al., 2024). Models depend on the datasets on which they are developed and the labels associated with them, which can amplify biases toward underrepresented groups. Differences in representation in the training data also lead to unequal results across demographic groups (Popović et al., 2024). An algorithm developed to classify chest X-rays using natural language processing was later trained to recognize pneumothorax, but a closer look revealed that the

presence of chest drains in most reports labeled as pneumothorax raises the question of whether the model was indeed accurate whether the algorithm recognized the drains, not the condition itself (Liong-Rung et al., 2022).

4. Results

The analysis of the three primary sources and the papers they refer to provides a picture in which the possibilities are described more convincingly than the confirmed effects. The results below are grouped according to where the authors agree, where they disagree, and what follows. The three primary sources were chosen according to the criteria set out in Section 2, and Table 1 compares their main characteristics. The last column of the table shows which type of indicator each source reports, following the distinction between outcome indicators and intermediate measures made in the Introduction.

Table 1. Comparison of the three primary sources

The source	Work and method	Part of the value creation cycle	Type of evidence	Indicators reported
Stamenović (2023)	Review paper; descriptive overview of 27 large pharmaceutical companies (Forbes Global 2000, 2021) and a case study of AbbVie	Drug discovery, clinical trials, company behavior	Company examples, secondary survey data (DIA), published financial results	Financial proxies (revenue, net income) and perceived barriers; no outcome indicator
Popović et al. (2024)	Review of scientific literature on applications in biotechnology and medicine	Methodological basis, drug discovery, personalized medicine, diagnostics	Results of experimental and clinical studies reported by other authors	Algorithm accuracy (intermediate measure); no outcome indicator
Zdravić et al. (2025)	Conference paper; descriptive overview of digital technologies with company examples	Production, supply chain, services	Company cases and industry reports, without quantification	Qualitative descriptions of reduced downtime, fewer errors and better traceability (intermediate measures); no outcome indicator

Source: Author's elaboration based on Stamenović (2023), Popović et al. (2024) and Zdravić et al. (2025).

4.1 Points of agreement and differences in focus and assessment of maturity

The assumption underlying all the sources analyzed is the same: artificial intelligence shortens the time and reduces the costs of development. Stamenović (2023) expresses this through a shortened deadline, reduced costs and an

accelerated innovation process, Popović et al. (2024) through a reduced need for clinical trials and a faster market entry without compromising safety, and Zdravić et al. (2025) through fewer losses and errors in production and distribution. The location of data is a second common point. In Stamenović (2023), the unavailability and non-standardization of data are the first limitation, in Popović et al. (2024) bias and inefficient data merging are among the main obstacles, and in the DIA research, the structure of the data is in second place among the obstacles, right after skills (Lamberti et al., 2019). Employee skills are the most frequently cited barrier, and Henstock (2019) explains this by the rare combination of necessary knowledge in a science-driven industry. A fourth common point is the safety and regulatory framework, which is treated as a requirement for work in all sources, rather than an obstacle to be circumvented (Klimenkova et al., 2021; Singh et al., 2023).

Stamenović (2023) focuses on drug discovery and company behavior, with a review of 27 large pharmaceutical companies selected by revenue from the Forbes Global 2000 list for 2021 (Forbes, 2021) and a case study of AbbVie. Popović et al. (2024) start from the scientific and methodological side and extend the analysis to medicine, agriculture and industrial biotechnology. Zdravić et al. (2025) take the later part of the cycle, production and service management, where solutions are already implemented and visible in operations. The gap in maturity assessment is more important than the difference in focus. Popović et al. (2024) explicitly state that AI-based technologies have not yet entered everyday practice and that few models have been implemented in healthcare. Stamenović (2023) is more restrained in his presentation of the problems, but confident in the direction, expecting growing adoption in the coming years. Zdravić et al. (2025), in contrast, document specific solutions already in operation at Pfizer, Novartis, AstraZeneca, Eli Lilly, Moderna, Sandoz and Hanmi Pharmaceutical.

4.2 Differences in the method of measurement and the most significant findings from the literature

None of the sources analyzed offer a direct measure of innovation performance. Stamenović (2023) openly admits that the revenues related to AbbVie's AI projects are not publicly available, with the constant growth of revenue and net profit being taken as an indicator of the soundness of the investment. This is a conclusion by analogy, not a measurement. In Popović et al. (2024) the numbers are correct, but they refer to the accuracy of the algorithms, for example over 91 percent, or 99.5 percent in detecting metastases, and not to the outcome of the development process. Zdravić et al. (2025) describe the effects qualitatively, through reduced downtime, fewer errors and faster product recognition, without accompanying numbers. In the terms defined in the Introduction, all three sources therefore report intermediate measures or financial proxies. None of them reports an outcome indicator, such as the duration of a development phase, the cost per registered drug or the rate of transition between phases.

The analysis shows that the impact on innovation performance is achieved through three direct channels: acceleration of the early stages of development, better selection and prioritization of candidates and reduction of uncertainty in clinical trials. The fourth channel is indirect and consists of traceability and quality control in production and supply, which act on losses and on the speed of reaction to deviations. The condition for all of them is the same. Organizational readiness, expressed through skills, data structure, budget, leadership and organizational culture, determines the limit to which technical capability is converted into an innovative result.

5. Discussion

A comparison of the sources shows that the claims about the impact of artificial intelligence on innovation performance are based on evidence of unequal strength. The strongest data are on the accuracy of individual algorithms in controlled conditions, and the weakest are precisely those that would be most needed, data on the outcome of the development process at the company level. Put in the terms of this paper, intermediate measures are well documented, while outcome indicators are almost entirely missing.

The problem is most clearly seen in the case study of AbbVie. The growth of revenue from $18.8 billion in 2014 to $45.8 billion in 2020, along with the growth in net profit, is cited as an indication that the investment in the technology has paid off. The same text states that Humira alone brought in about $20 billion in 2020, which is almost half of the total revenue. The growth of a company that relies on a single product registered long before the introduction of these technologies can hardly serve as evidence of their contribution. The same source also contains an internal inconsistency, with net income for 2020 listed in one place as $10.1 billion and in another as $5.5 billion. Such discrepancies require caution when referring to financial indicators.

The DIA study requires similar caution. The text cites 402 processed responses and data from 217 organizations, while the accompanying chart with the percentages of obstacles indicates that the number of respondents is 103. A check of the original article (Lamberti et al., 2019) confirms 402 analyzed responses from 217 unique organizations, as well as the shares of 55, 52 and 49 percent for staff skills, data structure and budgets. The first number counts individual respondents and the second counts the organizations they belong to, so the two do not contradict each other. The value of 103 appears only in the chart reproduced by Stamenović (2023) and matches neither total.. The percentages themselves express the perception of the respondents, not a measured state. They indicate what organizations experience as an obstacle, which is useful for understanding behavior, but is not the same as what actually determines success. High accuracy values, such as 99.99 percent in plant disease recognition or 98.19 percent in model training (Popović et al., 2024), come from narrow experimental settings. The transfer of such results to everyday work is precisely what the same authors assess as still unachieved. High accuracy in laboratory conditions, therefore, is not evidence of an innovation effect in work. It remains an intermediate measure, and

its link to outcome indicators still has to be demonstrated. The organizational side of the whole picture emerges as a stronger determinant than the technological one. When skills are listed as an obstacle by 55 percent of respondents, and technological application by 32 percent (Stamenović, 2023), the focus of the problem shifts to human resource management and data structure. Partnerships with specialized companies, such as those concluded by AbbVie, become understandable precisely as a response to the lack of internal capabilities, and not only as a way to access new technology. Future research would make sense if it focused on measurable indicators: duration of individual phases, transition rates between phases, number of registrations per invested unit and comparison between companies with different levels of application. Without such data, the link between artificial intelligence and innovation performance remains a plausible assumption with a strong theoretical basis and modest empirical confirmation.

The measurable indicators listed above can be turned into a more concrete research agenda with four lines of work. The first concerns the development pipeline. Candidates discovered with the help of artificial intelligence could be compared with conventionally discovered ones by the duration of each phase and by the rate of transition from one phase to the next, using public trial registries such as ClinicalTrials.gov and the pipeline disclosures of companies. Early evidence of this kind already exists. In an analysis of the clinical pipelines of AI-native biotechnology companies, Jayatunga et al. (2024) found Phase I success rates of 80 to 90 percent, well above historical averages, while success in Phase II, at around 40 percent, was close to the usual industry level. That analysis covers a small number of molecules and specialized companies rather than large pharmaceutical groups, so repeating it on the portfolios of the companies discussed here would be a natural next step.

The second line of work concerns the company level. Panel studies could relate an index of adoption intensity, built from disclosed partnerships, patents related to artificial intelligence, dedicated platforms and specialist hiring, to research and development spending per registered drug and to the number of registrations per unit of investment. Such studies would have to control for company size and for dependence on a single product, since the AbbVie case shows how easily revenue from an older best-selling drug can be mistaken for the effect of a new technology. The third line concerns organizational readiness. Surveys repeated over time in the same organizations, rather than one-off surveys of perceptions, could test whether skills, data structure and budget strengthen or weaken the link between adoption and outcome indicators. The fourth line concerns production and supply. The open question there is whether gains in intermediate measures, such as less downtime or better traceability, lead to a shorter time from registration to market launch, fewer rejected batches or fewer supply interruptions for new products.

6. Conclusion

The literature review shows that artificial intelligence in global pharmaceutical companies is no longer an experiment, but a working tool, but that its contribution to innovation performance remains more certain in descriptions than in measurements. The technology operates at four points in the development cycle: in the identification of biological targets, in the screening of compounds, in the optimization of candidates and in the design and execution of clinical trials. Computational processing of large data sets replaces some of the manual testing and redirects work to the candidates with the best prospects. This is followed by the Internet of Things, blockchain technology and radio frequency identification, which operate later in the cycle and contribute through traceability, condition control and less waste.

The conditions within the organization itself have proven to be a stronger determinant than the technology. The main obstacles to implementation are employee skills, data structure and budget, and the combination of computer, mathematical and business knowledge is rarely found in the same people in a science-driven industry. The usual answer to this shortcoming is partnerships with specialized companies.

The limitations are consistently stated in all sources. The availability and quality of data, the ambiguity of models, the biases arising from data sets, as well as ethical and regulatory requirements, determine the speed with which technology penetrates everyday work. How easily high accuracy can mean something other than what is expected is shown by the example of recognizing chest drains at the site of pneumothorax. The available literature lacks direct measurement. None of the sources analyzed connects the application of artificial intelligence with a measurable outcome of the development process at the company level. The conclusion of a positive impact relies on a set of indications: shortened procedures in separate phases, accurate algorithms in controlled conditions, a growing number of partnerships and revenue growth at investing companies. Each of these indications is convincing in itself, but none of them closes the question. From the analyzed sources, it can be concluded that artificial intelligence improves the conditions for innovation in the pharmaceutical industry, that its effect depends on the readiness of the organization as much as on the technology itself, and that the true extent of that impact has yet to be determined by research that will work with outcome indicators, not just a description of the possibilities. Since the review is a narrative synthesis of a limited set of sources, these conclusions are best treated as a reasoned starting point for such research, not as a final assessment.

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DIGITAL ECOSYSTEM AND COOPERATIVES: DIGITAL MARKETPLACES FOR WOMEN'S COOPERATIVES

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Abstract

Women's cooperatives are essential organizational models that enable women to actively participate in economic and social life, serving as key actors in the Social and Solidarity Economy, sustainable local development, and social inclusion. Today, adapting their marketing, distribution, and management processes to the digital ecosystem has become critical for these cooperatives to access markets and gain a competitive advantage. This study aims to examine the opportunities and transformational spaces that digital marketplaces create for women's cooperatives through a literature-based approach. Within the scope of the study, the advantages and structural challenges faced by cooperatives in their digitalization processes are evaluated framed by academic literature and policy documents. Methodologically, mainstream digital marketplaces operating in Türkiye (Trendyol, Hepsiburada,) and platform models focusing on women's labor/local production (HayatHatay, Hepyerinden, Anadoludakiler etc.) are analysed using the case study method. The analysis reveals that while large-scale platforms offer high visibility, they also entail risks such as high commission rates and algorithmic competition; conversely, cooperative-based platforms foster a more direct and solidarity-driven bond between producers and consumers. However, the success of digital transformation remains limited by the cooperatives' digital literacy levels and institutional capacities. These findings suggest that supporting solidarity-oriented alternative structures rather than standard commercial platforms and increasing tailored public/infrastructure incentives for cooperatives are crucial for their sustainable digitalization.

Keywords: Women's cooperatives, digital marketplace, Türkiye, digital ecosystems

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1. Introduction

Cooperatives are enterprises that operate throughout the world in accordance with their principles and values. Concepts such as voluntary association, joint ownership, democratic governance, and autonomy are among the characteristics that distinguish cooperative enterprises from other types of businesses. Since their establishment, cooperatives have carried out activities aimed at improving the well-being of their members and the communities in which they operate.

The United Nations highlighted the importance of cooperatives for individuals and societies worldwide under the slogan “Cooperatives Build a Better World” in both 2012 and 2025. The 2026 theme, “Cooperatives for a Peaceful World,” emphasizes the contribution of cooperative enterprises to social justice, inclusiveness, and solidarity (United Nations, 2026). Moreover, many of the Sustainable Development Goals are closely associated with cooperatives. Among these goals, gender equality, decent work and economic growth, reduced inequalities, and the eradication of poverty are particularly aimed at improving the position of women in society. In many countries around the world, including Türkiye, efforts are being undertaken to eliminate the disadvantaged conditions experienced by women in society through cooperatives. For this purpose, women's cooperatives and women-led cooperatives have been established. However, the extent to which these cooperatives can contribute to the economic empowerment of women, enable them to reach broader markets with their products and services, and enhance their competitiveness depends on their ability to adapt to changing economic and technological conditions.

Compared to men, women are more likely to be employed in lower-paid, part-time, seasonal, and informal jobs. Gender-based discrimination, women's limited access to information and social networks, and their systematic underrepresentation in rural institutions and organizations further weaken their voice and decision-making power (FAO, 2024).

Women's cooperatives have become central to discussions on local development as collective organizations that enhance the economic, social, and cultural visibility of women's labour (Göç, 2025). Beyond generating income, these organizations foster solidarity, self-confidence, participation in decision-making processes, and the attainment of social status (Çabuk, 2026). The long-term sustainability of women's cooperatives is directly influenced by structural factors such as market access, institutional capacity, digital skills, and dependence on external support (Mızrak et al., 2026). In this context, digital marketplaces should be regarded not merely as technical channels for product sales but as market infrastructures that reshape production, marketing, branding, and organizational learning processes (Gürsoy Yenilmez, 2022).

Accordingly, this study examines both general commercial marketplaces and marketplaces that focus on women's labour and local production. It further evaluates the opportunities, limitations, and areas of transformation that different digital marketplace models present for women's cooperatives.

2. Conceptual Framework

The primary purpose of women's cooperatives is to meet the economic, social, and cultural needs of their members, as well as their needs related to the production and marketing of goods and services within the scope of their economic activities. They also aim to support women's entrepreneurial initiatives, enhance their production skills, promote the recognition and utilization of women's labour, and thereby safeguard the economic interests of their members while enabling them to live in a healthy and developed environment (Ministry of Trade, 2026). A study conducted by the Committee for the Promotion and Advancement of Cooperatives (COPAC) highlights the contributions of cooperatives to gender equality and the economic empowerment of women. These contributions include economic empowerment (equal access to paid employment, opportunities to transition into the formal economy through cooperation, access to working capital, finance, and markets, access to knowledge and skills necessary for economic activities, and economic development in rural areas), improved working conditions (fair and adequate earnings/equal pay for work of equal value, decent work under safe working conditions, collective bargaining power, and increased participatory democracy in the workplace), and social empowerment (learning opportunities such as technical skills development and management training, access to affordable and accessible goods and services, and increased self-esteem and self-confidence) (COPAC, 2024). In Türkiye, women's cooperatives and women-led cooperatives are organized as two distinct types of cooperatives. Both types of cooperatives are established and operate in accordance with the Cooperatives Law No. 1163. However, those established in rural areas are predominantly organized as Agricultural Development Cooperatives under the authority of the Ministry of Agriculture and Forestry and operate in accordance with the *Articles of Association of the Agricultural Development Cooperative*. Women's cooperatives established in both rural and urban areas under the authority of the Ministry of Trade operate in accordance with the *Articles of Association of the Women's Initiative Production and Business Cooperative*. Differences are also observed in the support provided to women by the two different ministries.Today, women's cooperatives constitute one of the most rapidly growing types of cooperatives in Türkiye.

The number of cooperatives operating under the Ministry of Trade is 1,211, with 14,874 members (Ministry of Trade, 2025). The number of cooperatives affiliated with the Ministry of Agriculture and Forestry whose membership consists predominantly of women is 162 (Ministry of Agriculture and Forestry, 2026). One of the most important public policy documents concerning women and women's cooperatives is the Cooperation Protocol on Strengthening Women's Cooperatives. The Protocol was signed in 2018 by the Ministry of Trade, the Ministry of Family and Social Services, and the Ministry of Agriculture and Forestry with the aim of strengthening women's cooperatives, ensuring their sustainability, improving their institutional and economic capacities to transform them into qualified enterprises, and promoting women's active participation in

economic and social life through cooperatives (Ministry of Family and Social Services, 2026). The Protocol was renewed for an additional five-year period in 2023. The motivations that encourage women to join a cooperative, such as the need for socialization, the desire to contribute economically, and the aspiration to achieve economic independence, directly influence the ways in which they use digital technologies. Conversely, the level of actual access to digital technologies, together with the opportunities and constraints offered by these technologies, significantly shapes women's participation in cooperative life and their opportunities for personal development within this process (Aytuna & Özkaya, 2026). Although cooperatives in Türkiye have established a digital presence, they have not been able to transform this visibility into a more sustainable, manageable, and sales-oriented structure (INGEV, 2026). Realizing this potential depends on overcoming several structural constraints. Low levels of digital literacy, unstable internet connectivity, shared technological equipment, and gender norms that restrict women's independent use of technology constitute the major barriers to digital transformation (Aytuna & Özkaya, 2026).

3. Materials And Methods

This study was designed as a qualitative assessment based on a literature review and a multiple case study design. The research materials consist of academic studies on women's cooperatives, digital marketplaces, digital marketing, local development, and women's entrepreneurship, as well as institutional reports and the official documents of the platforms examined. Within the scope of the case study, two groups of platforms were comparatively analyzed. The first group consists of Trendyol and Hepsiburada, which are general digital marketplaces providing broad consumer access in Türkiye. The second group comprises HayatHatay, Hepyerinden, and Anadoludakiler, which place a stronger emphasis on women's labour, local production, and the solidarity economy.

4. Digital Marketplaces and Women's Cooperatives in Türkiye

Digital marketplaces provide rapid access to markets by directly connecting producers and consumers without requiring the capital needed to establish a physical store. They reduce transaction costs and minimize inefficiencies in the supply chain. Sellers are also able to coordinate with suppliers and customers at any time (Dina & Dewaranu, 2022). According to the E-Marketplace Platforms Sector Review Report (2022), the factors influencing sellers' choice of e-marketplaces include a large consumer base, high conversion rates, timely payments, reasonable commission rates, the availability of additional services, effective seller relationship management, and the affordable provision of supplementary services. The report indicates that only 17.2% of sellers operate on a single e-marketplace, whereas 82.8% sell through multiple digital marketplaces, with sellers operating on an average of 3.5 marketplaces. Furthermore, 83.1% of sellers stated that they participate in marketplaces to benefit from "the marketplace's recognition and its broad consumer base" (Competition Authority,

2026). Compared with the total number of women's cooperatives established in Türkiye, only a limited number of cooperatives operate in digital marketplaces, and even fewer participate in multiple digital marketplaces.

Cooperatives are also striving to adapt to the digitalization process in order to maintain their competitiveness while improving productivity, customer satisfaction, and member satisfaction. Digital marketplaces constitute one of the factors facilitating this adaptation in favor of women.

The first impact of digital marketplaces is that they increase the visibility of women's cooperatives beyond their local markets (Ergin Demirdağ & Aydoğan, 2025). Digital platforms also enable cooperative products to be presented together with their geographical, cultural, and local values (İştar Işıklı, 2024). A second area of impact is the potential of digital marketplaces to diversify income sources and expand the customer base of women's cooperatives (Gürsoy Yenilmez, 2022). Increased income may encourage members' willingness to participate in cooperatives and strengthen local economic development (Nuhoğlu & Ekinci Hamamcı, 2025). Women's cooperatives often evaluate economic gains together with social benefits, solidarity, and collective learning (Arslan & Güler, 2025). Therefore, the success of digital marketplaces should be assessed not only in terms of sales volume but also by the extent to which they enhance members' empowerment, learning, and organizational commitment (Çabuk, 2026).

According to the Digital Capacity Survey of Women's Cooperatives in Türkiye (2026), although women's cooperatives have a high level of digital visibility, this visibility is not adequately reflected in e-commerce sales. Their digital presence is maintained largely through social media, particularly Instagram (78%), while only 20% own a corporate website. Furthermore, 67% of cooperatives are not present on any e-commerce channel, whereas 33% participate in e-commerce, with the majority operating only through marketplaces (21%). The proportion of cooperatives selling through marketplaces (13% on Hepsiburada and 8% on Trendyol) and those operating their own e-commerce websites is limited to 12%. Cooperatives primarily prefer marketplaces because they provide ready-made customer traffic; however, they remain insufficient in developing their own digital sales infrastructure. The relatively low proportion of cooperatives using both corporate websites and marketplaces simultaneously (12%) indicates that a multi-channel digital sales model has not yet become widespread (INGEV, 2026).

Recently, women's cooperatives have begun to receive support from the Ministry of Trade and digital sales platforms in the field of digital marketing. By making women's cooperative products available on e-commerce platforms, these initiatives have contributed to increasing women's participation in social life and strengthening their economic position (Özdemir & Koca, 2025).

One of the ways in which women can achieve economic empowerment through cooperatives is by increasing their sales, and consequently their income, through reaching a larger number of consumers, particularly via digital marketplaces. For this purpose, joint digital platforms featuring women's cooperatives and their products have been established by public institutions and organizations, including Hepyerinden, HayatHatay, and Anadoludakiler. In addition, cooperatives are also present on Türkiye's two largest digital

marketplace platforms, Trendyol and Hepsiburada. To better understand the role of digital marketplaces in supporting women's cooperatives, the selected platforms are classified according to their institutional structures.

4.1. Digital Marketplaces Established by Public Institutions and Organizations

Hayathatay project, initiated by the Hatay Governorship by providing financial and technical support to women's cooperatives that remained operational following the 2023 earthquake, also offers training to women in branding, labeling, barcoding, standardization, and product development. Within the scope of the project, the number of geographically indicated products in Hatay increased from 25 to 53. Through this project, the income generated by women's cooperatives contributes to the economic and social development of the region. On this marketplace platform, products are displayed on the homepage under categories such as spices, jams, olive oil, molasses, desserts, tomato paste, olives, pomegranate molasses, accessories, and other categories. In addition to individual orders, bulk orders can also be placed through the website. The Hayat Hatay platform features products from 27 cooperatives (HayatHatay, 2026).

The Anadoludakiler Digital Platform was established and is operated by the General Directorate of Development Agencies (KAGM) under the Ministry of Industry and Technology of the Republic of Türkiye. The platform aims to support local producers, preserve traditional culture, and promote the discovery of local potential through digital technologies. It features products that possess geographical distinctiveness, are produced through responsible production practices, utilize traditional production methods, and have existing or potential capacity to generate employment and support regional economic development. Under the "Cooperatives" section of the platform, detailed information is provided on 155 women's cooperatives. Furthermore, local products are marketed collectively through a social procurement mechanism, whereby institutional buyers submit a product request form for bulk purchasing (Anadoludakiler, 2026).

4.2. Digital Marketplaces Established by International Organizations

The Hepyerinden Digital Platform, developed under the technical leadership of the Food and Agriculture Organization of the United Nations (FAO) and representing the first initiative of its kind in Türkiye, is a cooperative-based e-commerce platform that enables women to reach wider markets with products they produce locally while providing them with sustainable market opportunities in the digital environment. The "Strong Livelihoods, Resilient Communities" project, financed by the European Union (EU), aimed to enable rural women's cooperatives to produce in compliance with food regulations and in integration with markets while strengthening their institutional capacities. The website platform is owned by the cooperatives, while the FAO technical team provides support in areas including concept development, design, technical installation, and digital infrastructure. Subsequently, the Hepyerinden Digital Platform acquired legal entity status and continues its activities under the name Hepyerinden Service

Cooperative. The platform currently hosts 30 women's cooperatives, including 18 Agricultural Development Cooperatives and 12 Women's Initiative Production and Business Cooperatives. Natural products are offered under six product categories: breakfast products, staple foods, snacks, accessories and home decoration, personal care and cosmetics, and geographical and cultural heritage products. Products available on the platform are marketed through Pazarama, a private digital marketplace. Within the Pazarama platform, these products are offered under the category "Women Farmers' Products" (Hepyerinden, 2026).

4.3. Digital Marketplaces Established by Private Enterprises

Trendyol is one of the largest e-commerce platforms in Türkiye, operating as a marketplace with more than 40 million products, 40 million active customers, and over 250,000 business partners. The platform delivers to 35 countries. In 2018, the Chinese e-commerce company Alibaba acquired 86.5% of Trendyol's shares, becoming the company's largest shareholder. With more than 200 million monthly visitors, Trendyol is estimated to account for approximately 35–40% of Türkiye's e-commerce market. The platform has a particularly strong position in the categories of fashion, cosmetics, home and living products, and electronics. (Magna Dijital, 2026; Trendyol, 2026). Through the Women Entrepreneurs and Women's Cooperatives Program, developed to support women entrepreneurs and women's cooperatives, women's cooperatives are able to sell their products on the platform under preferential commission rates after uploading their initial products together with stock and pricing information. In this way, the program facilitates women's cooperatives' access to digital marketplaces while supporting them in reaching broader consumer markets. The marketplace includes 22 cooperatives Furthermore, when the keyword "women's cooperative" is entered into the Trendyol search bar, products belonging to women's cooperatives are displayed collectively. This facilitates consumers' access to these products while enhancing the digital visibility of women's cooperatives (Trendyol, 2026).

Hepsiburada is one of Türkiye's most visited e-commerce platforms, operating in more than 30 product categories with over 200 million products. In addition to selling its own products, the platform hosts more than 100,000 businesses, enabling them to reach millions of potential customers through Hepsiburada's digital infrastructure. Holding an estimated market share of approximately 15–18%, the platform maintains its leading position particularly in categories such as electronics, small household appliances, and books. Through its Technology Empowerment for Women Entrepreneurs Program, launched in 2017, Hepsiburada aims to make local production sustainable within the digital economy by offering women's cooperatives a permanent 1% commission rate, permanent free shipping, free product photography services, and advertising credit support. By positioning women's cooperatives as key stakeholders within the e-commerce ecosystem, the program has created one of Türkiye's largest digital networks for women entrepreneurs, encompassing more than 72,000 women entrepreneurs and over 320 cooperatives. Within the framework of the "Entrepreneurial Women of Türkiye" Protocol, signed with the Ministry of Family

and Social Services in 2024, Hepsiburada also supports five pilot women's cooperatives through the "From Tradition to the Future: Women's Cooperatives Go Digital" project by assisting them in e-commerce and branding processes. Products produced by women's cooperatives can be accessed on the Hepsiburada marketplace through the "Women Entrepreneurs" tab located on the platform's homepage (Hepsiburada, 2026).

4.4. The Impact of Digital Marketplaces on Women's Cooperatives

Although numerous digital marketplaces are available to women's cooperatives in Türkiye, only a limited number of cooperatives participate in these platforms, despite the fact that the number of women's cooperatives exceeds one thousand. This study examines digital marketplaces established by the private sector, public institutions, and international organizations for women's cooperatives and identifies the key advantages and structural challenges associated with these marketplaces (Table 1). Women's cooperatives are able to reach a larger consumer base through private-sector digital marketplaces and benefit from the opportunities offered by these platforms. However, their limited visibility reduces the extent to which they can benefit from these marketplaces. In addition, insufficient digital knowledge and skills among women, together with the intense competition resulting from the large number of sellers operating on these platforms, constitute important structural challenges. In comparison, digital marketplaces established by public institutions and international organizations provide a wider range of advantages for women's cooperatives. Professional platform management, the provision of equipment, training and financial support, and direct access to consumers are among the main advantages. On the other hand, difficulties in maintaining product standardization, the marketing of similar local products (except for distinctive products), and the limited ability to reach a large number of consumers can be considered the main structural challenges (Tablo 1).

From a transformation perspective, digital marketplaces are driving women's cooperatives from being locally oriented production organizations toward hybrid structures engaged in data management, branding, customer relationship management, and network management (Kuruoğlu, 2023). When this transformation is successful, women's cooperatives are no longer limited to selling products but can also become actors in local development, social entrepreneurship, and digital inclusion (Göç, 2025).

Table 1. Comparative Assessment of Digital Marketplaces for Women's Cooperatives

Digital marketplaces established by public institutions and international organizations		**Digital marketplaces established by the private sector**	
Advantages	**Structural challenges**	**Advantages**	**Structural challenges**
*Increasing demand for local and geographically indicated products, *Establishing a direct	*Difficulties in maintaining product standardization, *Limited diversity of products and services,	*Low-cost market entry, *Access to a broad customer base and millions of potential	*Limited digital literacy and insufficient knowledge of e-commerce

connection between producers and consumers, *Providing integrated support for logistics, payment infrastructure, customer services, accounting, and product photography, *Enabling rapid market entry and direct product promotion through visual content, *Offering multiple payment options, *Promoting collaboration among women's cooperatives, *Ensuring professional management of sales and after-sales services, *Strengthening women's cooperatives socially and empowering women economically, *Extending benefits to both cooperative members and beneficiaries, *Supporting women's cooperatives through enabling policies and financial assistance from public institutions and international organizations, *Providing consumers with direct access to women's cooperative products, *Offering both wholesale and retail sales opportunities, *Achieving higher sales volumes than private-sector digital marketplaces, *Enhancing the	*The sale of similar local products, with the exception of certain distinctive products, *Limited ability to reach a sufficient number of consumers, *The need for advertising and promotional activities, *Governance-related challenges within the marketplace cooperatives, *Women's limited business experience within cooperatives, *Inadequate product labeling and barcoding, *The inability of cooperatives to achieve a sustainable income-generating structure, *The production of products that are readily available in the market, *National economic conditions.	customers without the cost of establishing an online store, *Integrated support for logistics, payment infrastructure, customer services, shipping, accounting, and product photography, *Rapid market entry and direct product promotion through visual content, *Enhancing the visibility of women's cooperatives, *Providing training and capacity-building support for women's cooperatives, *Establishing a direct connection between producers and consumers, *Offering multiple payment options, *Providing artificial intelligence–based platform support, *Utilizing consumer data to analyze customer preferences and market trends, *Offering a wide variety of product categories and services.	regulations, *Low brand awareness of women's cooperatives, *Insufficient knowledge of digital marketing and customer engagement strategies, *Limited business experience among women in cooperatives, *Intense competition, making it difficult to differentiate from competitors and maintain profit margins, *Challenges in developing competitive pricing strategies, *The similarity of products offered by women's cooperatives, *Limited product variety, customer reviews, and consumer access to women's cooperative products, *Insufficient product information, visual content, and storytelling, *The need to build consumer trust as a new brand, *Commission fees applied after reaching certain sales thresholds, *The large number of sellers and products available on the marketplace, *Insufficient financial resources for advertising and promotional activities.

positive public perception of women's cooperatives, *Facilitating access to international markets.			

5. Conclusion And Recommendations

This study comparatively examined digital marketplaces established by the private sector, public institutions, and international organizations for women's cooperatives in Türkiye. The findings show that these marketplaces differ not only in their commercial characteristics but also in the type of support they provide to women's cooperatives. Private-sector digital marketplaces offer wider market access and larger customer bases. However, limited visibility, intense competition, and insufficient digital competencies reduce the ability of women's cooperatives to fully benefit from these platforms. In contrast, marketplaces established by public institutions and international organizations provide broader support through training, financial assistance, and capacity-building activities, although their consumer reach remains relatively limited. The findings suggest that the successful participation of women's cooperatives in digital marketplaces depends not only on access to digital platforms but also on strengthening their digital and institutional capacities. Therefore, supporting digital literacy, branding, product standardization, and digital marketing skills, while enhancing cooperation among public institutions, international organizations, private-sector platforms, and women's cooperatives, will contribute to the sustainable digital transformation and competitiveness of women's cooperatives.

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THE INFLUENCE OF DIGITAL SOCIAL PROOF ON ONLINE PURCHASE DECISION

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Abstract

In conditions of intensive digitalization, consumers increasingly make purchasing decisions in environments characterized by limited direct interaction with products and increased uncertainty. In such contexts, online reviews and ratings represent an important source of information that shapes perceptions of product quality, reliability, and credibility. Digital social proof, expressed through consumer-generated evaluations and experiences, influences the way consumers evaluate products and reduce uncertainty in e-commerce environments. The objective of this paper is to examine the influence of digital social proof on online purchase decision-making, with particular focus on the mediating role of trust. The research analyzes review volume, review valence, and perceived review credibility as key dimensions of digital social proof and evaluates their relationship with trust and online purchase decision-making. Within the scope of this study, online purchase decision-making is interpreted as consumers' readiness to proceed with purchasing in a digital environment, rather than as direct observation of completed transactions. The study is based on a quantitative explanatory research approach using survey data collected from active online consumers. Empirical findings indicate that perceived credibility and positive valence of online reviews have the strongest influence on trust formation, while trust significantly influences consumers' readiness to proceed with online purchasing. The results also suggest that trust functions as an important mediating factor between digital social proof and online purchase decision-making. The paper provides additional insight into the role of consumer-generated content in shaping trust and purchasing behavior in contemporary digital commerce environments.

Keywords: Digital social proof, Online purchase decision, Trust, Online reviews, E-commerce.

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1. Introduction

The digital transformation of commerce has fundamentally changed how consumers make purchasing decisions. Unlike traditional retail, online shopping limits direct product evaluation, increasing uncertainty and perceived risk. Consequently, consumers increasingly rely on digital social proof, particularly online reviews, ratings, and other consumers' experiences, when evaluating products and services. According to social proof theory, individuals rely on others' behavior and opinions when making decisions under uncertainty (Cialdini, 2006). Applying signaling logic (Spence, 1973), online reviews serve as informational signals that reduce information asymmetry and help consumers assess product quality and reliability. Because these evaluations originate from consumers rather than sellers, they are often perceived as more credible. Shared through electronic word-of-mouth (e-WOM), they shape consumer trust and purchase intentions (Ismagilova et al., 2017). Trust therefore acts as a key mechanism enabling online purchasing (Mayer et al., 1995), with perceived risk moderating its influence on purchase decisions (Handoyo, 2024).

Recent studies show that review valence and perceived review credibility positively influence purchase intentions (Qiu & Zhang, 2024) and purchase decisions, while trust frequently serves as an important mediator (Sudaryanto et al., 2025; Andari et al., 2025). However, prior research has largely treated digital social proof as a single construct, leaving open whether its dimensions reach the purchase decision by the same route. To address this gap, this study integrates social proof theory, signaling theory, e-WOM, and trust theory into a single framework and decomposes the mediating role of trust dimension by dimension. It examines the relationships between review volume, review valence, perceived review credibility, trust, and online purchase decision, with particular emphasis on the mediating role of trust in digital purchasing environments.

2. Literature review

2.1 Digital social proof

The growth of digital platforms has transformed consumer decision-making, making online reviews and ratings one of the most influential forms of digital social proof. According to social proof theory, individuals evaluate their decisions by observing the attitudes and behavior of others (Cialdini, 2006). In e-commerce, products with numerous positive reviews are generally perceived as more reliable and trustworthy. In this study, digital social proof is operationalized through three dimensions: review volume, review valence, and perceived review credibility. Review volume reflects product popularity, review valence represents the positive or negative orientation of consumer evaluations, and perceived review

credibility refers to the extent to which reviews are considered trustworthy. Recent studies consistently identify review valence and perceived review credibility as key determinants of consumer behavior (Qiu & Zhang, 2024; Rachmiani et al., 2024).

2.2 Theoretical background

The conceptual framework integrates social proof theory, signaling theory, and electronic word-of-mouth (e-WOM). Social proof theory explains that consumers rely on others' experiences when making decisions under uncertainty (Cialdini, 2006), while signaling theory holds that observable cues reduce information asymmetry by signaling otherwise unobservable quality (Spence, 1973), a logic extended here to products. In online shopping, review volume, review valence, and ratings therefore function as quality signals that assist product evaluation. These signals are transmitted through e-WOM, which enables consumers to exchange experiences and opinions across digital platforms (Ismagilova et al., 2017). Together, these theories explain how consumer-generated information shapes perceptions of product quality, credibility, and purchasing decisions.

2.3 Trust and the online purchase decision

Trust plays a central role in online purchasing because consumers cannot directly evaluate products before purchase. It is defined as the willingness to accept vulnerability based on positive expectations about another party's behavior (Mayer et al., 1995). In e-commerce, trust significantly influences purchase decisions, with perceived risk moderating this relationship (Handoyo, 2024). Because online reviews support information search and evaluation (Kotler & Keller, 2012), trust is expected to mediate the relationship between digital social proof and online purchase decision, consistent with recent empirical evidence (Sudaryanto et al., 2025; Andari et al., 2025).

2.4 Hypothesis development

Based on the integrated theoretical framework, this study examines the direct relationships between digital social proof dimensions, trust, and online purchase decision, together with the mediating role of trust (Figure 1).

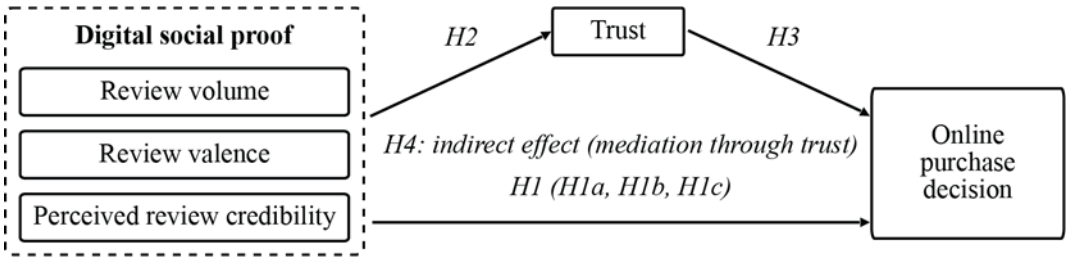


Figure 1. Conceptual research model

H1: Digital social proof has a statistically significant positive relationship with online purchase decision.

H1a: Review volume has a positive relationship with online purchase decision.

H1b: Review valence has a positive relationship with online purchase decision.

H1c: Perceived review credibility has a positive relationship with online purchase decision.

H2: Review volume, review valence, and perceived review credibility have positive relationships with trust.

H3: Trust has a positive relationship with online purchase decision.

H4: Trust mediates the relationship between digital social proof and online purchase decision.

3. Methodology

3.1 Research design

This study employed a quantitative, cross-sectional explanatory design to examine statistical relationships among digital social proof, trust, and online purchase decision (Creswell, 2009). The conceptual model integrates social proof theory, signaling theory, electronic word-of-mouth (e-WOM), and trust theory. Review volume, review valence, and perceived review credibility were specified as predictor variables, trust as the mediator, and online purchase decision as the dependent variable which captures behavioral readiness to finalize a transaction rather than observed purchases, and is interpreted as such throughout.

3.2 Sample and data collection

The target population comprised internet users in North Macedonia with previous online shopping experience. Data were collected through a structured online questionnaire distributed by e-mail to the customer contact database of an active online store, ensuring recent genuine purchasing experience. Of the 170 completed questionnaires, 16 failed the attention check and 4 met the predefined straight-lining criterion (identical responses across all 26 items), resulting in a final sample of 150 respondents. Participation was voluntary and anonymous, and the data were used solely for scientific research. Because the objective was theory testing rather than population estimation, nonprobability sampling was considered appropriate, although it limits generalizability (Hair et al., 2019).

3.3 Research instrument

The questionnaire comprised 26 items measuring five constructs: review volume (5 items), review valence (5), perceived review credibility (5), trust (6), and online purchase decision (5), using a five-point Likert scale (1 = strongly disagree; 5 = strongly agree). It also included demographic questions and one attention-check item. Construct scores were calculated as the mean of their items. For H4, digital social proof was the mean of the three review dimensions (α = 0.701), a composite index whose components are tested separately in Section 4.5.

3.4 Data analysis

Data were analyzed using IBM SPSS Statistics 32.0. Descriptive statistics and Cronbach's α assessed distribution and internal consistency. Construct validity was evaluated using Principal Axis Factoring with Promax (oblique) rotation.

Factors were retained using the Kaiser criterion and scree plot inspection. The factor structure was assessed through loadings, communalities, and secondary loadings. Discriminant validity was evaluated using HTMT ratios, while Harman's single-factor test assessed potential common method variance. Pearson correlations, multiple regression, and bootstrap mediation analysis with 5,000 resamples were used to test the hypotheses. A robustness analysis including demographic covariates was conducted ($p < 0.05$).

4. Results

4.1 Sample characteristics

The final analytical sample comprised 150 respondents with previous online shopping experience (Table 1). The largest age group was 25–34 years (34.0%), while 45.3% held a bachelor's degree.

Table 1. Demographic profile of the sample

Variable	Distribution
Gender	Male 78 (52.0%); Female 69 (46.0%); Prefer not to answer 3 (2.0%)
Age	18–24: 27 (18.0%); 25–34: 51 (34.0%); 35–44: 38 (25.3%); 45–54: 22 (14.7%); ≥55: 12 (8.0%)
Education	High school 30 (20.0%); Bachelor's 68 (45.3%); Master's 37 (24.7%); Doctoral 3 (2.0%); Other 12 (8.0%)

4.2 Measurement model assessment

Descriptive statistics indicated generally positive evaluations across all constructs (M = 3.697–4.099; Table 2). Internal consistency was high (Cronbach's α = 0.862–0.906), exceeding 0.70. KMO (0.922) and Bartlett's test, $\chi^2(325) = 2583.764$, $p < 0.001$, confirmed suitability for factor analysis. Five factors met the Kaiser criterion, with initial eigenvalues of 11.590, 2.164, 1.776, 1.473, and 1.159. Initial eigenvalues explained 69.854%, while the extracted PAF solution explained 62.735% of variance.

Principal Axis Factoring (PAF) with Promax (oblique) rotation supported the proposed five-factor structure. Primary loadings ranged from 0.575 to 0.884 and communalities from 0.530 to 0.741 (Table 3). No secondary loading exceeded 0.30, and every item loaded highest on its intended factor. The factor correlation matrix showed moderate positive inter-factor correlations (0.404–0.679), supporting the use of oblique rotation. HTMT ratios ranged from 0.426 to 0.793 and remained below 0.85. Harman's single-factor test did not indicate a dominant general factor, although common method variance cannot be fully excluded.

Table 2. Descriptive statistics and internal consistency

Construct	**M**	**SD**	**Skew.**	**Kurt.**	**Cronbach's α**
Review volume	3.797	0.700	−0.300	−0.391	0.862
Review valence	4.099	0.602	−0.374	−0.139	0.893
Perceived review credibility	3.875	0.813	−0.609	−0.055	0.886
Trust	3.697	0.706	−0.040	−0.532	0.901
Online purchase decision	3.999	0.601	−0.197	−0.323	0.906

Table 3. Summary of the rotated factor matrix

Construct	Items	Loading range	Communality range
Review volume	V1–V5	0.671–0.823	0.530–0.718
Review valence	VAL1–VAL5	0.697–0.884	0.597–0.685
Perceived review credibility	CR1–CR5	0.668–0.801	0.577–0.667
Trust	TR1–TR6	0.575–0.854	0.570–0.704
Online purchase decision	PD1–PD5	0.611–0.803	0.628–0.741

Note. Extraction: Principal Axis Factoring; rotation: Promax (oblique). Loading values are pattern-matrix coefficients, while communalities are rotation-invariant.

4.3 Relationships among constructs

Pearson correlation analysis demonstrated statistically significant positive relationships among all study constructs (Table 4). Trust showed the strongest correlation with online purchase decision ($r = 0.715$), followed by perceived review credibility ($r = 0.641$) and review valence ($r = 0.613$). Multiple regression analyses supported the proposed relationships (Table 5).

Perceived review credibility was the strongest predictor of trust and the strongest DSP predictor in the direct decision model. After trust was included, explained variance increased from 55.4% to 62.5% ($\Delta R^2 = 0.071$), and trust became the strongest predictor ($\beta = 0.379$). Valence ($\beta = 0.243$) and credibility ($\beta = 0.241$) had nearly identical effects, while review volume became nonsignificant ($\beta = 0.101$, $p = 0.098$). VIF values of 1.315–2.025 indicated no multicollinearity.

Table 4. Pearson correlation matrix

Construct	**1**	**2**	**3**	**4**	**5**
1. Review volume	1				
2. Review valence	0.374	1			
3. Perceived credibility	0.460	0.498	1		
4. Trust	0.515	0.559	0.613	1	
5. Online purchase decision	0.499	0.613	0.641	0.715	1

Note. All reported correlations are positive and statistically significant ($p < 0.001$).

Table 5. Multiple regression analysis

Model	Predictor	β	t	p	VIF
Model 1: Trust	Review volume	0.242	3.634	<0.001	1.315
	Review valence	0.291	4.263	<0.001	1.379
	Perceived review credibility	0.356	4.995	<0.001	1.504
	$R^2 = 0.506$; Adj. $R^2 = 0.496$; $F(3, 146) = 49.877$; $p < 0.001$				
Model 2: Purchase decision	Review volume	0.193	3.049	0.003	1.315
	Review valence	0.353	5.443	<0.001	1.379
	Perceived review credibility	0.376	5.551	<0.001	1.504
	$R^2 = 0.554$; Adj. $R^2 = 0.545$; $F(3, 146) = 60.476$; $p < 0.001$				
Model 3: Purchase decision (with trust)	Review volume	0.101	1.663	0.098	1.434
	Review valence	0.243	3.835	<0.001	1.551
	Perceived review credibility	0.241	3.573	<0.001	1.761
	Trust	0.379	5.243	<0.001	2.025
	$R^2 = 0.625$; Adj. $R^2 = 0.615$; $F(4, 145) = 60.460$; $\Delta R^2 = 0.071$; $\Delta F(1, 145) = 27.49$; $p < 0.001$				

Note. Standardized coefficients are reported.

4.4 Mediation analysis

Bootstrap mediation analysis with 5,000 resamples confirmed a significant indirect relationship between aggregate digital social proof and online purchase decision through trust (Table 6). The indirect effect was β = 0.276, 95% CI [0.162, 0.392], accounting for 37.6% of the total relationship. The direct effect remained significant, β = 0.459, 95% CI [0.316, 0.602], indicating partial statistical mediation. Given the cross-sectional design, these findings represent associations rather than causal effects.

Table 6. Bootstrap mediation analysis

Effect	β / effect	95% CI LL	95% CI UL	p / Conclusion
Total effect (c)	0.735	0.625	0.845	<0.001
Path a: DSP → Trust	0.710	0.595	0.824	<0.001

Effect	β / effect	95% CI LL	95% CI UL	p / Conclusion
Path b: Trust → Purchase decision	0.389	0.246	0.533	<0.001
Direct effect (c′)	0.459	0.316	0.602	<0.001
Indirect effect (a × b)	0.276	0.162	0.392	Significant

Note. Standardized coefficients are reported. The indirect-effect confidence interval is a percentile bootstrap interval based on 5,000 resamples; intervals for the total, direct, and path (a and b) effects are standard (normal-theory) confidence intervals. DSP = aggregate digital social proof score.

4.5 Dimension-specific indirect effects

Dimension-specific analyses showed significant indirect relationships between all three DSP dimensions and online purchase decision through trust (Table 7), while controlling for the other dimensions. Review volume had a significant indirect but nonsignificant direct effect, indicating an indirect-only statistical pattern. Review valence and perceived review credibility retained significant direct and indirect effects, indicating partial statistical mediation.

Table 7. Dimension-specific mediation effects controlling for the other DSP dimensions

Path	β	95% CI LL	95% CI UL	Conclusion
Indirect: Volume → Trust → Purchase decision	0.092	0.041	0.153	Significant
Indirect: Valence → Trust → Purchase decision	0.111	0.050	0.187	Significant
Indirect: Credibility → Trust → Purchase decision	0.135	0.068	0.216	Significant
Direct: Volume → Purchase decision	0.101	−0.019	0.222	Not significant
Direct: Valence → Purchase decision	0.243	0.118	0.368	Significant
Direct: Credibility → Purchase decision	0.241	0.108	0.374	Significant

Note. Standardized coefficients are reported. Indirect-effect intervals are percentile bootstrap intervals (5,000 resamples); direct-effect intervals are standard (normal-theory) intervals. Each analysis controlled for the other two DSP dimensions. Trust → Purchase decision: β = 0.379, 95% CI [0.236, 0.522].

4.6 Robustness and summary of hypothesis testing

Including gender, age, and education did not materially alter the direction, significance, or interpretation of the main relationships. With demographic covariates added, the model explained 63.6% of the variance in purchase decision ($R^2 = 0.636$) versus 62.5% ($R^2 = 0.625$) in the main model, and no demographic covariate was significant. The findings were therefore robust to demographic adjustment. Overall, digital social proof was positively associated with online purchase decision, while trust showed a significant relationship with decision and served as an important mediating mechanism. Hypothesis results are summarized in Table 8.

Table 8. Summary of hypothesis testing

Hypothesis	Statement	Conclusion
H1	Digital social proof (DSP) → online purchase decision	Supported
H1a	Review volume → online purchase decision	Partially supported
H1b	Review valence → online purchase decision	Supported
H1c	Perceived review credibility → online purchase decision	Supported
H2	DSP dimensions → trust	Supported
H3	Trust → online purchase decision	Supported
H4	Trust mediates DSP → decision	Supported (partial overall; indirect-only for review volume)

Note. Standardized coefficients are reported. H1 and H1a–H1c were evaluated in the direct model without trust. Review volume significantly predicted decision in this model ($\beta = 0.193$, $p = 0.003$), supporting H1a, but after trust was added, volume became nonsignificant ($\beta = 0.101$, $p = 0.098$), while its indirect effect remained significant. H4 was supported for aggregate DSP, with an indirect effect of $\beta = 0.276$, 95% CI [0.162, 0.392], indicating partial statistical mediation overall.

5. Discussion

The findings show that digital social proof is positively associated with online purchase decision, though its dimensions contribute unequally. Perceived review credibility was the strongest predictor, marginally ahead of review valence, whereas review volume became nonsignificant once trust was introduced. This is consistent with e-WOM literature highlighting volume among the weakest predictors of purchase intention and argument quality and valence among the

strongest (Ismagilova et al., 2017). The ordering of the two quality dimensions nonetheless departs from evidence identifying valence as the dominant antecedent (Qiu & Zhang, 2024). Trust showed a strong positive relationship with the decision, and the rise in explained variance from 55.4% to 62.5%, with significant bootstrap-mediated indirect effects, confirms its central role (Andari et al., 2025), converging with Sudaryanto et al. (2025), who likewise found that trust does not fully mediate this relationship.

Taken together, the dimensions of digital social proof appear to perform distinct functions. Review volume is a relatively low-diagnostic cue because it signals popularity without necessarily providing detailed product information. It predicted decision in the direct model but became nonsignificant after trust was included, suggesting that its contribution operates mainly through trust. Valence and credibility provide richer evaluative information and retained both direct and indirect relationships with decision.

Vendors should prioritize review credibility over volume. Verified-purchase labels, reviewer authentication, and transparent moderation matter more than review counts. This priority is grounded in the results: credibility showed stronger relationships with trust and purchase decision than volume, making credible review signals particularly important for vendors in emerging, trust-sensitive markets.

These findings should be read in light of the study's limitations. The cross-sectional, self-reported design does not support causal inference, and some common-method bias may remain despite the validity assessments. Although the sample of 150 was adequate for regression and mediation analysis, it was relatively modest for a 26-item factor analysis. Finally, the single-country sample limits generalizability.

6. Conclusion

This study integrated social proof theory, signaling theory, e-WOM, and trust theory into a framework linking digital social proof, trust, and online purchase decision. Review quality showed stronger direct relationships with decision than review quantity. Valence and perceived credibility were related to decision both directly and through trust. Review volume predicted decision in the direct model but became nonsignificant after trust and the other dimensions were included, while its indirect relationship remained significant. These findings suggest that different dimensions of digital social proof perform distinct roles in the consumer decision-making process, with review quality primarily reducing uncertainty and strengthening trust before influencing purchase readiness. Trust

therefore represents an important mechanism linking consumer-generated information with purchase readiness. For retailers in emerging, trust-sensitive markets, prioritizing review credibility over volume, via verification, moderation, and transparency, matters more than review volume alone. Future research should use longitudinal, cross-cultural, and behavioral designs, apply confirmatory factor analysis, and examine how AI-generated reviews affect perceived credibility and trust.

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STRATEGIES AND INITIATIVES TO REDUCE THE RISKS OF USING GENERATIVE ARTIFICIAL INTELLIGENCE SYSTEMS

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Abstract

This paper examines the implications of the increasing use of Generative Artificial Intelligence (GenAI) systems. The emergence and development over the past few years of numerous GenAI systems that answer questions, write code, compose documents, and create multimedia content has led to a deepening of human dependence on digital devices and a change in the way of thinking. Although generative artificial intelligence applications do not pose an immediate threat to human cognitive and social abilities, the passive and indiscriminate use of such algorithmic tools creates conditions for the weakening of key mental functions and the emergence of digital amnesia. The aim of the paper is to outline basic strategies for maintaining cognitive resilience and for developing new skills for critical, autonomous, and creative participation in the process of active, reflective, and purposeful use of GenAI systems, as well as to systematize various legislative initiatives to minimize human dependence on generative artificial intelligence applications.

Keywords: Generative Artificial Intelligence, GenAI Applications.

1. Introduction

Generative artifial intelligence (GenAI) systems have already changed the way people across generations work, think, feel, communicate, and perceive reality. The use of chatbots, virtual consultants, intelligent companions, and AI agents has become an important part of modern online habits for finding ways to quickly solve complex creative and business tasks with just a few clicks of the mouse. At the same time, however, this ease in solving complex cases that only a few years ago required extensive and in-depth research is leading to a gradual loss of critical thinking in people.

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As with any technology, how it is used determines the consequences of its application. The ethical creation and use of generative AI systems requires the transformation of traditional digital competencies into a new kind of literacy. Increasing the level of AI literacy enables critical analysis, effective interaction, and use of AI technologies without the need for knowledge to create one's own AI models (Chan & Colloton, 2024, p. 65).

The well-intentioned development and use of socio-technical systems with artificial intelligence is the responsibility of both their developers and administrative institutions, business organizations and civil society (Corrigan, Asakipaam, Kponyo, & Luetge, 2023, p. 8). Over the past year, concerns about the intensity of use of GenAI applications and the cognitive, social and emotional risks of interacting with them have been raised in various studies and research and have found a response in a number of legislative initiatives to limit access to digital technologies and platforms.

2. Strategies for Minimizing the Risks of Using Generative Artificial Intelligence Systems

Although generative artificial intelligence systems do not pose an immediate threat to people's cognitive, social, and emotional skills, the passive and indiscriminate use of such algorithmic tools creates conditions for the weakening of key mental functions and for the manifestation of processes of cognitive decline, social atrophy and decline in interpersonal communication, anthropomorphization of interaction with GenAI systems, and addiction to their use.

Scientific research by scientists from Oxford, MIT, UCLA and Carnegie Mellon University among 1,222 volunteers to solve mathematical reasoning and reading comprehension tasks independently or through GPT-5, for example, shows that even a brief interaction with an artificial intelligence within 15 minutes can reduce the motivation to think independently (Liu, Bakker, Christian, Dubey, & Dumbalska, 2026). According to the researchers, these results do not indicate a decrease in the intellectual abilities of the participants in the experiment, but a decrease in motivation: when the large language model provides instant solutions, the human brain begins to perceive its own thinking as "unnecessary" or "uncomfortable."

Gallup and Walton Family Foundation study among 2,500 people from Generation Z in the US shows that although 74% of them regularly use chatbots to solve life and study tasks, 79% of respondents express concerns that their use leads to the development of laziness in their thinking, and 65% believe that the momentary satisfaction of an immediately returned solution to a problem does not contribute to its deep understanding (Lira, Folk, Ungar, & Duckworth, 2026).

The following strategies can be used to minimize the risks of using generative AI systems:

1) Preliminary independent formulation of hypotheses, interpretations or solutions, which can subsequently be subjected to verification by GenAI systems acting as critical validators, not as substitutes for the thought process.

2) Using active self-learning strategies that support the formation of long-term knowledge - taking notes, solving tasks independently before consulting artificial intelligence tools, using test questions, flashcards, etc.

3) Self-regulation of learning in online courses for general and professional development through the use of chatbot tools with programmed ethical safeguards to examine behavior and learning outcomes (Hamonic & Sharrock, 2025, p. 258).

4) Conceptual generation of creative ideas without initial algorithmic intervention and subsequent use of generative applications to further develop, structure or edit the content.

5) Restoring and maintaining the ability to cognitively concentrate through practices of purposefully slowing down the pace of work, refusing to use automatically generated text summaries, and setting aside time to independently deal with complex information tasks.

6) Maintaining the autonomy of human thinking, creating unique, biographically and emotionally conditioned associations that cannot be replicated by probabilistic models, and consciously managing the interaction with artificial intelligence technologies.

7) Seeking balance in communication with GenAI systems by asking precise instructions and moderately polite questions with a clear awareness of the psychological mechanisms[3] built into them for purposeful retention of the user in communication.

3. Initiatives to Limit Dependence on Generative Artificial Intelligence Systems

Recognition of the risks of "digital zombification" and brainwashing of young people from a number of countries around the world has led to the launch of legislative initiatives to regulate excessive smartphone[4] and social media use, to address alienation, to combat depression and sleep problems, and to build basic work habits.

Currently, **there is no specific law** that directly limits dependence on generative artificial intelligence applications, but there are several legislative initiatives that indirectly aim to reduce the risks of addiction, overuse, emotional manipulation, and dependence on the algorithms in them.

[3] Modern chatbot programs, programmed using the Reinforcement Learning from Human Feedback technique (Human-centered AI: An illustrated scientific quest, 2025) , exhibit servile, reflexive, and even morally responsible behavior. A comparison of the propensity of various major language models to take “moral initiatives” to report ethical violations of users to authorities can be found on the website of developer Theo Brown (*https://snitchbench.t3.gg/*), creator of SnitchBench - a software framework for testing the degree of implemented support for generally accepted moral principles in popular artificial intelligence models.

[4] At the end of May 2026, for example, former Health Secretary Alan Milburn warned that "Britain is facing economic disaster and risks losing an entire generation if it does not wean young people off smartphones" **(SkyNews , 2026)** .

The AI Act is the first global legal framework for regulating artificial intelligence systems that introduces mechanisms to limit the ability of GenAI applications to create addictive behaviors. The European Union document (European Union, 2024) prohibits the creation, distribution and use of manipulative techniques and algorithms that significantly distort user behavior and encourage excessive use of generative programs.

The United Kingdom is introducing regulation (**Online Safety Act**) on algorithmic recommendations that can cause addiction in children and is drafting rules on AI transparency and limiting "behavioral profiling" (United Kingdom Government, 2023).

During the previous US president's term, the White House issued **an Executive Order on AI** - a set of standards for developing safe, secure, and trustworthy artificial intelligence that protects the privacy of Americans (The White House, 2023) and **an AI Bill of Rights** - a non-binding framework to guide the safe, equitable, and rights-respecting design and deployment of automated systems in the United States (White House, 2022). The documents establish key principles for the development and deployment of artificial intelligence systems with built-in mechanisms to protect against manipulative algorithms, systemic opacity, and harmful behavioral influence. The states of California and New York have bills to restrict algorithms that create digital addictions (especially on social networks).

China has introduced several regulations on recommendation algorithms and GenAI systems. **Regulations on the Administration of Algorithmic Recommendation in Internet Information Services** (Cyberspace Administration of China, 2022) give users real control over recommendation systems by requiring mainstream platforms to provide an option to opt out of personalized recommendations. **Provisions on the Administration of Deep Synthesis Internet Information Services** (Cyberspace Administration of China, 2022) impose restrictions on algorithms that create "feed" addiction in users (infinite scrolling, highly personalized information flows). **Interim Measures for the Management of Generative Artificial Intelligence Services** (Cyberspace Administration of China, 2023) introduce strict controls on GenAI services, including registration, censorship, and monitoring.

The first Bulgarian legislative initiative to directly address the dependence on algorithms and GenAI systems is **the Draft Law on the Use and Development of Artificial Intelligence** (Draft Law on the Use and Development of Artificial Intelligence, 2025). The document includes measures against digital addiction, assessment of aggressive algorithms for recommending content on social networks, a ban on training language models with children's personal data, a ban on the use of AI for recommending content by online gambling operators, and transparency of content recommendation algorithms.

A comparison of several key criteria of the listed regulatory **initiatives** in different jurisdictions around the world is given in Table 1 below:

Table 1. Comparative table of key regulations for GenAI systems in different global jurisdictions

Jurisdiction	Type of influence on a	Mechanisms	Transparency of built-

	specific addiction or behavior	included to protect children or vulnerable groups	in content generation algorithms
EU	Indirectly prohibiting manipulative techniques, directly prohibiting high-risk systems	Yes – protection for use in education and social services	Yes – mandatory transparency and labeling of GenAI content
United Kingdom	Directly restricts harmful and addictive content	Yes – strong focus on online child safety	Yes – requirements for algorithmic recommendation platforms
USA	Indirectly protecting consumers from manipulative and opaque systems	Partially – through principles of fairness and non-discrimination	Yes – right to explainability and control over automated systems
China	Direct ability to exclude recommendations and limit feed dependencies	Yes – restrictions on the type and time of access to online content	Yes – mandatory registration and control of algorithms
Bulgaria	Indirectly protecting users from addictive recommendations, gambling, and risky digital practices	Yes – special focus on children and personal data	Yes – transparency requirements for recommendation algorithms

The above-mentioned and subsequent legislative initiatives alone would have no effect if the risks of addiction to generative AI systems were not recognized by individuals. Self-regulation of digital habits for useful and safe consumption of online content requires building and training sustainable behavioral habits and techniques for interacting with the intrusive and addictive algorithms of generative AI programs. Awareness of the supporting, but not replacing, role of AI applications would lead to the development of new skills for critical, autonomous and creative interaction with them.

4. Conclusion

Using software to create text content, get financial advice, read medical documents, “chat” with virtual companions, etc. has become an integral part of the online habits of people of different generations. The behavioral sustainability of generative content users can be maintained through active, reflective and purposeful use of GenAI systems, where thinking remains the leading mechanism, not the technology.

Despite aggressive attempts by technology companies to push GenAI applications as the “inevitable future” people are already facing the contradiction between promises of efficiency and warnings of massive job losses and are starting to react with growing skepticism and even a certain amount of hostility towards them. So far, there is no country or law that explicitly prohibits or limits reliance on generative AI, but a number of legislative initiatives have been launched to control high-risk artificial intelligence systems, shed light on generative algorithms, prohibit manipulative techniques, protect children, limit

gambling and risky recommendations, and introduce ethical standards for GenAI applications.

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BULGARIA'S TRADE IN AGRICULTURAL PRODUCTS: CHALLENGES, OPPORTUNITIES AND DEVELOPMENT PROSPECTS

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Abstract

In Bulgaria, agriculture remains one of the key sectors ensuring food security and economic stability in the context of global economic, political and climatic changes both on the international and domestic markets. Trade in agricultural products has specific characteristics that distinguish it from trade in industrial and consumer goods, such as dependence on natural and climatic conditions, seasonality of production, price fluctuations and high requirements for the quality and safety of products. In a dynamic market environment, the agricultural sector faces a number of challenges related to increasing competitiveness, adapting to climate change, implementing European environmental standards and integrating digital technologies into production and trade processes. At the same time, new opportunities for development are opening up through the implementation of innovations, smart solutions, precision farming systems, sustainable resource management and expanding access to international markets.

The aim of the study is to analyze the state and development of Bulgaria's trade in agricultural products, identifying the main challenges facing the sector, the opportunities for increasing its competitiveness and the prospects for sustainable development in the context of European integration and global economic processes.

Bulgarian agriculture and the market realization of its products have significant development potential, supported by the Common Agricultural Policy of the European Union, digitalization processes and the growing demand for quality and sustainably produced food. Realizing this potential requires targeted policies to modernize the sector, improve infrastructure, encourage innovation and strengthen the export orientation of Bulgarian producers.

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1. Introduction

The agricultural sector is strategic for the Bulgarian economy, contributing significantly to foreign trade, food security, and regional development. In the context of globalization, climate change, digital transformation, and growing competition, international trade in agricultural products is becoming increasingly important for sustainable economic development.

Foreign trade is a key factor for the competitiveness of the agricultural sector. Since Bulgaria's accession to the European Union in 2007, producers have gained free access to the single European market, resulting in substantial changes in the structure, volume, and geographical orientation of agricultural trade (European Commission, 2024a). Agriculture remains an important source of raw materials for the food industry, employment in rural areas, and export revenues.

In recent years, agricultural trade has been shaped by the COVID-19 pandemic, supply chain disruptions, the war in Ukraine, inflation, climate change, and the accelerated adoption of digital technologies (OECD and FAO, 2024). At the same time, the European Green Deal, the Farm to Fork Strategy, and the reforms of the Common Agricultural Policy have introduced new requirements related to sustainability, traceability, and digitalization (European Commission, 2024b).

Despite favorable natural conditions and established traditions in cereal, oilseed, fruit, and vegetable production, Bulgarian agricultural exports remain dominated by unprocessed raw materials with low added value. This constrains income growth, employment, and international competitiveness while maintaining dependence on imports of processed food products (Ministry of Agriculture and Food, 2024a).

The article aims to analyze the development of Bulgaria's foreign trade in agricultural products by identifying the main factors, challenges, and opportunities for enhancing the sector's competitiveness in the context of digital transformation.

To achieve this objective, the study:

- examines the dynamics and structure of Bulgarian agricultural trade;
- assesses the impact of digitalization and European policies on sector competitiveness, including the role of B2B platforms, blockchain technologies, and precision agriculture;
- formulates recommendations for the sustainable development and international competitiveness of Bulgarian agricultural products.

The empirical analysis is based on official data from the Ministry of Agriculture and Food, the National Statistical Institute, Eurostat, FAOSTAT, OECD, and the European Commission for the period 2019–2024. This period encompasses major events affecting international trade, including the COVID-19 pandemic, supply chain disruptions, the energy crisis, the war in Ukraine, the 2023 - 2027 reform of the Common Agricultural Policy, and the accelerated digitalization of agriculture, enabling an assessment of the adaptability of Bulgaria's foreign agricultural trade to a changing international environment.

2. Literature Review and Theoretical Framework

International trade in agricultural products plays a key role in resource allocation, food security, and economic growth. Its theoretical foundations were established by Adam Smith and David Ricardo through the concepts of absolute and comparative advantage, later expanded by the Heckscher - Ohlin theory, which emphasizes factor endowments as determinants of trade flows (Krugman, Obstfeld, & Melitz, 2018).

Agricultural trade has specific characteristics resulting from the dependence of production on natural and climatic conditions, seasonality, biological processes, sanitary and phytosanitary regulations, and government support. These factors increase market volatility and sensitivity to economic, political, and climatic changes (OECD, 2024).

Contemporary research argues that agricultural competitiveness depends not only on production costs and natural resources but also on value addition, innovation, digitalization, sustainable resource management, and integration into value chains (Porter, 1990; European Commission, 2024b). Competitiveness is therefore viewed as the ability to sustain competitive advantages through higher productivity, technological progress, and efficient resource use (Porter, 1990), requiring modernization of processing, logistics, digital technologies, and marketing channels.

Following Bulgaria's accession to the European Union, agricultural development has been shaped by the Common Agricultural Policy (CAP), whose direct payments, rural development measures, and market interventions have influenced production patterns, farm incomes, and competitiveness (European Commission, 2024b). Although the CAP has supported modernization, assistance remains concentrated in cereals and oilseeds, while fruit, vegetable, and livestock production continue to face structural challenges (Ivanov, 2021). Despite sustained export growth, Bulgarian agricultural exports remain dominated by unprocessed raw materials, limiting value creation and economic efficiency (Ivanov, 2021; Ministry of Agriculture and Food, 2024).

Recent studies also reveal significant structural imbalances within Bulgarian agriculture. Intensive subsectors, including fruit, vegetable, and livestock production, experience technological deficiencies, high climate vulnerability, and weak market integration, whereas grain production is comparatively advanced (Ivanov, Todorova, & Popova, 2026). Unstable

contractual relations further discourage innovation and increase transaction costs (Bashev, 2026), while the existing digital divide limits the adoption of advanced technologies by small farms (Penchev, 2025; Kyosova, 2025).

Digitalization has become a major driver of agricultural competitiveness. The concept of Agriculture 4.0 encompasses e-commerce, precision agriculture, the Internet of Things (IoT), artificial intelligence, blockchain, and big data analytics, with potential benefits for traceability, logistics, market access, and production efficiency (OECD & FAO, 2024). Digital platforms can improve access to market information, strengthen connections between producers and buyers, and reduce transaction costs along agricultural value chains (World Bank, 2024). Blockchain-based traceability can increase transparency and consumer trust and may create economic benefits where consumers value verifiable information about product origin and production practices (Fiore et al., 2024). Artificial intelligence and predictive analytics are increasingly used to improve demand forecasting and decision-making in agri-food supply chains (Veliz Guzman et al., 2025).

According to the European Commission (2024b), the future competitiveness of European agriculture will depend on the interaction between digitalization, environmental transformation, and sustainable agri-food systems. Consequently, competitiveness should be evaluated not only through price advantages but also through innovation capacity, environmental performance, and the ability to generate higher value-added products.

The literature indicates that previous studies have mainly examined foreign trade, competitiveness, the Common Agricultural Policy, and digitalization separately. However, comprehensive analyses integrating trade dynamics, recent geopolitical and economic shocks, digital transformation, and value creation in Bulgarian agricultural exports remain limited. This study addresses this gap by analyzing Bulgaria's agricultural foreign trade during 2019 - 2024 through an integrated assessment of trade trends, digitalization, and European policies, and by proposing recommendations to increase value added, diversify export markets, and strengthen the use of CAP instruments in the context of digital and green transformation.

3. Results and Discussion

3.1. Structure and Dynamics of Foreign Trade in Agricultural Products

Foreign trade in agricultural products is one of the most dynamic segments of the Bulgarian economy. Analysis of official data from the Ministry of Agriculture and Food indicates that during 2019–2024 agricultural trade developed under major external shocks, including the COVID-19 pandemic, supply chain disruptions, the energy crisis, and the war in Ukraine. Despite these challenges, Bulgaria maintained a positive agricultural trade balance, with exports consistently exceeding imports throughout the period (Ministry of Agriculture and Food, 2025).

Global crises significantly affected agricultural trade. The COVID-19 pandemic disrupted logistics and increased transport costs, while the war in Ukraine intensified volatility in global grain, vegetable oil, fertilizer, and energy markets (FAO, 2024b). For Bulgaria, these developments created both opportunities, through higher export prices, and risks, due to rising production costs and greater uncertainty for agricultural producers.

The European Union remained Bulgaria's principal trading partner, accounting for more than half of agricultural exports and nearly three quarters of agricultural imports (Ministry of Agriculture and Food, 2025). This demonstrates the strong integration of Bulgarian agriculture into the Single European Market, while also highlighting its dependence on EU regulations, market conditions, and pricing mechanisms.

Trade values fluctuated considerably during the analyzed period because of changes in international commodity prices and climatic conditions affecting production. The sharpest increase occurred in 2022, followed by partial stabilization in 2023 - 2024 (OECD & FAO, 2024). Consequently, higher export values did not necessarily reflect increased export volumes but were largely driven by price dynamics.

Bulgarian agricultural exports continue to be dominated by primary commodities, particularly cereals (wheat, maize, and barley), oilseeds (sunflower and rapeseed), and vegetable oils, reflecting favorable natural conditions and the competitiveness of grain production (Ministry of Agriculture and Food, 2025). Bulgaria also maintains competitive positions in exports of essential oil crops, essential oils, wine, and selected processed food products.

Despite export growth, the export structure remains concentrated in low-value-added raw materials. As a result, much of the value generated through processing, branding, and marketing is created outside Bulgaria, limiting productivity growth, income generation, and the international competitiveness of the agri-food sector (European Commission, 2024a).

These findings support previous research demonstrating that agricultural competitiveness depends not only on natural resources and production costs but increasingly on processing, technological innovation, and integration into value chains (Porter, 1990; European Commission, 2024b). Strengthening Bulgaria's international competitiveness therefore requires expanding the production and export of higher value-added products through greater investment in food processing, digitalization of agri-food supply chains, and diversification of export markets beyond traditional destinations.

3.2. Geographical structure of trade in agricultural products

The geographical structure of agricultural trade reflects the degree of integration of the national economy into international markets and the sustainability of its export potential. Analyzing trade patterns provides insight into both the concentration of trade flows and opportunities for market diversification.

Since Bulgaria's accession to the European Union, the Single European Market has become the main destination for agricultural trade. In 2024, 53.8% of

agricultural exports were directed to EU Member States, while 71.4% of agricultural imports originated from the EU. Bulgaria's principal trading partners include Greece, Romania, Germany, Turkey, Spain, Italy, the Netherlands, and France. These figures demonstrate the strong integration of Bulgarian agriculture into the European market, while also highlighting its dependence on EU economic conditions and regulatory frameworks.

At the same time, nearly half of Bulgaria's agricultural exports are destined for markets outside the European Union, particularly the Middle East, North Africa, and the Balkans, where cereals, sunflower, and vegetable oils dominate exports. Although this broadens export opportunities, the concentration of trade in a limited number of markets increases vulnerability to geopolitical tensions, trade policy changes, and international price volatility.

The international environment during 2020 - 2024 - including the COVID-19 pandemic, supply chain disruptions, the war in the Black Sea region, rising transport costs, and inflation - substantially affected the geographical structure of agricultural trade. Nevertheless, Bulgaria largely maintained its positions in key foreign markets, indicating a relatively high degree of adaptability.

As shown in Table 1, agricultural exports increased by approximately 73% between 2020 and 2022, reaching EUR 8.27 billion. During 2023 - 2024, however, both exports and the trade surplus declined. In 2024, exports and imports were almost equal, reducing the positive trade balance to only EUR 2.2 million. This trend signals a weakening of Bulgaria's traditionally strong export position and highlights its dependence on international price fluctuations and the predominance of low-value-added exports.

These findings support Ivanov's (2021) conclusion that Bulgaria maintains comparative advantages in exporting primary agricultural commodities but remains less competitive in higher value-added products. They are also consistent with broader European trends, where competitiveness increasingly depends on processing, innovation, and digitalization rather than price advantages alone. Accordingly, future development should prioritize higher value-added agri-food exports, diversification of export markets, and wider adoption of digital technologies in production and logistics.

Table 1. Bulgaria's foreign trade in agricultural products during the period 2020–2024 (thousand euros)

Year	Exports	Imports	Trade turnover	Trade balance
2020	4,786,052	3,998,783	8,784,835	787,269
2021	6,041,007	4,418,463	10,459,470	1,622,544
2022	8,269,923	6,668,884	14,938,807	1,601,039
2023	7,941,122	6,201,085	14,142,207	1,740,037
2024	6,739,500	6,737,329	13,476,829	2,171

Source: Ministry of Agriculture and Food (2025), based on data from the National Statistical Institute (NSI).

The data in Table 1 indicate two distinct stages in Bulgaria's agricultural foreign trade during 2020 - 2024. The first (2020 - 2022) was marked by rapid export growth, reaching EUR 8.27 billion in 2022 - approximately 73% above the 2020 level - driven by favorable international prices and the surge in cereal and oilseed prices following the outbreak of the war in Ukraine. The second stage (2023 - 2024) saw declining export values due to the normalization of global prices, weaker harvests, and softer external demand. Consequently, the positive trade balance fell sharply, reaching only EUR 2.2 million in 2024, the lowest level of the analyzed period.

The trade structure remains dominated by exports of primary agricultural commodities, particularly wheat, sunflower, and maize. While these products sustain a positive trade balance, they generate limited added value and increase dependence on commodity price fluctuations and climatic conditions. At the same time, imports of processed food products continue to rise, reflecting the limited development of Bulgaria's food-processing industry and the underutilization of domestic processing capacity.

These findings support the conclusions of Ivanov (2021) and the European Commission that Bulgaria's comparative advantage remains concentrated in primary agricultural production, whereas higher value-added production is still underdeveloped. (Ivanov, 2021; European Commission, 2024a) Strengthening long-term competitiveness therefore requires structural transformation through greater investment in food processing, digitalization of production and logistics, traceability technologies, and export market diversification.

Overall, although Bulgaria maintained a positive agricultural trade balance during most of the analyzed period, the current export model has reached its structural limits. The heavy reliance on raw material exports has increased vulnerability to international price fluctuations, as illustrated by the sharp decline in the trade surplus in 2024. Future competitiveness will therefore depend less on expanding export volumes than on increasing the technological, innovative, and market value of agricultural products through processing, digital transformation, and sustainable agri-food value chains.

4. Challenges, opportunities and prospects for the development of foreign trade in agricultural products

The development of foreign trade in agricultural products is taking place in the context of accelerated economic, technological and geopolitical changes that are transforming international agri-food markets. Increased competition, digital transformation, climate change and new regulatory requirements are changing the factors determining the competitiveness of national agrarian economies. In this context, Bulgaria’s ability to increase the share of high value-added products depends on successfully overcoming a number of structural constraints and effectively using emerging opportunities (European Commission, 2024b).

4.1. Main challenges

A major structural challenge for Bulgarian agricultural trade is the continued dominance of unprocessed agricultural exports. This limits domestic value creation and increases dependence on international commodity prices and climatic conditions. At the same time, Bulgaria remains a net importer of processed food products, reflecting the insufficient development of its food-processing industry (Ministry of Agriculture and Food, 2024a).

Another significant challenge is the high concentration of trade within the European Union. While the Single European Market provides stable market access, it also increases producers' exposure to changes in demand, regulatory requirements, and competitive pressure from other Member States (European Commission, 2024c).

Climate change further intensifies production risks through more frequent droughts, extreme precipitation, and temperature anomalies, reducing production stability and complicating long-term export planning (FAO, 2024b). In parallel, the European Green Deal and the Farm to Fork Strategy require substantial investments in environmentally sustainable production technologies.

The uneven adoption of digital technologies also constrains sectoral competitiveness. Small and medium-sized enterprises often face limited access to investment capital, shortages of qualified personnel, and inadequate digital infrastructure (OECD, 2024). These challenges are reinforced by complex administrative procedures, extensive regulatory requirements, and an unstable international logistics environment, reducing the sector's capacity to adapt to changing market conditions.

4.2. Development opportunities

Despite the identified challenges, Bulgarian agribusiness has considerable potential to strengthen its international competitiveness.

Digital transformation offers significant opportunities to improve productivity, optimize resource use, and reduce production costs. The adoption of precision agriculture, the Internet of Things (IoT), artificial intelligence, and big data analytics can enhance production efficiency, risk management, and export planning (OECD & FAO, 2024).

Blockchain technologies represent another promising area by improving product traceability, increasing consumer confidence, and facilitating access to markets with stringent quality and food safety requirements (European Commission, 2024c; Schrobback et al., 2023).

Further opportunities lie in diversifying export destinations, particularly by expanding the presence of Bulgarian agricultural products in the Middle East, North Africa, and Asia. Such diversification would reduce dependence on traditional markets and improve the resilience of foreign trade.

Equally important is the development of the food-processing industry, which would increase exports of higher value-added products, including dairy and meat products, processed fruit and vegetables, wine, essential oils, and products with protected geographical indications.
Finally, investments in logistics infrastructure, regional distribution centers, and digital trade platforms can improve the efficiency of export supply chains and further enhance the international competitiveness of Bulgarian producers.

4.3. Prospects

The findings indicate that the future development of Bulgaria's agricultural foreign trade depends on transitioning from a raw material export model to one based on higher value-added products. This requires accelerated digitalization of agricultural holdings, modernization of the food-processing industry, intelligent logistics systems, and stronger cooperation between research institutions, businesses, and public authorities.
In line with European sustainability policies, strategic priorities include investment in research and development, innovation, the circular economy, and the expansion of Bulgarian agricultural products into new international markets (European Commission, 2024). Achieving these objectives requires consistent public policies, effective use of European Union financial instruments, and active business participation in technological modernization. Under these conditions, agricultural foreign trade can become a key driver of productivity, innovation, and the long-term competitiveness of the Bulgarian agri-food sector, while continuing to generate export revenues.

5. Conclusion

The findings confirm that foreign trade in agricultural products remains a strategic driver of the Bulgarian economy and an important source of competitiveness within the European Union. Despite the adverse effects of the COVID-19 pandemic, supply chain disruptions, the energy crisis, and geopolitical instability, Bulgaria has maintained its position as a net exporter of several agricultural products. However, the sustainability of this performance is constrained by the dominance of unprocessed raw materials in the export structure and the sector's high dependence on international price fluctuations.

The study confirms that future growth in agricultural foreign trade should rely not on expanding export volumes alone but on strengthening technological, innovative, and product competitiveness. In this context, digitalization, the development of the food-processing industry, the adoption of smart technologies, and the diversification of export markets are essential for increasing value added and strengthening Bulgaria's integration into international agri-food value chains (OECD, 2024; European Commission, 2024b).
Overall, the long-term competitiveness of Bulgarian agricultural foreign trade will depend on the successful transition from a raw material export model to one based on innovation, digitalization, higher value-added production, and sustainable

resource management. Such a transformation would strengthen the competitiveness of the Bulgarian agri-food sector, increase its contribution to the national economy, and reinforce Bulgaria's position in international markets.

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REGIONAL READINESS FOR THE AGENT ECONOMY: An ASSESSMENT OF TURKISH PROVINCES

Bige Küçükefe[1]

Abstract

The rise of autonomous AI agents systems capable of performing decision-making, coordination, and transactional tasks with limited human intervention is reshaping economic activity and giving rise to what is increasingly termed the Agent Economy. As this transformation unfolds, regions are likely to differ substantially in the structural conditions that enable participation in agent-driven economic processes. However, no indicator currently exists that directly measures AI-agent adoption at the sub-national level, particularly in the Turkish context.

This study addresses that gap by constructing a Digital and Innovation Readiness Index, intended as a proxy for the structural preconditions of the emerging Agent Economy across Türkiye's 81 provinces. Drawing on publicly available provincial data, the index integrates four dimensions consistently associated in the literature with digital and technological transformation capacity: digital connectivity infrastructure, human capital, innovation capacity, and economic ecosystem strength. Indicators are normalized and aggregated to produce a composite provincial score, allowing for a comparative assessment of relative structural readiness rather than a direct measurement of AI-agent adoption itself.

The findings reveal substantial regional disparities, with a small number of metropolitan provinces concentrating the majority of digital and innovation capacity, while many provinces exhibit uneven profiles strong in one dimension but weak in others. These asymmetries suggest that regional gaps in the future Agent Economy are unlikely to follow a simple core-periphery pattern, but rather reflect dimension-specific structural deficits.

The study contributes to the emerging discussion on AI-driven economic transformation by offering the first province-level composite assessment of its structural preconditions in Türkiye. It explicitly frames its findings as indicative of structural readiness rather than causal or behavioral evidence of AI-agent adoption, and discusses policy implications for reducing regional disparities in digital and innovation capacity as a foundation for more equitable participation in agent-driven economic change.

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1. Introduction

Artificial intelligence (AI) has entered a new stage of development with the rapid emergence of autonomous AI agents capable of perceiving information, reasoning, planning, and executing complex tasks with limited human intervention. Unlike conventional AI systems that primarily assist users by generating predictions or content, AI agents can independently coordinate workflows, interact with digital environments, utilize external tools, and make sequential decisions toward predefined objectives. This transition from generative AI to agentic AI is expected to reshape production systems, business processes, public administration, and regional economic structures, giving rise to what is increasingly referred to as the Agent Economy. Recent studies argue that AI agents should be viewed not merely as productivity-enhancing technologies but as autonomous economic actors capable of participating in increasingly complex digital ecosystems.

The economic implications of this transformation extend well beyond firm-level productivity gains. International organizations increasingly emphasize that the benefits of AI adoption will be distributed unevenly across countries and regions because technological transformation depends heavily on existing structural conditions such as digital infrastructure, human capital, innovation capacity, and institutional readiness. Cerutti et al. (2025) argue that AI is likely to widen existing productivity and income gaps unless countries possess the complementary capabilities required to absorb AI technologies effectively. Similarly, the OECD highlights that the geography of generative AI is highly uneven, with metropolitan regions generally exhibiting greater readiness due to stronger innovation ecosystems, higher-skilled labor markets, and superior digital connectivity.

These observations suggest that the future distribution of the Agent Economy will not depend solely on technological innovation itself but also on the spatial distribution of structural capabilities that enable AI adoption. Regions with advanced digital infrastructure, strong universities, innovative firms, and diversified industrial ecosystems are expected to adopt autonomous AI technologies more rapidly than regions lacking these complementary assets. Consequently, understanding regional readiness has become an important policy issue for governments seeking to reduce territorial inequalities and promote inclusive digital transformation.

Despite growing international interest, measuring readiness for AI-driven economic transformation remains challenging. Existing international indices,

including the Oxford Government AI Readiness Index, the IMF AI Preparedness Index, the Stanford AI Index, and several other global benchmarking initiatives, primarily evaluate AI readiness at the national level. These frameworks generally focus on institutional quality, digital infrastructure, innovation systems, regulatory capacity, and human capital, providing valuable cross-country comparisons for policymakers. However, they offer limited insight into regional disparities within individual countries and therefore cannot identify sub-national strengths and weaknesses that influence the diffusion of AI technologies. Recent OECD assessments similarly acknowledge that internationally comparable AI indicators remain scarce, particularly below the national scale, while emphasizing the importance of place-based analysis for understanding the geography of AI adoption.

Turkiye has experienced substantial improvements in digital infrastructure, higher education, industrial production, and innovation performance over the past two decades. Nevertheless, significant regional disparities persist across provinces in terms of technological capability, research capacity, industrial specialization, and digital connectivity.

This study addresses this gap by constructing a province-level AI Agent Readiness Proxy Index covering all 81 Turkish provinces. The proposed index evaluates the structural preconditions that are consistently associated with successful digital transformation. Following the conceptual framework presented in this study, the composite index integrates four complementary dimensions: Digital Infrastructure, Human Capital, Innovation Capacity, and Economic Ecosystem. Sixteen publicly available indicators are normalized and aggregated into a composite measure that captures relative structural readiness rather than observed adoption behavior. This approach is explicitly consistent with the study's objective of assessing enabling conditions rather than predicting or measuring AI deployment directly.

The study makes several contributions to the emerging literature on AI and regional development. First, it provides, to the best of our knowledge, the first province-level composite assessment of structural readiness for the Agent Economy in Türkiye. Second, it extends existing national AI readiness frameworks to the regional scale by operationalizing structural readiness through publicly available provincial indicators. Third, beyond producing a single composite ranking, the index decomposes readiness into four interpretable dimensions, enabling policymakers to identify strengths of the provinces and structural bottlenecks. Finally, the study evaluates the robustness of the proposed index through alternative weighting schemes based on principal component analysis, demonstrating that the empirical findings remain highly stable under different aggregation assumptions.

Overall, the paper argues that the future geography of the Agent Economy is likely to reflect existing regional inequalities in digital and innovation capacity unless proactive, regional policies strengthen the structural foundations necessary for AI adoption. By providing the first systematic provincial assessment of these preconditions in Türkiye, the proposed index offers both an empirical benchmark for future research and a practical tool for evidence based regional policy in the age of autonomous artificial intelligence.

2. Conceptual Framework and Literature Review

2.1. Agent Economy and AI Agents

Recent experimental studies demonstrate that generative agents can exhibit believable social behavior, long term memory, and autonomous planning in simulated environments (Park et al., 2023). This evidence suggests that AI agents are evolving beyond automation toward increasingly autonomous digital actors.

The rapid advancement of artificial intelligence (AI) has fundamentally transformed its role from a decision support technology into an increasingly autonomous economic actor. While earlier generations of AI primarily focused on prediction, classification, and content generation, recent advances in large language models (LLMs), multimodal foundation models, and tool using architectures have enabled the emergence of AI agents capable of perceiving their environment, reasoning, planning, interacting with external systems, and executing complex sequences of actions with limited human intervention. Unlike conventional AI applications that respond to isolated user prompts, modern AI agents integrate language understanding, memory, planning algorithms, retrieval systems, application programming interfaces (APIs), and adaptive feedback mechanisms to pursue long term objectives autonomously. These capabilities allow agents to decompose complex tasks, revise execution strategies, collaborate with other agents, and directly interact with digital environments, making them increasingly comparable to autonomous knowledge workers rather than traditional software applications. This technological evolution has given rise to the concept of the Agent Economy, an emerging economic paradigm in which autonomous AI systems actively participate in production, coordination, service delivery, and market transactions. Beyond automating routine tasks, AI agents are expected to perform increasingly sophisticated cognitive activities, including project management, financial analysis, software development, legal assistance, logistics coordination, and scientific research, thereby expanding the economic scope of AI far beyond conventional automation. Their defining characteristics, including goal directed autonomy, adaptive reasoning, tool integration, and multi agent collaboration, suggest that AI agents may represent one of the most transformative technological innovations since the emergence of cloud computing and the internet.

The emergence of the Agent Economy also introduces an important spatial dimension to technological development because the diffusion of autonomous AI depends not only on technological availability but also on complementary regional capabilities. Economic geography and regional innovation literature consistently demonstrate that technological revolutions spread unevenly across space, reflecting differences in digital infrastructure, human capital, research institutions, innovation ecosystems, entrepreneurial activity, and industrial capacity. Regions possessing these structural assets are expected to adopt agent-based technologies more rapidly, whereas structurally weaker regions may experience delayed adoption, reinforcing existing territorial inequalities. Consequently, regional structural readiness has become a critical prerequisite for participation in the Agent Economy. However, despite growing interest in AI agents, empirical evidence on regional preparedness remains limited, particularly at the sub national level. Existing studies primarily focus on technological architectures, governance issues, or organizational adoption, while comprehensive frameworks for measuring regional readiness are largely absent. In response to this gap, the present study conceptualizes structural readiness as the most appropriate proxy for assessing provincial preparedness in the absence of direct measures of AI agent adoption. Accordingly, the proposed AI Agent Readiness Proxy Index evaluates four complementary dimensions: Digital Infrastructure, Human Capital, Innovation Capacity, and Economic Ecosystem to capture the structural preconditions that enable future participation in the Agent Economy, thereby extending existing digital transformation and AI readiness literature to the regional scale.

2.2. AI Readiness Frameworks

As artificial intelligence has become a strategic driver of economic competitiveness, governments and international organizations have increasingly sought to evaluate countries' preparedness for AI adoption through comprehensive readiness frameworks (Kergroach and Héritier, 2025; Maslej et al., 2025). These frameworks generally assume that successful AI deployment depends not only on technological availability but also on complementary capabilities such as digital infrastructure, human capital, innovation systems, governance quality, and institutional capacity (Cazzaniga et al., 2024; Oxford Insights, 2024). Consequently, AI readiness has evolved into a multidimensional concept reflecting the structural conditions that enable economies to develop, adopt, and benefit from AI technologies.

Among the most influential initiatives, the Oxford Government AI Readiness Index evaluates governments across three major pillars Government, Technology Sector, and Data & Infra structure providing an international benchmark for AI preparedness (Oxford Insights, 2024). Similarly, the IMF AI

Preparedness Index emphasizes digital infrastructure, education, labor market characteristics, innovation capacity, and regulatory quality as essential determinants of AI driven economic transformation (Cazzaniga et al., 2024). The Stanford AI Index complements these approaches by documenting global trends in AI research, investment, industrial adoption, education, governance, and responsible AI, thereby offering one of the most comprehensive assessments of AI development worldwide (Maslej et al., 2025).

Despite methodological differences, these frameworks converge on a common conclusion: AI readiness is fundamentally multidimensional and depends upon the interaction between technological, institutional, human, and economic resources rather than any single factor (Kergroach and Héritier, 2025). However, existing readiness indices also share several limitations. First, they operate almost exclusively at the national level, implicitly assuming that countries represent homogeneous units of analysis. Such an assumption overlooks considerable regional disparities that characterize digital transformation within many countries, particularly those exhibiting pronounced differences in economic development and innovation capacity.

Second, current frameworks primarily evaluate general AI readiness rather than preparedness for autonomous AI agents. While conventional AI adoption focuses on analytics, prediction, and machine learning applications, the emerging Agent Economy requires broader structural capabilities, including digitally connected ecosystems capable of supporting autonomous decision making, organizational coordination, and knowledge intensive production. Existing frameworks therefore provide an important conceptual foundation but require adaptation to capture the distinctive characteristics of agent based economic systems.

2.3. Regional Digital Readiness

Regional economics has long recognized that technological innovation is geographically uneven. According to the regional innovation systems literature, economic performance increasingly depends upon interactions among infrastructure, universities, research institutions, firms, entrepreneurship, and public policies (Cooke, 2001; Asheim et al., 2019). Consequently, digital transformation follows spatial patterns rather than occurring uniformly across regions.

Previous studies consistently identify four fundamental determinants of regional digital readiness. The first is digital infrastructure, including broadband penetration, high speed internet connectivity, and communication networks, which provide the technological foundation for AI deployment. The second is human capital, reflected in educational attainment, research personnel, and advanced

technical skills that enable organizations to develop and implement AI applications (World Economic Forum, 2025). The third is innovation capacity, commonly measured through patents, research activity, technological entrepreneurship, and knowledge creation. Finally, the economic ecosystem, including industrial diversification, entrepreneurship, export performance, and firm dynamics, facilitates the commercialization and diffusion of emerging technologies (Porter, 1998; Boschma, 2005).

In Türkiye, previous studies have documented persistent regional disparities in socio economic development, innovation performance, industrial competitiveness, and educational attainment. Nevertheless, these studies generally examine individual dimensions separately instead of integrating them into a multidimensional framework capable of evaluating readiness for AI driven transformation. Consequently, although regional inequality has been extensively documented, little empirical evidence currently exists regarding provincial preparedness for the emerging Agent Economy.

2.4. Composite Indices in Regional Studies

Composite indicators have become one of the most widely adopted methodological tools for measuring multidimensional socio-economic phenomena, including regional competitiveness, innovation performance, sustainability, resilience, and digital transformation (OECD/European Union/EC-JRC, 2008). By aggregating multiple indicators into a single quantitative measure, composite indices facilitate comparisons across regions while preserving the multidimensional nature of complex concepts.

The construction of composite indicators generally involves five sequential stages: indicator selection, normalization, weighting, aggregation, and robustness assessment (OECD/European Union/EC-JRC, 2008). Among alternative normalization procedures, min–max normalization remains one of the most frequently employed because it transforms heterogeneous variables into a common scale while preserving their ordinal relationships. Likewise, equal weighting is commonly adopted when no theoretical justification exists for assigning differential importance to individual dimensions (Saltelli, 2007).

Nevertheless, methodological literature emphasizes that composite indicators should not rely solely on arbitrary weighting assumptions. Robustness analyses including principal component analysis (PCA), alternative weighting schemes, sensitivity analysis, Cronbach's alpha, and factor adequacy tests are increasingly regarded as best practice in composite indicator construction (Saltelli et al., 2000). These procedures demonstrate whether empirical findings remain stable under alternative methodological specifications rather than being artifacts of particular modeling choices.

Consistent with these recommendations, the present study applies equal weighting as the baseline specification while evaluating robustness using PCA derived weights. The extremely high correlation between the baseline and alternative specifications indicates that the substantive findings are not driven by weighting assumptions but instead reflect genuine structural variation across Turkish provinces.

The literature reviewed above reveals an important research gap at the intersection of AI readiness, regional development, and composite indicator methodology. Existing AI readiness frameworks developed by Oxford Insights, the IMF, Stanford University, and the OECD provide valuable national benchmarks but offer little insight into sub national heterogeneity in structural preparedness (Oxford Insights, 2024; Cazzaniga et al., 2024; Maslej et al., 2025).

Within Türkiye, no previous study has developed a province level composite index specifically designed to evaluate structural readiness for the emerging Agent Economy. Furthermore, official statistics on AI agent adoption remain unavailable, making direct measurement impossible. Under these circumstances, evaluating structural preconditions represents the most appropriate empirical strategy for assessing regional preparedness.

Accordingly, this research contributes simultaneously to the literature on AI readiness, regional development, and composite indicator methodology while providing one of the earliest empirical assessments of regional preparedness for the emerging Agent Economy. It also establishes a framework that can be extended longitudinally or adapted to other countries as sub national AI adoption data become available.

3. Data and Methodology

3.1 Indicator Selection and Data Sources

The composite index integrates 16 indicators across the four dimensions specified in the conceptual framework, with four indicators assigned to each dimension to preserve equal representation. All indicators refer to the 2024 reference year and cover all 81 Turkish provinces.

Digital Infrastructure: broadband penetration rate (%), fiber optic subscribers per 1,000 population, mobile telephony penetration rate (%), and fiber optic cable length per 1,000 population sourced from the Information and Communication Technologies Authority's (BTK) *Annual Statistical Bulletin at Provincial Level*.

Human Capital: higher education graduate rate (%), master's degree holders per 1,000 population, doctoral degree holders per 1,000 population, and higher education faculty staff per 100,000 population derived from the Turkish Statistical Institute's (TÜİK) Address Based Population Registration System education statistics.

Innovation Capacity: patent applications, utility model applications, trademark applications, and patent registrations, each expressed per 100,000 population sourced from the Turkish Patent and Trademark Office's provincial statistics.

Economic Ecosystem: per capita exports by economic activity (ISIC Rev.4), the number of active Organized Industrial Zones (OIZs) per 100,000 population, the number of firms registered in OIZs per 100,000 population, and newly established companies (per Union of Chambers and Commodity Exchanges of Türkiye, TOBB) per 100,000 population.

3.2 Scale Adjustment

Every indicator were normalized as outlined in Section 3.2. Raw counts of patents, exports, or newly founded firms are mechanically dominated by the sheer population size of metropolitan provinces; using them unadjusted would reduce the index to a proxy for city size rather than structural readiness. All 16 indicators were therefore expressed per capita, per 1,000, or per 100,000 population as appropriate to the indicator's typical magnitude (Table 1).

Table 1. Indicators, dimensions, and data sources

Dimension	Indicator	Unit / Measure	Source
Digital Infrastructure	Broadband penetration rate	%	BTK
	Fiber optic subscribers	per 1,000 population	BTK
	Mobile telephony penetration rate	%	BTK
	Fiber optic cable length	per 1,000 population	BTK
Human Capital	Higher education graduate rate	%	TÜİK
	Master's degree holders	per 1,000 population	TÜİK
	Doctoral degree holders	per 1,000 population	TÜİK
	Higher education faculty staff	per 100,000	TÜİK

Dimension	Indicator	Unit / Measure	Source
		population	
Innovation Capacity	Patent applications	per 100,000 population	Turkish Patent and Trademark Office
	Utility model applications	per 100,000 population	Turkish Patent and Trademark Office
	Trademark applications	per 100,000 population	Turkish Patent and Trademark Office
	Patent registrations	per 100,000 population	Turkish Patent and Trademark Office
Economic Ecosystem	Exports by economic activity (ISIC Rev.4)	per capita	TÜİK
	Active Organized Industrial Zones (OIZs)	per 100,000 population	OSBÜK
	Firms registered in OIZs	per 100,000 population	OSBÜK
	Newly established companies	per 100,000 population	TOBB

3.3 Normalization

Each population adjusted indicator was rescaled to a common [0, 100] range using min max normalization:

$$N_i = \frac{x_i - \min(x)}{\max(x) - \min(x)} \times 100 \qquad (1)$$

where x_i is the per capita value for province i, and min(x)/max(x) are the minimum and maximum values observed across all 81 provinces for that indicator. This transformation assigns 100 to the top performing province and 0 to the bottom performing province on each individual indicator, allowing indicators

expressed in heterogeneous units (percentages, counts per 1,000, monetary values per capita) to be aggregated on a common scale.

3.4 Dimension Scores and Composite Index

Each dimension score is the unweighted arithmetic mean of its four normalized indicators. The composite AI Agent Readiness Proxy Score is the unweighted arithmetic mean of the four dimension scores, giving each dimension an equal 25% weight:

$$Composite_i = 0.25\,D_{1i} + 0.25\,D_{2i} + 0.25\,D_{3i} + 0.25\,D_{4i} \qquad (2)$$

Equal weighting was adopted as the most defensible default in the absence of a theoretically grounded alternative, consistent with common practice in composite indicator construction where no dimension can be argued a priori to be more determinative of AI agent readiness than another.

3.5 Robustness Check: Data Driven Weighting

To assess whether the equal weighting assumption drives the results, an alternative weighting scheme was derived empirically via Principal Component Analysis (PCA) applied to the four standardized (z scored) dimension scores. The first principal component explained 66.8% of total variance across the four dimensions, indicating that they move together along a strong common "general readiness" axis rather than capturing four independent constructs. PC1 loadings were converted into weights by taking absolute values and rescaling to sum to one, yielding: Digital Infrastructure 27.5%, Human Capital 23.9%, Innovation Capacity 26.0%, and Economic Ecosystem 22.6% a distribution close to, but not identical to, the equal weight baseline.

The composite score computed under PCA derived weights correlates with the equal weight composite at r = 0.9998, and province rankings under the two schemes correlate at r = 0.999 (Spearman equivalent), with a mean absolute rank shift of 0.69 positions and a maximum shift of 5 positions across all 81 provinces. This indicates that the substantive findings are not an artifact of the equal weighting choice.

Additional robustness diagnostics further support the stability of the proposed index. The 16 normalized indicators exhibit high internal consistency (Cronbach's $\alpha = 0.887$), indicating that they jointly capture complementary aspects of regional structural readiness. Sampling adequacy is confirmed by a

Kaiser–Meyer–Olkin statistic of 0.766 (Kaiser, 1974), while Bartlett's test of sphericity strongly rejects the null hypothesis of an identity correlation matrix ($\chi^2 = 1269.36$, $df = 120$, $p < 0.001$), supporting the use of multivariate aggregation techniques (Kline, 2016). Finally, a leave one dimension out sensitivity analysis demonstrates that province rankings remain highly stable even when each of the four dimensions is omitted in turn (Spearman correlations ranging from 0.929 to 0.981). These findings indicate that the composite index is not driven disproportionately by any single dimension and is robust to alternative model specifications.

4. Findings

4.1 Overall Distribution

The composite AI Agent Readiness Proxy Score ranges from 6.4 (Şırnak) to 71.5 (Ankara), with a small cluster of provinces separated by a wide margin from the rest of the distribution. Ankara (71.5) and Istanbul (66.8) occupy a distinct top tier, scoring roughly 20 points above the third ranked province, Kocaeli (47.1). A second tier Eskişehir (46.4), Izmir (46.3), Kayseri (43.6), Bursa (42.1), Bilecik (40.3), Isparta (39.8), and Sakarya (39.3) clusters between 39 and 47 points. The bottom of the distribution is occupied predominantly by southeastern provinces: Şırnak (6.4), Muş (7.0), Şanlıurfa (7.2), Ağrı (8.3), Hakkari and Bitlis (10.0), Batman (11.6), Van (11.7), Mardin (12.0), and Siirt (12.3).

4.2 Dimension Specific Asymmetries

Disaggregating the composite score into its four dimensions reveals that provincial profiles are not uniform across dimensions, which constitutes the index's most policy relevant contribution. Ankara leads decisively in Human Capital (89.2) and Innovation Capacity (78.9), reflecting its concentration of universities, research institutions, and patent active firms, but scores comparatively lower on Economic Ecosystem (51.0) relative to its own peak dimension. Istanbul shows the inverse pattern in relative terms: its Digital Infrastructure score (77.7) exceeds its Human Capital score (59.8), despite the latter still ranking among the highest nationally.

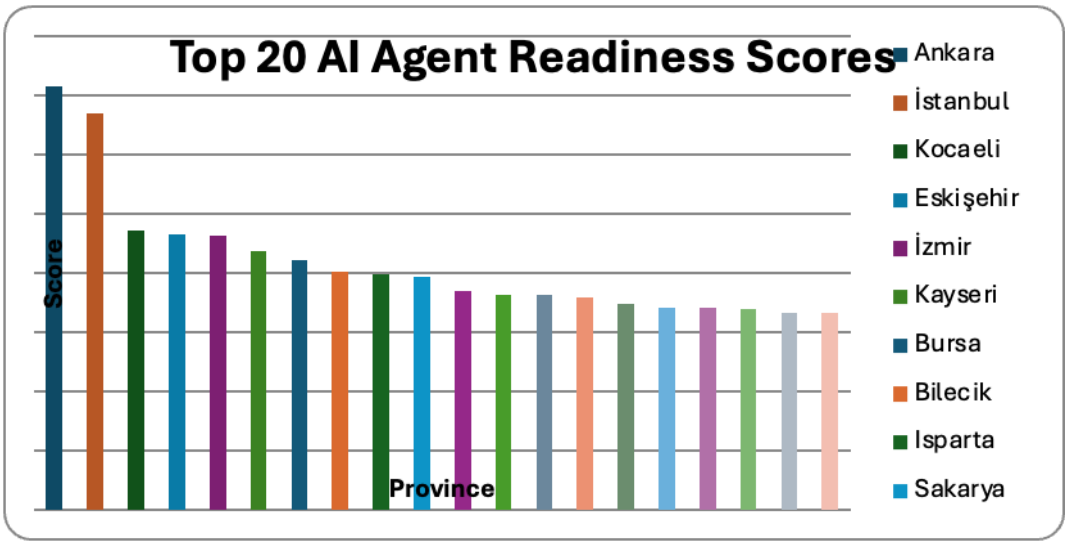


Figure 1. AI Agent Readiness Scores

More striking asymmetries appear outside the top tier. Bilecik, despite a modest overall rank, records the *highest* Economic Ecosystem score in the sample (56.8), driven by high per capita OIZ firm density, while its Innovation Capacity (21.0) lags well behind. Eskişehir combines a strong Human Capital score (68.2) with comparatively weak Economic Ecosystem performance (26.3), consistent with its identity as a university dense city with a smaller industrial base relative to Kocaeli or Bursa. These patterns suggest that structural gaps are dimension specific rather than uniform: a province may be simultaneously well positioned in one precondition for agent driven economic activity and structurally underdeveloped in another, a distinction the composite score alone would obscure.

4.3 Population and the Metropolitan Concentration Effect

Despite the per capita transformation applied to every indicator (Section 3.2), the composite score retains a moderate positive correlation with provincial population ($r = 0.54$). This indicates that larger provinces are not mechanically inflating the index through population size alone the normalization step addressed that risk but that population and structural readiness remain genuinely, moderately associated: larger provinces in Türkiye do host denser innovation ecosystems and infrastructure independent of scale effects. This finding should be reported transparently rather than interpreted as a methodological artifact, and it tempers any claim that per capita adjustment fully equalizes the playing field between metropolitan and peripheral provinces.

4.4 Robustness to Weighting Assumptions

As detailed in Section 3.5, substituting PCA derived dimension weights for the equal weight baseline leaves both the composite score (r = 0.9998) and the resulting province ranking (r = 0.999) virtually unchanged. The largest rank movements under the alternative weighting are modest five positions at most and concentrated among mid ranked provinces rather than at either extreme of the distribution. The identity of the top ranked and bottom ranked provinces is unaffected by the choice of weighting scheme, providing empirical support for treating the equal weight results as the primary specification rather than one arbitrary choice among many defensible alternatives.

5. Discussion and Policy Implications

5.1 Interpreting the Findings within the Regional Disparity Literature

The distribution of proxy readiness scores documented in Section 4 reproduces a familiar pattern in the Turkish regional development literature: a small number of metropolitan and industrialized provinces, Ankara, Istanbul, and a second tier anchored by Kocaeli, Izmir, Bursa, and Eskişehir concentrate the overwhelming share of digital, educational, and innovation capacity, while a cluster of southeastern provinces persistently occupies the lower tail across nearly every indicator examined. This mirrors decades of findings on core periphery disparities in Türkiye's socio-economic development indices, suggesting that whatever structural conditions will govern the diffusion of agent driven economic activity are likely to follow, rather than disrupt, existing regional development trajectories. In this sense, the Agent Economy does not appear to introduce a fundamentally new geography of advantage; it appears poised to inherit one.

At the same time, the dimension specific asymmetries identified in Section 4.2 complicate any simple core periphery narrative. The fact that Bilecik outperforms every other province including Ankara and Istanbul on the Economic Ecosystem dimension, or that Eskişehir's Human Capital strength is not matched by comparable industrial density, indicates that structural readiness is not a single latent trait that provinces possess in greater or lesser degree, but a multidimensional profile in which different provinces accumulate different, non-substitutable forms of capacity. This has a direct bearing on policy design: a province with strong human capital but weak economic infrastructure faces a different constraint, and requires a different intervention, than one with strong infrastructure but a thin innovation base.

5.2 Policy Implications

Because the index decomposes into four independently interpretable dimension scores, its principal policy value lies not in the ranking of the composite score itself but in the pattern of gaps it reveals within each province. Rather than treating "AI agent readiness" as a single deficit to be closed through generic digital transformation spending, the findings support a dimension targeted approach: provinces whose Digital Infrastructure score substantially exceeds their Innovation Capacity score (a pattern visible among several mid-tier provinces in the sample) may benefit more from R&D incentives, techno park expansion, or university industry linkage programs than from further broadband investment, whose marginal returns in those provinces are likely diminishing. Conversely, provinces with strong Human Capital scores but weak Economic Ecosystem scores, such as Eskişehir, being the clearest example suggest a mismatch between the local supply of skilled graduates and the local demand for that skill base, pointing toward industrial attraction or entrepreneurship support policy rather than further educational investment.

For the provinces occupying the lower tail of the distribution across all four dimensions simultaneously a pattern concentrated in the southeast, the findings imply that no single dimension intervention is likely to be sufficient. These provinces lack not one precondition but several concurrently, and the gap between them and the leading tier is large enough (a 60 plus point spread on a 0–100 scale) that closing it will plausibly require sustained, multi-dimensional investment rather than a single flagship program. Policymakers should also note the population correlation finding (Section 4.3): because larger provinces retain a genuine, non-artifactual advantage even after per capita adjustment, purely population proportional allocation of digital transformation resources risks reinforcing rather than narrowing existing gaps, and formula based regional funding mechanisms may need to weight structural indicators more heavily than population share alone.

5.3 Limitations and Directions for Future Research

Future research extending this work might pursue three directions: (i) constructing a multi-year panel to test whether the metropolitan periphery gap is closing or widening as digital and innovation infrastructure diffuse; (ii) supplementing the index with firm level or establishment level survey data on actual AI tool and agent adoption, once such data becomes available for Türkiye, to empirically test the assumed link between structural readiness and behavioral adoption; and (iii) extending the Economic Ecosystem and AI & Digital Economy dimensions with the administrative data currently pending (industrial registry counts, TÜBİTAK provincial support distribution, and NACE disaggregated firm

counts) to produce a fully populated version of the five dimension framework originally proposed.

6. Conclusion

This study set out to provide a preliminary, province level assessment of Türkiye's structural readiness for the emerging Agent Economy, addressing the absence of any indicator that directly measures AI agent adoption at the sub national level by constructing a Digital and Innovation Readiness Index from 16 population adjusted indicators spanning digital infrastructure, human capital, innovation capacity, and economic ecosystem strength across all 81 provinces.

The findings reveal pronounced and multidimensional regional disparities. Ankara and Istanbul form a distinct leading tier, followed by a second cluster of industrialized and university dense provinces, while a persistent group of southeastern provinces lags across nearly every dimension examined. Critically, the index's dimensional decomposition shows that structural readiness is not monolithic: provinces accumulate strength unevenly across infrastructure, human capital, innovation, and economic capacity, producing distinct profiles that a single composite ranking would otherwise conceal. The index also proved robust to methodological choice, with data driven (PCA) weighting reproducing the equal weight results at a correlation of 0.9998, lending confidence that the reported patterns reflect genuine structural variation rather than an artifact of the aggregation scheme.

Consistent with the framing established at the outset, these results should be read as indicative of structural preconditions rather than as predictions of AI agent adoption itself, and as correlational rather than causal evidence. Within that scope, the study contributes the first province level composite assessment of its kind for Türkiye, and offers a dimension targeted rather than uniform basis for policy discussion: closing Türkiye's prospective gaps in agent driven economic participation is likely to require distinct interventions calibrated to each province's specific pattern of structural strength and deficit, rather than a single undifferentiated digital transformation strategy applied uniformly across the country.

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ANALYSIS OF THE PERFORMANCE OF A BUSINESS ENTITY USING ARTIFICIAL INTELLIGENCE

Mimoza Mijoska[1]

Abstract

This paper compares human-driven and AI-assisted performance analysis of medium-sized businesses, using only their audited financial statements publicly available on seinet.com.mk for the last 10 years. By limiting the input data to standardized audited disclosures, the study isolates what signal sets each approach can extract from formal financial reporting and how those signals influence performance assessment, risk identification, and action recommendations. Identical, pre-processed financial data feeds two parallel workflows. The human analyst workflow applies traditional techniques - ratio analysis, trend decomposition, cash flow stress testing, industry benchmarking, and qualitative interpretation of audit notes and accounting policies. The AI-enabled workflow uses Microsoft Power BI for data ingestion, normalization, visualization, automatic trend detection, and forecasting (including time series and machine learning regressors), while Clode performs natural language synthesis, hypothesis generation, anomaly explanation, and report drafting. The AI pipeline records transformations, modeled artifacts, and reminders to support reproducibility and governance. The AI workflow's audit trail and templated processes improve reproducibility and enable efficient reanalysis across multiple time periods. Humans also adapt preventive recommendations to organizational constraints and stakeholder dynamics in ways that AI results alone may not be able to capture.

Keywords: artificial intelligence, financial statement analysis, DuPont analysis, Return on Equity, Claude.

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1. Introduction

The evaluation of a business entity's financial performance has traditionally been the domain of trained financial analysts who apply ratio analysis, trend decomposition, and qualitative judgment to audited financial statements (Beaver, 1966; Altman, 1968). In recent years, artificial intelligence (AI) tools — ranging from business-intelligence platforms with automated analytics (Chen *et al*., 2012) to large language models (LLMs) capable of natural-language reasoning over numerical data (Kokina & Davenport, 2017) — have become widely accessible and are increasingly used to support, and in some cases substitute for, this analytical work. Recent evidence suggests this substitution may be further along than commonly assumed: Kim, Muhn, and Nikolaev (2024) find that an LLM given only standardized, anonymized financial statements can predict the direction of future earnings more accurately than human financial analysts, and can generate useful narrative insight in doing so, without any narrative or industry-specific information. This raises a practical question of direct relevance to small and medium-sized economies such as the Republic of North Macedonia, where many listed companies are covered by few, if any, professional equity analysts: can AI tools, given only the same publicly disclosed audited financial statements a human analyst would use, produce a performance analysis of comparable depth, accuracy, and usefulness?

This paper addresses that question through a controlled comparison. Two workflows — one human-led, one AI-enabled — are applied to identical, preprocessed financial data sourced exclusively from audited financial statements published on the official disclosure portal of the Macedonian Stock Exchange, seinet.com.mk. The comparison is grounded in five parallel case studies conducted as part of this research: all firms headquartered in the city of Prilep and all listed on the Macedonian Stock Exchange, with audited financial disclosures available via seinet.com.mk spanning roughly ten to eleven years: AD Prilepska Pivarnica (brewing and beverage bottling), Vitaminka AD Prilep (food manufacturing, analysed on a consolidated Group basis), Tutunski Kombinat AD Prilep (tobacco processing), Mermeren Kombinat AD Prilep (marble quarrying and processing), and Sigurnosno Staklo AD Prilep (originally glass manufacturing, now largely a property-rental entity). These five companies were deliberately not pre-selected for a common financial profile; as Section 5 shows, they range from a highly liquid, debt-free brewer to a company with persistently negative equity, giving the comparison a wide base of financial conditions on which to test the AI-assisted workflow.

The paper has the following content: the second chapter provides overview of the analytical methods applied. The third chapter describes a comparison of traditional and AI-assisted financial analysis. The fourth chapter describes the methodology used in the research. In this study, DuPont decomposition of ROE; horizontal and vertical analysis of balance sheet and income statement line items;

trend indexing of revenue, profit, assets, and equity; and a full ratio suite covering liquidity, solvency, profitability, and efficiency was chosen, which provides the necessary information about the business entity's work to the management so that it can take specific activities in a timely manner. Necessary information about the business entity's work is placed on the shareholders and future interested shareholders. The fifth and sixth chapters provide a case study for the business entities AD Prilepska pivarnica, Vitaminka AD Prilep, Tutunski Kombinat AD Prilep, Mermeren Kombinat AD Prilep and Sigurnosno Staklo AD Prilep. The seventh chapter provides a comparison between human analysis and AI analysis. And the last chapter provides a conclusion to this paper.

2. Overview of the analytical methods applied

Five complementary methods were applied to each company's financial statements. Each is briefly described below before being applied across the five case studies in Section 5.

2.1 Horizontal analysis

Horizontal analysis measures the percentage change in each financial statement line item from one period to the next. It answers the question "how much, and how fast, did this figure move?" and is the most direct way to locate the specific year in which a company's trajectory changed — a cost shock, a demand surge, a debt-financed acquisition — rather than only observing that a multi-year average has shifted.

2.2 Vertical analysis (common-size analysis)

Vertical analysis expresses each balance sheet line as a percentage of total assets, and each income statement line as a percentage of total revenue. This restates companies of very different absolute size on a comparable footing and reveals structural characteristics — how equity-funded a balance sheet is, how much of revenue is consumed by a specific cost category — that raw figures alone can obscure.

2.3 Trend analysis

Trend (index) analysis restates a multi-year series relative to a fixed base year (base = 100), isolating the shape of growth or decline independent of the absolute scale of the underlying numbers. It is particularly useful for comparing whether different financial statement lines (for example, revenue versus net profit, or assets versus equity) are growing at the same pace or diverging.

2.4 Financial ratio analysis

Ratio analysis combines figures from the financial statements into standardized measures across four families: liquidity ratios (for example, the

current ratio, assessing short-term solvency), leverage or solvency ratios (for example, the debt ratio and debt-to-equity ratio, assessing capital structure and long-term financial risk), profitability ratios (for example, net profit margin, Return on Assets, and Return on Equity), and efficiency ratios (for example, asset turnover and inventory turnover, assessing how productively a company deploys its resources).

2.5 DuPont analysis

The DuPont framework decomposes Return on Equity (ROE) into three multiplicative components: ROE = Net Profit Margin × Asset Turnover × Equity Multiplier. Net profit margin captures cost control relative to revenue; asset turnover captures how efficiently the asset base generates revenue; the equity multiplier captures financial leverage — how much of the asset base is funded by debt rather than equity. Because these three components are independently observable from the same financial statements used elsewhere in the analysis, DuPont decomposition also functions as a built-in consistency check: recomputing ROE from its three parts and comparing it to the company's own disclosed figure verifies that the underlying data has been extracted correctly (Soliman, 2008).

3. Background: AI-assisted financial analysis

Traditional financial statement analysis rests on a small set of well-established techniques: horizontal and vertical ratio analysis, trend decomposition across multiple reporting periods, liquidity and cash-flow stress testing, peer and industry benchmarking, and qualitative review of audit opinions, notes to the financial statements, and accounting policy disclosures (Beaver, 1966; Altman, 1968). These techniques require an analyst to manually locate, transcribe, and reconcile figures across multiple annual reports — a process that is time-consuming and prone to transcription error, particularly when statements are filed as scanned PDF documents, as is common on regional disclosure portals such as seinet.com.mk.

AI tools address different parts of this workflow. Business-intelligence platforms such as Microsoft Power BI automate data ingestion, normalization across inconsistent reporting formats, visualization, and trend or anomaly detection, including time-series and machine-learning-based forecasting, building on a broader business intelligence and analytics research tradition (Chen *et al*., 2012). Large language models such as ChatGPT and Claude complement this by performing natural-language synthesis over structured and unstructured inputs alike — reading narrative annual reports, auditor's notes, and management commentary in addition to tabular figures — and generating hypotheses, anomaly explanations, and draft analytical narratives, consistent with the growing literature on AI in accounting and auditing (Kokina & Davenport, 2017) and on domain-

specialized and general-purpose LLMs applied to financial text and disclosures (Wu, *et al*., 2023; Huang *et al*., 2023; Kim *et al*., 2024).

4. Research design and methodology

4.1 Data source and constraints

All financial data used in this study originates from audited annual financial statements and independent auditors' reports for the five companies, filed via seinet.com.mk and, in the majority of cases, supplied directly as source documents for this study. Where a specific year's audited statement could not be obtained, this is explicitly flagged in the relevant case study (Section 5) rather than filled with an unverified estimate presented as confirmed data.

4.2 The human-analyst workflow

The human-analyst workflow applied the five methods described in Section 2 to each company: DuPont decomposition of ROE; horizontal and vertical analysis of balance sheet and income statement line items; trend indexing of revenue, profit, assets, and equity; and a full ratio suite covering liquidity, solvency, profitability, and efficiency. Critically, the human workflow also cross-referenced each year's figures against the auditors' own notes and management commentary to identify the disclosed drivers behind a given movement — for example, attributing a margin decline to a specific, disclosed input-cost shock rather than treating it as an unexplained residual.

4.3 The AI-enabled workflow

The AI-enabled workflow used Claude for data extraction from the source financial statements (including scanned and OCR-degraded documents, where individual line items were cross-validated against restated prior-year comparatives in adjacent filings), computation of all horizontal, vertical, trend, ratio, and DuPont figures, visualization of the resulting time series, and automated detection of trend breaks and anomalies (such as the negative-operating-profit-but-positive-net-profit pattern identified for Tutunski Kombinat in Section 5.3, or the going-concern emphasis of matter identified for Sigurnosno Staklo in Section 5.5). Each computed figure was cross-checked arithmetically — for instance, recomputing each year's ROE from its three DuPont components and confirming it matched the value implied by the source statements — and every extracted figure retains a traceable link back to the specific source document and, where applicable, the specific page or note. This logging of transformations and sources is what allows the workflow's outputs to be independently re-verified rather than taken on faith.

4.4 Comparative evaluation criteria

The two workflows are compared on: analytical depth (the granularity of decomposition and identification of underlying drivers, not just headline figures); factual accuracy (verified by a human expert reviewing the AI-generated output against the underlying source statements); reproducibility (whether an independent party could regenerate the same figures from the same source documents); efficiency (the time required to extend the analysis to an additional year or an additional company); and contextual judgment (the ability to weigh organizational constraints and stakeholder dynamics not encoded in the financial statements themselves).

5. Case studies

Each of the five companies was analysed across its full available audited history using all five methods from Section 2. For brevity, the tables below show selected representative years (approximately every second year) from each company's full analysis; complete year-by-year tables, common-size statements, and additional charts are provided in the previously prepared reports for each company.

5.1 Case study I: AD Prilepska pivarnica

A brewery, beverage bottler, and distributor. This is the most financially conservative of the five companies: equity has funded 88–93% of the asset base in every year, and the equity multiplier has never left a narrow 1.07×–1.14× band across the entire eleven-year window.

Table 1. AD Prilepska Pivarnica — DuPont decomposition (figures in thousand MKD).

Year	Revenue (000 MKD)	Net Profit (000 MKD)	Assets (000 MKD)	Equity (000 MKD)	Net Margin	Asset Turnover	Equity Multiplier	ROE
2015	1,652,794	150,952	1,908,717	1,697,523	9.13%	0.866×	1.124×	8.89%
2017	1,859,847	178,594	2,276,745	1,998,233	9.60%	0.817×	1.139×	8.94%
2019	1,946,078	20,022	2,217,955	2,003,090	1.03%	0.877×	1.107×	1.00%
202	1,725,06	92,698	2,493,25	2,281,75	5.37%	0.692×	1.093×	4.06

Year	Revenue (000 MKD)	Net Profit (000 MKD)	Assets (000 MKD)	Equity (000 MKD)	Net Margin	Asset Turnover	Equity Multiplier	ROE
1	8		5	1				%
2023	2,079,974	122,133	2,710,018	2,467,844	5.87%	0.768×	1.098×	4.95 %
2025	2,257,805	153,121	3,310,135	2,988,924	6.78%	0.682×	1.108×	5.12 %

Net margin ranged from a near-breakeven 1.03% (2019) to 9.60% (2017) — more than a ninefold spread — while the equity multiplier moved by only about 1.06× across the same period, confirming that this company's ROE story is almost entirely a margin story. Two documented cost shocks (2018: input-cost and depreciation pressure; 2022: a 57% energy-cost spike) explain the two sharpest margin contractions in the series. A structural first appears only in 2025: the company's first-ever long-term liability (an IFRS 16 lease obligation), ending eleven years of being entirely debt-free.

5.2 Vitaminka AD Prilep (2016–2025, consolidated Group basis)

A food manufacturer and confectioner with several subsidiaries, analysed on a consolidated basis. Unlike Prilepska Pivarnica, Vitaminka's balance sheet has grown steadily more leveraged.

Table 2. Vitaminka AD Prilep — selected years, consolidated DuPont decomposition (figures in thousand MKD).

Year	Revenue (000 MKD)	Net Profit (000 MKD)	Assets (000 MKD)	Equity (000 MKD)	Net Margin	Asset Turnover	Equity Multiplier	ROE
2016	1,658,637	3,570	1,369,833	791,152	0.22%	1.211×	1.731×	0.45 %
2018	2,211,774	28,832	2,219,276	845,451	1.30%	0.997×	2.625×	3.41 %
2020	2,401,757	25,842	2,522,800	867,670	1.08%	0.952×	2.908×	2.98 %

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Year	Revenue (000 MKD)	Net Profit (000 MKD)	Assets (000 MKD)	Equity (000 MKD)	Net Margin	Asset Turnover	Equity Multiplier	ROE
2022	3,801,690	69,827	3,119,213	975,724	1.84%	1.219×	3.197×	7.16%
2023	3,340,517	99,297	3,189,670	1,092,871	2.97%	1.047×	2.919×	9.09%
2025	4,611,069	9,934	4,008,616	1,233,504	0.22%	1.150×	3.250×	0.81%

The equity multiplier climbed from 1.73× (2016) to a peak of 3.25× (2025), traced to a 2018 debt-financed acquisition of a refined-oil production facility. Because leverage is high here, margin shocks are amplified in both directions: 2023's peak (net margin 2.97%, ROE 9.09%) and 2025's collapse (net margin 0.22%, ROE 0.81%, on the highest leverage in the Group's history) are both larger swings than the same margin move would produce at Pivarnica's leverage level — a direct, quantifiable illustration of financial leverage as a risk amplifier.

5.3 Tutunski Kombinat AD Prilep (2017–2025, partial)

A tobacco processor recovering from roughly two decades as one of the country's largest loss-making listed companies (accumulated losses of approximately EUR 148 million prior to this study's window).

Table 3. Tutunski Kombinat AD Prilep — selected years, DuPont decomposition (figures in thousand MKD; 2018 ROE marked Not Meaningful due to near-zero equity).

Year	Revenue	Net Profit/(Loss)	Total Assets	Equity	Net Margin	Eq. Mult.	ROE
2017	1,000,383	(51,811)	1,069,182	206,248	-5.18%	5.184×	-25.12%
2018	1,039,979	(188,210)	1,037,071	18,506	-18.10%	56.040×	N/M
2020	1,013,929	31,004	909,181	88,875	3.06%	10.230×	34.88%
2021	1,301,778	134,707	1,019,003	224,515	10.35%	4.539×	60.00%
2023	826,983	164,864	998,881	539,001	19.94%	1.853×	30.59%
2025	1,171,370	421,125	2,277,801	1,126,857	35.95%	2.021×	37.37%

Equity fell to just 18,506 thousand MKD in 2018 (liabilities were 98.2% of total assets) before recovering roughly sixtyfold to over 1.1 billion MKD by

2025 — the most dramatic capital-structure recovery of the five companies. A methodological complication specific to this company: 2018's ROE is mathematically distorted by a near-zero equity denominator and is reported as Not Meaningful rather than as a misleading number. A further finding, identified through the AI workflow's automated cross-checking of income-statement components against Macedonian Stock Exchange summary data: 2023–2025 each show negative operating profit alongside strongly positive net profit, indicating the recent reported profitability depends on gains below the operating line that are not yet explained by the summary data available.

5.4 Mermeren Kombinat AD Prilep (2015–2025, complete series)

A marble quarrying and processing company exporting primarily to China and Greece. This is the strongest and most consistently profitable of the five companies, and the only one with a complete, gap-free eleven-year audited serises.

Table 4. Mermeren Kombinat AD Prilep — selected years, DuPont decomposition (figures in thousand MKD; 2015 estimated from disclosed ratios).

Year	Revenue	Net Profit	Total Assets	Equity	Net Margin	Eq. Mult.	ROE
2015*	1,004,500	301,350	1,450,170	1,107,000	30.00%	1.310×	27.22%
2017	1,609,596	653,056	1,602,768	1,338,713	40.57%	1.197×	48.78%
2019	2,223,060	1,237,781	2,547,461	2,366,186	55.68%	1.077×	52.31%
2021	1,856,679	911,864	2,713,573	2,649,117	49.11%	1.024×	34.42%
2023	1,801,448	843,234	2,288,917	2,192,664	46.81%	1.044×	38.46%
2025	1,877,664	774,025	2,490,684	2,377,411	41.22%	1.048×	32.56%

Net margin ranged from 20.8% to 57.1% and ROE from 18.0% to 55.4%, while the equity multiplier stayed within a tight 1.02×–1.31× band throughout — leverage contributes essentially nothing to this company's returns in any year. The 2017–2018 period shows a genuine demand-driven earnings boom (a surge in Chinese marble demand): net profit grew 114.9% in 2018 alone while the company was simultaneously paying down debt, a clean signal that the growth was operational rather than financially engineered.

5.5 Sigurnosno Staklo AD Prilep (2015–2025)

Originally a glass manufacturer, now a small company deriving most of its revenue from property rental (and, since 2022, electricity generation and sales), with revenue and total assets an order of magnitude smaller than the other four companies.

Table 5. Sigurnosno Staklo AD Prilep — selected years (figures in thousand MKD). ROE is not applicable in any year with negative equity.

Year	Revenue	Net Profit/(Loss)	Total Assets	Equity	ROE
2015	9,214	(267)	30,351	244	N/A
2017	3,493	(2,212)	27,259	(4,992)	N/A
2019	4,436	(2,975)	19,972	(7,161)	N/A
2021	1,009	(102)	17,480	(10,549)	N/A
2023	10,433	989	31,370	(8,129)	N/A
2025	7,518	(6,047)	N/A	(17,955)*	N/A

This company required an explicit methodological adaptation: total equity has been negative in nine of the eleven years analysed, which makes conventional ROE mathematically misleading (a loss divided by negative equity produces a positive percentage, and vice versa). Return on Assets was substituted as the primary profitability measure throughout, since total assets remain positive in every year with confirmed data. The most recent audited statement (FY2025) includes a formal going-concern emphasis of matter: current liabilities exceed current assets by 181,450 thousand MKD, alongside a very large non-cash revaluation of investment property that more than doubled the reported value of that asset in a single year.

6. Comparative synthesis across the five companies-

Figure 1. Return on Equity, four of the five companies (Sigurnosno Staklo excluded; see Section 4.5). Mermeren Kombinat and Tutunski Kombinat run at a materially higher and more volatile ROE than Pivarnica or Vitaminka.

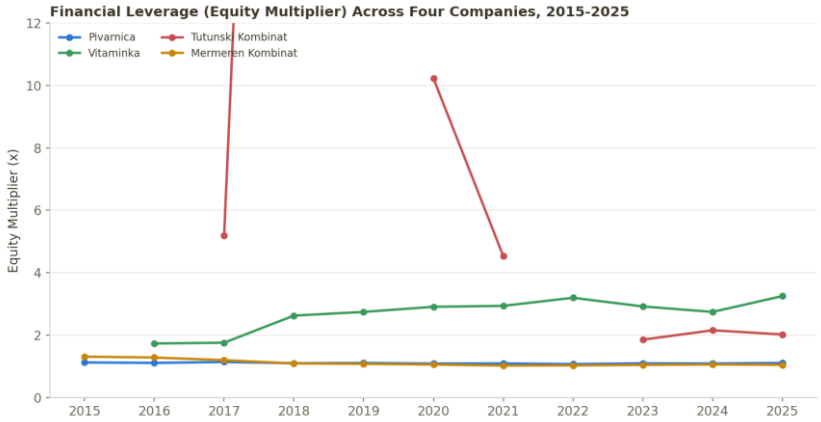


Figure 2. Financial leverage (equity multiplier). Pivarnica and Mermeren Kombinat are consistently low-leverage; Vitaminka shows a sustained upward leverage trend; Tutunski Kombinat's 2018 spike reflects its near-zero-equity distortion rather than a deliberate leverage decision.

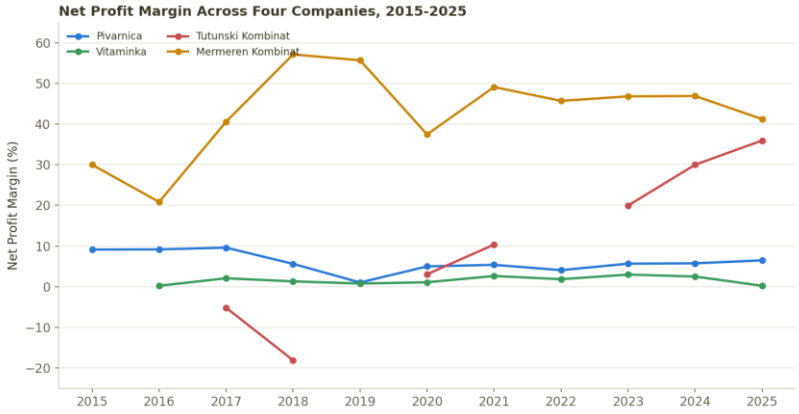


Figure 3. Net profit margin. Mermeren Kombinat's margin (20–57%) sits in a different tier entirely from the other companies, consistent with marble quarrying's naturally high value-added economics versus food and beverage manufacturing

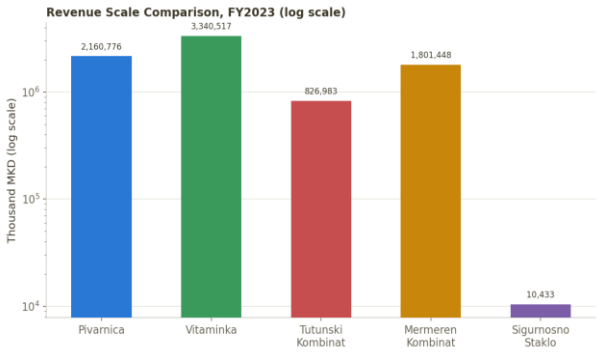


Figure 4. Revenue scale comparison, FY2023 (logarithmic scale, given the roughly 300-fold difference between the largest and smallest company by revenue).

Three cross-company patterns stand out. First, leverage and margin volatility appear related but not identical across companies: Vitaminka's rising leverage amplifies an already-volatile margin, while Tutunski Kombinat's extreme leverage swings are mostly a mechanical artifact of a near-zero equity base recovering from historic losses, not a deliberate financing strategy. Second, industry appears to matter more than company size: Mermeren Kombinat (marble) and, in its recovery years, Tutunski Kombinat (tobacco) both sustain markedly higher margins than the food and beverage manufacturers (Pivarnica, Vitaminka), consistent with different competitive and cost structures across these sectors. Third, capital structure conservatism (Pivarnica, Mermeren Kombinat) correlates with lower ROE volatility but not necessarily with higher average ROE — Mermeren Kombinat combines low leverage with the highest sustained returns of any company in the study, showing that low leverage and high profitability are not in tension when the underlying operating margin is strong enough.

7. Comparative findings: human-conducted versus AI-assisted analysis

Across all five case studies, the AI-enabled workflow successfully performed a detailed, internally consistent, and source-verifiable analysis of each business entity's operations, provided sufficient audited input data was available — confirming, across a substantially larger and more varied sample than a single-company pilot, the pattern reported by Kim, Muhn, and Nikolaev (2024) that large language models can extract decision-relevant signal from standardized financial statements with a reliability that approaches that of a trained analyst on well-structured tasks. The workflow's advantages were most visible in three respects. First, reproducibility: every figure in every table in this paper traces back to a specific source document, and in most cases to a specific page or note, an audit trail that would be substantially more time-consuming for a human analyst to maintain across five companies and up to eleven years each. Second, consistency

of method: the same five analytical techniques, defined identically, were applied to companies ranging from a debt-free brewer to a company with negative equity, with the DuPont and ratio framework flexing appropriately in each case (for example, substituting Return on Assets for Sigurnosno Staklo, or flagging Tutunski Kombinat's 2018 ROE as Not Meaningful) rather than mechanically producing a misleading number. Third, anomaly detection: several of this study's more consequential findings — Tutunski Kombinat's negative-operating-profit-but-positive-net-profit pattern, Sigurnosno Staklo's going-concern emphasis of matter, Mermeren Kombinat's cleanly debt-free earnings boom — emerged from the AI workflow's systematic cross-checking of figures against each other and against auditors' own disclosed commentary, rather than from a targeted, hypothesis-first human review.

At the same time, the comparison surfaced the same limits identified in prior single-company work: the AI-enabled workflow is most reliable when good-quality source data is available, and its output quality degrades gracefully but noticeably when source documents are heavily scanned, OCR-degraded, or internally inconsistent (as with several of Sigurnosno Staklo's and Tutunski Kombinat's older filings), requiring explicit human-verified caveats rather than silently interpolated figures. The human-analyst workflow's comparative advantage remained in contextual, stakeholder-aware judgment — for instance, weighing what a specific company's ownership structure or local market position would make of a given recommendation — which is not encoded in the financial statements and which AI output does not supply without explicit human framing (Dietvorst, Simmons, & Massey, 2015, on the broader tendency of human decision-makers not to defer uncritically to algorithmic output even when it performs well, underscoring the value of the human-in-the-loop review step retained throughout this study).

8. Conclusion

This study applied horizontal, vertical, trend, ratio, and DuPont analysis to five Prilep-based joint-stock companies with materially different financial profiles, using an AI-enabled workflow built on Claude for data extraction, computation, visualization, and automated trend and anomaly detection. Across all five companies, the AI-assisted analysis produced detailed, internally consistent, and source-traceable results that a human expert reviewer judged accurate and useful, including in cases requiring explicit methodological adaptation (Return on Assets substituted for ROE at Sigurnosno Staklo; ROE marked Not Meaningful for Tutunski Kombinat's 2018 near-zero-equity year) rather than a mechanical, potentially misleading application of standard formulas. The comparative synthesis across companies further shows that industry and capital-structure choices, more than company size, explain the largest differences in profitability and leverage observed in this sample. As in prior single-company work, the most effective analytical process combined AI-enabled data processing, cross-validation, and synthesis with human review and contextual judgment,

rather than relying exclusively on either approach — a conclusion this five-company study puts on firmer ground than a single case could support.

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CORRELATION ANALYSIS OF NET WAGES AND THE MINIMUM CONSUMER BASKET IN THE REPUBLIC OF NORTH MACEDONIA AND THE REPUBLIC OF SERBIA

Meri Spirkoska[1]

Abstract

Wages represent the compensation that workers receive for the tasks or work they have completed, while the net wage represents the same compensation reduced by all mandatory taxes and contributions. The net wage essentially reflects the amount that the worker actually has available for spending. In this context, the consumer basket represents a standard set of goods and services purchased by an average household, which can be calculated on a monthly or annual basis. It serves as an important indicator of the minimum living costs for an average family on a monthly or annual level, as well as the purchasing power of the population. In this paper, a correlation analysis will be conducted between the average net wage and the minimum consumer basket in the Republic of North Macedonia and the neighboring Republic of Serbia. After calculating and interpreting the results, a comparative analysis will be conducted to examine changes in North Macedonia and Serbia during the periods before, during and after the COVID-19 pandemic (2018-2025). The analysis will also identify differences in living standards between the two neighboring countries and assess how they responded to the economic shock caused by the pandemic. The results indicate a statistically significant and very strong positive correlation between the average monthly net wage and the minimum consumer basket in both North Macedonia and Serbia. Furthermore, the comparative analysis shows that Serbia maintained a more favorable balance between wage growth and the cost of living, whereas in North Macedonia the growth of the minimum consumer basket outpaced wage growth, particularly during and after the COVID-19 pandemic.

Keywords: net wage, minimum consumer basket, correlation analysis, comparative analysis, COVID-19 pandemic

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1. Introduction

The main objective of this research is to examine the relationship between the average monthly net wage and the minimum consumer basket with the correlation analysis and comparative analysis of the average net wage and the minimum consumer basket in the Republic of North Macedonia and the Republic of Serbia. By comparing North Macedonia and Serbia over the period from 2018-2025, the reasearch provides empirical evidence on whether wage growth has kept pace with increases in the cost of living, particularly during the periods of economic uncertanty including the COVID-19 pandemic. The analysis includes the calculation of the coverage of the minimum consumer basket by the average net wage, an examination of the annual changes in both indicators (January-to-January), and a comparison of the obtained results between the two countries. The selected period covers the years before the COVID-19 pandemic, during the pandemic itself and the period after the COVID-19 pandemic. The study employed Pearson's correlation analysis, covariance analysis, significance testing, and comparative analysis based on official statistical data covering the period from 2018 to 2025. The results were obtained using Microsoft Excel.

2. Literature Review

The relationship between wages, prices, and living standards has been widely analysed in economic literature, as changes in wages and prices directly influence households' purchasing power. Specifically, the way in which wages and prices adjust is important when it comes to determining whether rises in income are enough to offset increasing living costs.

Jiménez-Bandala and Jiménez-Bandala (2024) analyzed the relationship between wages and the Well-being Basket in Mexico, with a particular focus on how the purchasing power of wages has changed in the period after the pandemic. The authors point out that, despite the economic instability caused by the COVID-19 pandemic, the Russia-Ukrain war and inflationary pressures, was moderated with government economic policies, especially with wage policies designed to raise the minimum wage have helped to narrow the gap between income levels and the cost of the consumption basket. The study highlights that consumer baskets represent an important indicator for assessing households' ability to cover essential expenditures and that it is essential to maintain sustainable wage growth for preserving purchasing power and improving living standards.

Sejdinaj, Mici and Lazaj (2026) analyzed the relationship between wages, cost of living, and real purchasing power in six Western Balkan capitals, including Skopje and Belgrade. Their study examines the capacity of individuals to cover essential living expenses and highlights persistent challenges related to wage adequacy, purchasing power disparities, and socio-economic differences compared to those of the European Union standards. The results emphasize the importance of wage growth, improved purchasing power, and effective economic

policies aimed at reducing the gap between income levels and living costs in the Western Balkan region.

The International Labour Organization (2025) emphasizes that wage-setting should be based on the needs of workers and their families, ensuring that wages are sufficient to cover the total cost of meeting those needs. According to the report, adequate wages should be determined by considering indicators such as the cost of living, inflation, productivity, employment, and overall economic conditions. The ILO highlights that it is essential to examine the relationship between wages and the cost of living for ensuring fair remuneration, preserving purchasing power, and improving workers' living standards.

Imeri Jusufi et al. (2024) examined the impact of rising retail prices and inflation on household purchasing power over the period from 2010 to 2022. Their study analysed the structure of the consumer basket, identifying the share and expenditure allocated to essential categories such as food, transport, electricity, fuel, and other basic household needs. Furthermore, they examined fluctuations in the prices of petroleum products and electricity, comparing these trends with those observed in European countries. In addition, the authors analysed the trends in the minimum net wage, the consumer basket, and the inflation rate during the period 2010–2022. Finally, they assessed the changes in the minimum and average net wages in relation to inflation, as well as the relationship between the average net wage and the minimum consumer basket. The present research differs from their study in both its objective and methodology. Rather than focusing primarily on the effects of inflation and the composition of the consumer basket, this study performs a correlation analysis to examine the relationship between the average monthly net wage and the minimum consumer basket separately for North Macedonia and Serbia. Furthermore, it provides a comparative analysis of the changes in these two indicators over the period from 2018 to 2025, with the aim of assessing how the COVID-19 pandemic influenced wage growth and minimum living costs in both countries and if the average net wage was enough to cover the expenses of the consumer basket.

3. Data and Methodology

This study is based on secondary data collected from the official national institutions in the Republic of North Macedonia and the Republic of Serbia. Data about the Average Monthly Net Wage in North Macedonia were obtained from the State Statistical Office (Statistical Office of the Republic of North Macedonia, 2018-2025), meanwhile data on the Minimum Trade Union Consumer Basket were obtained from the Federation of Trade Unions of Macedonia (Federation of Trade Unions of Macedonia, 2018-2025). For Serbia, the data for the Average Monthly Net Wage were obtained from the Statistical Office of the Republic of Serbia (Statistical Office of the Republic of Serbia, 2018-2025), meanwhile the data for Minimum Consumer Basket were collected from the Ministry of Internal and External Trade of the Republic of Serbia (Ministry of Internal and External Trade of the Republic of Serbia, 2018-2025). The analysis is based exclusively on

January data for each year from 2018 until 2025. A quantitative research methodology was applied in this study. First, a correlation analysis was conducted separately for North Macedonia and Serbia using the formulas for Covariance and Pearson's Correlation Coefficient to examine the relationship between the variables. The calculations of the Covariance and the Pearson's correlation coefficient were performed according to the formulas presented in the book Statistics for Business and Economics (5th edition) presented by Anderson, Sweeney, and Williams. Furthermore, a comparative analysis was conducted to examine the changes between the Average Monthly Net Wage and the Minimum Consumer Basket from one January to the next one over the period from 2018 until 2025, as well as the percentage coverage of the Minimum Consumer Basket by the Average Monthly Net Wage across the pre-COVID-19, during COVID-19 and post-COVID-19 periods. All calculations and graphical presentations were performed using Microsoft Excel.

4. Results and discussion

4.1. Correlation analysis

Before starting the analysis, it should be noted that the Minimum Trade Union Consumer Basket in North Macedonia and the Minimum Consumer Basket in Serbia are based on different methodologies and are calculated by different institutions. However, both indicators share a common economic objective: estimate the minimum level of expenditure required to meet the basic needs of a household. Consequently, in this research these indicators are considered comparable measures for examining the relationship between average net wages and the minimum costs of living.

To examine the relationship between the average monthly net wage and the minimum trade union consumer basket or minumum consumer basket, a correlation analysis was conducted separately for North Macedonia and Serbia using Pearson's Correlation coefficient and Covariance. Formulas that are used for determining the *Pearson's Correlation coefficient* are:

$$r_{x\gamma} = \frac{\sum x_i y_i - (\sum x_i \sum y_i)/n}{\sqrt{\sum x_i^2 - (\sum x_i)^2/n}\sqrt{\sum y_i^2 - (\sum y_i)^2/n}} \quad (1)$$

$$r_{x\gamma} = \frac{S_{x\gamma}}{S_x S_\gamma} \quad (2)$$

Meanwhile, for the *Covariance*, formulas that are used are:

$$S_{x\gamma} = \frac{\sum (x_i - \bar{x})\,(y_i - \bar{y})}{n-1} \quad (3)$$

$$\sigma_{x\gamma} = \frac{\sum (x_i - \mu_x)(y_i - \mu y)}{N}$$

(4)

$$r_{xy} = \frac{S_{xy}}{S_x S_y} \tag{5}$$

In *Table 1*, are presented all the calculations needed for the correlation analysis.

Table 1. Calculations for the Correlation Analysis for Republic of North Macedonia

	Average Monthly Net Wage	*Minimum Trade Union Consumer Basket*	*Sample Covariance*			*Population Covariance*			*Pearson Product Moment Correlation Coefficient: Sample Data*		*Pearson Product Moment Correlation Coefficient: Sample Data, Alternate Formula*		
January	*X (10^3 Macedonian Denars)*	*Y (10^3 Macedonian Denars)*	$(x_i-\bar{x})$	$(y_i-\bar{y})$	$(x_i-\bar{x})(y_i-\bar{y})$	$(x_i-\mu_x)$	$(y_i-\mu_y)$	$(x_i-\mu_x)(y_i-\mu_y)$	$(x_i-\bar{x})^2$	$(y_i-\bar{y})^2$	x_iy_i	x_i^2	y_i^2
2018	24.025	32.354	-7.334	-9.969	73.106	-7.334	-9.969	73.106	53.782	99.373	777.305	577.201	1,046.781
2019	24.517	32.761	-6.842	-9.562	65.417	-6.842	-9.562	65.417	46.808	91.425	803.201	601.083	1,073.283
2020	27.540	32.791	-3.819	-9.532	36.398	-3.819	-9.532	36.398	14.582	90.852	903.064	758.452	1,075.250
2021	28.272	33.650	-3.087	-8.673	26.769	-3.087	-8.673	26.769	9.527	75.214	951.353	799.306	1,132.323
2022	29.980	35.811	-1.379	-6.512	8.977	-1.379	-6.512	8.977	1.901	42.401	1,073.614	898.800	1,282.428
2023	33.943	50.799	2.584	8.476	21.906	2.584	8.476	21.906	6.679	71.849	1,724.270	1,152.127	2,580.538
2024	39.542	57.163	8.183	14.840	121.444	8.183	14.840	121.444	66.968	220.237	2,260.339	1,563.570	3,267.609
2025	43.050	63.252	11.691	20.929	244.693	11.691	20.929	244.693	136.688	438.039	2,722.999	1,853.303	4,000.816
Total:	***250.869***	***338.581***	***0.000***	***0.000***	***598.711***	***0.000***	***0.000***	***598.711***	***336.935***	***1,129.390***	***11,216.145***	***8,203.841***	***15,459.027***

$\bar{x}$	31.359		$\bar{y}$	42.323

For North Macedonia, the Pearson correlation coefficient was calculated at $\mathbf{r_{xy}}$ = **0.970559761,** indicating a strong positive relationship between the average monthly net wage and the consumer basket. This suggests that increases in the wages were generally accompanied by increases in the consumer basket during the observed period. Meanwhile the positive covariance value, $\mathbf{S_{xy}}$ **= 85.530** confirms that both variables moved in the same direction.

Table 2. Calculations for the Correlation Analysis for Republic of Serbia

	Average Monthly Net Wage	Minimum Consumer Basket	Sample Covariance			Population Covariance			Pearson Product Moment Correlation Coefficient: Sample Data		Pearson Product Moment Correlation Coefficient: Sample Data, Alternate Formula		
January	X (10^3 Serbian Dinars)	Y (10^3 Serbian Dinars)	$(x_i-\bar{x})$	$(y_i-\bar{y})$	$(x_i-\bar{x})(y_i-\bar{y})$	$(x_i-\mu_x)$	$(y_i-\mu_y)$	$(x_i-\mu_x)(y_i-\mu_y)$	$(x_i-\bar{x})^2$	$(y_i-\bar{y})^2$	x_iy_i	x_i^2	y_i^2
2018	50.048	36.214	-23.030	-7.222	166.316	-23.030	-7.222	166.316	530.358	52.155	1,812.438	2,504.802	1,311.454
2019	54.521	36.608	-18.557	-6.828	126.701	-18.557	-6.828	126.701	344.344	46.620	1,995.905	2,972.539	1,340.146
2020	59.941	37.486	-13.137	-5.950	78.161	-13.137	-5.950	78.161	172.568	35.401	2,246.948	3,592.923	1,405.200
2021	63.109	38.141	-9.969	-5.295	52.782	-9.969	-5.295	52.782	99.371	28.036	2,407.040	3,982.746	1,454.736
2022	70.920	41.758	-2.158	-1.678	3.620	-2.158	-1.678	3.620	4.655	2.815	2,961.477	5,029.646	1,743.731
2023	82.769	49.420	9.692	5.984	57.995	9.692	5.984	57.995	93.925	35.810	4,090.444	6,850.707	2,442.336
2024	95.836	52.775	22.759	9.339	212.544	22.759	9.339	212.544	517.949	87.219	5,057.745	9,184.539	2,785.201
2025	107.476	55.085	34.399	11.649	400.712	34.399	11.649	400.712	1,183.257	135.702	5,920.315	11,551.091	3,034.357
Totals	584.620	347.487	0.000	0.000	1098.832	0.000	0.000	1,098.832	2,946.426	423.758	26,492.313	45,668.994	15,517.160

According to *Table 2*, for Serbia, the Pearson correlation coefficient was calculated at $\mathbf{r_{xy} = 0.983395274}$, showing a strong positive relationship between the two variables. Also indicating that changes of the average net wage were followed by changes in the consumer basket over the analysed perion, while the positive covariance value, $\mathbf{S_{xy} = 156.976}$, also confirms that both variables moved in the same direction.

To determine whether the observed correlation coefficient is statistically significant, a t-test was performed. The null hypothesis assumes that there is no statistically significant relationship between the average monthly net wage and the consumer basket, while the alternative hypothesis assumes the existence of a significant relationship.

$$H_0 : \rho_{xy} = 0$$

$$H_a : \rho_{xy} \neq 0 \quad (6)$$

Formulas that were used for the calculations are:-

$$t_1 = r_{xy}\sqrt{\frac{n-2}{1-r^2_{xy}}} \quad (7)$$

$$df = n\text{-}2 \quad (8)$$

The calculated t-value for North Macedonia was $\mathbf{t_1 = 9.8715}$ with 6 degrees of freedom **(df = 6)**. At the 5% significance level **($\alpha = 0.05$),** the critical t-value is **±2.447**. Since the calculated t-value is greater than the critical value **(9.8715 > 2.447)**, the null hypothesis is rejected. Therefore, it can be concluded

that there is *a statistically significant and very strong positive linear correlation* between the analyzed variables in North Macedonia.

The statistical significance of the Pearson correlation coefficient was also tested for Serbia. The calculations showed that $\mathbf{t_1 = 13.280}$ with 6 degrees of freedom **(df = 6),** which is greater than the critical value **(13.280 > 2.447, α = 0.05)**. Consequently, the null hypothesis is rejected. Therefore, it can be concluded that there is a *statistically significant and very strong positive linear correlation* between the analyzed variables in Serbia.

4.2. Comparative analysis between North Macedonia and Serbia

In *Table 3*, are presented the data for North Macedonia and Serbia about the average monthly net wage and the consumer's basket for each January for the period from 2018 until 2025. This table is devided in three groups (periods). The first period is before the COVID-19 pandemic, during the COVID-19 pandemic and after the COVID-19 pandemic. As shown in the table, both countries exhibited an overall upward trend during the observed period, although the pace of growth differed between North Macedonia and Serbia. But one main thing that we can establish from Table 3 is that the average net wage covers more than 100% of the consumers basket in Serbia, while in North Macedonia is less than an 100%.

Table 3. Comparative analysis between Republic of North Macedonia and Republic of Serbia

	REPUBLIC OF NORTH MACEDONIA			*REPUBLIC OF SERBIA*		
YEAR	*Average monthly net wage*	*Minimum Trade Union Consumer Basket*	*Coverage of the Consumer Basket by the Average Net Wage (%)*	*Average monthly net wage*	*Minimum Consumer Basket*	*Coverage of the Consumer Basket by the Average Net Wage (%)*
BEFORE COVID-19 PANDEMIC						
JANUARY 2018	24 025	32 354	74.26	50 048	36 214	138.20
JANUARY 2019	24 517	32 761	74.84	54 521	36 608	148.93
DURING COVID-19 PANDEMIC						
JANUARY 2020	27 540	32 791	83.99	59 941	37 486	159.90
JANUARY 2021	28 272	33 650	84.02	63 109	38 141	165.46
JANUARY 2022	29 980	35 811	83.72	70 920	41 758	169.84
JANUARY 2023	33 943	50 799	66.82	82 769	49 420	167.48
AFTER COVID-19 PANDEMIC						
JANUARY 2024	39 542	57 163	69.17	95 836	52 775	181.59
JANUARY 2025	43 050	63 252	68.06	107 476	55 085	195.11

**Note: The data in the Average Monthly Net Wage and Minimum Trade Union Consumer Basket columns for the Republic of North Macedonia are expressed in Macedonian denars (MKD), whereas the data in the Average Monthly Net Wage and Minimum Consumer Basket columns for the Republic of Serbia are expressed in Serbian dinars (RSD).*

Firstly, as shown in *Table 3*, the average monthly net wage in the Republic of North Macedonia exhibited an upward trend over the observed period. Between January 2018 and January 2019, the average monthly net wage was increased by 492 Denars, while the value of the minimum trade union consumer basket was increased by 407 Denars. This period represents the pre-COVID-19 phase and reflects relatively stable economic conditions prior to the outbreak of the pandemic. The increase in the average monthly net wage exceeded the increase in the value of the minimum trade union consumer basket, indicating a slight improvement in the relationship between wages and minimum living costs during this period. Furthermore, between January 2019 and January 2020, the average monthly net wage was increased by 3023 Denars, while the value of the minimum trade union consumer basket was increased by only 30 Denars. This indicates that the growth rate of the average monthly net wage was significantly higher than the increase in the trade union's consumer basket suggesting a further improvement in the purchasing power of employees during this period.

In 2020, the peak of the COVID-19 pandemic began to affect economic conditions. During the period from January 2020 to January 2021, the average monthly net wage increased by only 732 Denars, which can be considered a signigicantly lower increase compared to the previod period (Jan 2019 – Jan 2020). While the minimum trade union consumer basket increased by 859 Denars, representing a considerably higher growth compared to the previous period. During the period from January 2021 to January 2022, the average monthly net wage was increased by 1708 Denars, while the value of the minimum trade union consumer basket increased by 2161 Denars. From the calculations, we can see that both the average net wage and the trade union consumer basket increased more than the previous period. Furthermore, between January 2022 and January 2023, the average monthly net wage increased by 3963 Denars, whereas the minimum trade union consumer basket recorded a substantially higher increase od 14988 Denars. This significant divergence between wage growth and the increase in minimum living costs indicates that the rise in the household expenses was considerably faster than the growth of incomes during the COVID-19 pandemic. Consequently, the purchasing power of employees was further reduced, as wages were unable to fully compensate for the rapid increase in the cost of living.

During the period from 2023-2024, the average monthly net wage increased by 5599 Denars, representing a higher increase compared to the previous period. At the same time, the value of the minimum trade union cosumer basket increased by 6364 Denars, which is significantly lower than the increase recorded in the previous period. Although the growth of living costs continued to exceed wage growth, we can see that it is significantly less than the previous period. In the following period, from January 2024 to January 2025, the average monthly net wage increased by 3508 Denars, while the minimum trade union consumer basket increased by 6089 Denars. This indicated that the increase in

minimum living costs continued to surpass wage growth, which may have contributed to continued pressure on household purchasing power.

As can be observed from the data presented in the *Table 3*, in Republic of Serbia, the period preceding the COVID-19 pandemic was characterized by a steady increase in the average monthly net wage. Between January 2018 and January 2019, the average monthly net wage was increased by 4473 Serbian Dinars, while between the period from January 2019 until January 2020 it recorded a further increase of 5420 Serbian Dinars. Meanwhile, the minumum consumer basket was also increased for 394 Serbian Dinars for the period from January 2018 unitl January 2019, and by 878 Serbian Dinars for the period between January 2019 – January 2020.

During the COVID-19 pandemic, the first period between January 2020 and January 2021, we can see that there is a lower increase in the average monthly net wage by 3168 Serbian Dinars, while the consumer's basket is increased by 655 Serbian Dinars, less than the period before the COVID-19 pandemic. After in the period between January 2021 and January 2022, the average monthly net wage is increased by 7811 Serbian Dinars or 4643 Serbian Dinars more that the period between 2020-2021. Also the consumer basket is increased by 3617 Serbian Dinars. We can see an noticeable improvement in the period 2022-2023, where the average net salary was increased significantly by 11849 Serbian Dinars, while the consumer basket was increased by 7662 dinars. Although the considerable increase in the average net wage may initially suggest a significant improvement in the living standards, the simultaneous and substantial rise in the cost of the minimum consumer basket indicates that a considerable portion of the wage growth was absorbed by higher living costs.

After the COVID-19 pandemic, in the two analysed periods, namely January 2023 to January 2024 and January 2024 to January 2025, a significant increase in the average monthly net wage can be observed, with the increase in the first period being slightly higher than that recorded in the second period. However, it is important to note that, although the minimum consumer basket continued to increase, its growth was relatively moderate and did not have a substantial impact on the increase in the average monthly net wage.

Table 4. Increase in the Average Monthly Net Wages in North Macedonia and Serbia

	North Macedonia		*Serbia*	
Years	*Increase in the Average Monthly Net Wages*	*%*	*Increase in the Average Monthly Net Wages*	*%*
Before COVID–19 pandemic				
2018-2019	*492*	*2.05*	*4473*	*8.94*
2019-2020	*3023*	*12.33*	*5420*	*9.94*
During COVID–19 pandemic				
2020-2021	*732*	*2.66*	*3168*	*5.29*
2021-2022	*1708*	*6.04*	*7811*	*12.38*
2022-2023	*3963*	*13.22*	*11 849*	*16.71*
After COVID–19 pandemic				
2023-2024	*5599*	*26.83*	*13 067*	*15.79*
2024-2025	*3508*	*8.87*	*11 640*	*12.15*

**Percentage calculation – for example - % = ((24.517-24.025)/24.025)*100*

** Note: The Average Monthly Net Wages data for the Republic of North Macedonia are expressed in Macedonian denars (MKD), while those for the Republic of Serbia are expressed in Serbian dinars (RSD). The analysis is conducted on a year-on-year basis, comparing the values recorded in January of each year during the period 2018–2025. The amounts were calculated based on the differences between two consecutive years*

Before the COVID-19 pandemic, the results indicate that in North Macedonia, between 2018 and 2019, the average monthly net wage and the minimum trade union consumer basket increased at a relatively similar pace. However, during the 2019–2020 period, the increase in the average monthly net wage exceeded the increase in the consumer basket. In contrast, Serbia recorded substantially higher growth in the average monthly net wage than in the minimum consumer basket in both the 2018–2019 and 2019–2020 periods.

Table 5. Increase in the Minimum Consumer Basket in North Macedonia and Serbia

	North Macedonia		*Serbia*	
Years	***Increase in the Minimum Trade Union Consumer Basket***	***%***	***Increase in the Minimum Consumer Basket***	***%***
Before COVID–19 pandemic				
2018-2019	*407*	*1.26*	*394*	*1.09*
2019-2020	*30*	*0.09*	*878*	*2.40*
During COVID–19 pandemic				
2020-2021	*859*	*2.62*	*655*	*1.75*
2021-2022	*2161*	*6.42*	*3617*	*9.48*
2022-2023	*14988*	*41.85*	*7662*	*18.35*
After COVID–19 pandemic				
2023-2024	*6364*	*12.53*	*3355*	*6.79*
2024-2025	*6089*	*10.65*	*2310*	*4.38*

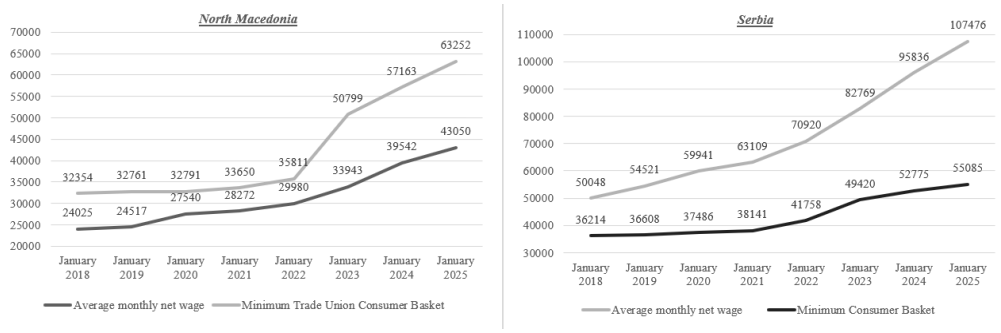
**Percentage calculation – for example - % = ((24.517-24.025)/24.025)*100*

**Note: The Minimum Consumer Basket data for the Republic of North Macedonia are expressed in Macedonian denars (MKD), while those for the Republic of Serbia are expressed in Serbian dinars (RSD). The analysis is conducted on a year-on-year basis, comparing the values recorded in January of each year during the period 2018–2025. The amounts were calculated based on the differences between two consecutive years.*

During the COVID-19 period, both countries experienced increases in average monthly net wages and consumer basket values; however, the patterns differed. In North Macedonia, the minimum trade union consumer basket increased at a faster rate than the average monthly net wage, particularly during the 2022–2023 period, indicating that the growth in wages was insufficient to fully offset the rising cost of living. In Serbia, although both indicators also increased, the growth of the average monthly net wage consistently exceeded the growth of the minimum consumer basket. Furthermore, the calculations show that in both countries the increase in average monthly net wages during the 2020–2021 period was lower than in the years preceding the COVID-19 pandemic. The

highest annual increase in the consumer basket was observed during the 2022–2023 period in both North Macedonia and Serbia, reflecting the strong inflationary pressures following the pandemic and the global energy crisis.

In the post-COVID-19 period, the differences between the two countries became even more pronounced. In North Macedonia, the minimum trade union consumer basket continued to increase at a faster rate than the average monthly net wage, suggesting a continued deterioration in purchasing power. Conversely, in Serbia, the average monthly net wage grew considerably faster than the minimum consumer basket, indicating a more favourable trend in maintaining



household purchasing power.

Figure 1. Changes in the Average Monthly Net Wage and the Minimum Consumer Basket in Republic of North Macedonia and the Republic of Serbia for the period from January 2018 until January 2025

5. Conclusion

To conclude, the results of this study indicate a statistically significant and very strong positive linear correlation between the average net wage and the minimum trade union consumer basket in the Republic of North Macedonia. Similarly, a statistically significant and very strong positive linear correlation was found between the average net wage and the minimum consumer basket in the Republic of Serbia. The comparative analysis indicates that the economic effects of the COVID-19 pandemic and the subsequent inflationary pressures affected both countries, although with varying intensity. Although both countries recorded continuous wage growth, the ability of wages to keep pace with the rising cost of living differed significantly. These findings highlight the importance of implementating economic and social policies that support sustainable wage growth while simultaneously limiting the adverse effects of increasing living costs on households. This study contributes to a better understanding of the relationship between wages and the minimum cost of living in North Macedonia and Serbia and provides useful evidence for future economic analyses and policy discussions.

5.1. Limitations of the study

This study has several limitations that should be acknowledged. First, the analysis is based on a relatively short observation period, from 2018 until 2025, which may not fully capture long-term economic trends and structural changes. Second, the analysis considers only two indicators, the average net wage and the minimum consumer basket (the minimum trade union consumer basket), which limits the scope of the findings and does not account for other factors that may influence the relationship between wages and the cost of living, such as inflation, unemployment, productivity, or economic growth. Therefore, the results should be interpreted within the context of these limitations.

5.2. Recommendations for the future research

Future studies could incorporate additional macroeconomic variables, such as inflations, unemployment, productivity, and economic growth, in order to provide a more comprehensive understanding of the factors influencing the relationship between wages and living costs. Furthermore, application of other statistical methods could enable more detailed analyses. Future studies could also extend the comparative analysis to include other Western Balkan countries.

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OPPORTUNITIES AND CHALLENGES OF ARTIFICIAL INTELLIGENCE FOR WOMEN ENTREPRENEURS: EXAMPLES OF WOMEN ENTREPRENEURS IN TÜRKIYE

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Abstract

Women's entrepreneurship plays a significant role in economic development, job creation, and the promotion of economic growth. Throughout history, women entrepreneurs have faced numerous challenges in both entrepreneurial activities and working life. These challenges include limited access to finance and resources, lower levels of education, lack of experience, and societal prejudices. Artificial Intelligence (AI) plays an important role in helping women entrepreneurs overcome challenges, become empowered, and ensure the sustainability of their businesses. While AI offers various opportunities for women entrepreneurs, it also brings certain challenges. In particular, AI facilitates access to finance and resources, enables the analysis of market trends and customer preferences, supports strategic decision-making, reduces operational costs, and enhances customer satisfaction and loyalty. However, AI also presents several challenges for women entrepreneurs, including algorithmic bias, competitive pressure, the digital divide, and limited access to technology. The research involved a literature review. It was observed that artificial intelligence increased the productivity and profitability of female entrepreneurs, facilitated their access to finance, and enhanced their competitiveness.

Keywords: Women's entrepreneurship, artificial intelligence, Turkish women entrepreneurs.

1. Introduction

Women's entrepreneurship refers to entrepreneurial activities carried out by women. Women's entrepreneurship plays an important role at the macro level in economic development, employment creation, and promoting economic growth, while at the micro level it contributes to the development and empowerment of the family (Nişancı & Ödemiş, 2022, p. 45). In addition, entrepreneurship provides women with economic security, the freedom to express

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themselves, independent decision-making within and outside the family, self-management, self-reliance, self-actualization, reinforcement of the desire to succeed, the ability to pursue greater goals, greater self-confidence, the ability to act more independently, and individual empowerment. Empowered women are valued both within the family and in society (Alom et al., 2025; Gãåven, 2021, p. 379; Panda, 2018).

Women entrepreneurs have faced many challenges throughout history due to being women, both in entrepreneurship and in working life. In particular, the barriers/challenges faced by women entrepreneurs in developing countries are greater than those faced by women entrepreneurs in developed countries. The reason is that women entrepreneurs in developing countries have either very limited or no access to opportunities and resources (such as access to education and healthcare services, inheritance rights, and access to capital and finance). In addition, women entrepreneurs face many problems such as gender discrimination, patriarchal social structure, work–family conflict, the glass ceiling, the glass cliff (Panda, 2018), lack of experience, having micro- or small-sized enterprises, lack of knowledge of marketing and e-commerce, low organizational awareness, and social prejudice. This situation further hinders the entrepreneurial development of women (Nazam et al., 2026).

Artificial Intelligence (AI), which has been frequently mentioned in recent years, increases both business intelligence and entrepreneurial performance. In particular, it plays an important role in empowering women entrepreneurs who own small enterprises. By integrating AI technology into women-owned businesses, these businesses will be able to adapt to market changes, optimize their processes, and achieve sustainable performance. Thus, for women entrepreneurs who want to succeed in a dynamic and competitive environment, integrating AI technologies into their businesses may be of vital importance (Iram et al., 2025).

The aim of the study is to reveal the opportunities or challenges provided by AI technologies for women entrepreneurs operating in various sectors in Türkiye. For this purpose, a literature review was conducted, and examples of women entrepreneurs operating in Türkiye and using AI-supported digital platforms in their business processes were included in the study. It is thought that this study will contribute to both the academic literature and women entrepreneurs..

2. Women's Entrepreneurship

Women's entrepreneurship refers to the process by which women start, organize, and manage business ventures. These ventures are generally micro- or small-sized enterprises. Some of these women-owned ventures may gradually grow over time (Munir & Watts, 2026).

A woman entrepreneur is a woman who owns a business established in her own name outside the home, works alone or together with employees in her business, or establishes a partnership as the owner, maintains contacts with various public and private institutions regarding the business, makes plans for the

future of the business, has authority over the investment and use of the income generated by the business, and assumes all the risks on behalf of the business. In this context, women who practice their own professions are not considered entrepreneurs because they work in the fields in which they were educated without taking any entrepreneurial risk. Women entrepreneurs possess generally accepted entrepreneurial characteristics such as risk-taking, ambition, dynamism, independence, self-confidence, competitiveness, and goal orientation (Soysal, 2010, p. 90). These characteristics of women entrepreneurs vary from country to country and even from region to region (urban or rural) within the same country (Gãåven, 2021, p. 379).

Under the influence of the social and cultural structure, women generally prefer jobs based on gender or jobs considered suitable for women. Especially in traditional societies, occupations or jobs are divided into women's work and men's work. Therefore, women tend to prefer the service and retail sectors, which are relatively smaller-scale businesses. This is because these sectors require less capital and equipment and enable women to balance both work and family life (Gãåven, 2021, p. 379). In Türkiye, the sectors in which women entrepreneurs are most active are clothing, tailoring, hairdressing, beauty salons, haberdashery, cosmetics, tourism, and food. Most of these businesses are small and medium-sized enterprises (SMEs), and a large proportion of them are family businesses (Çabuk et al., 2015, p. 427).

By engaging in entrepreneurial activities, women create employment both for themselves and for the people they employ. There are two factors that lead women to entrepreneurship: "push" factors and "pull" factors. Push factors refer to the negative conditions or situations that cause women to start their entrepreneurial journey. These include unemployment, excessive pressure and expectations from a previous employer, dissatisfaction with the current job, workplace mobbing, the glass ceiling and queen bee syndrome, family responsibilities such as housework and elderly/child care, insufficient family income, the need for flexible working hours, unsuitable working conditions, and gender discrimination. Pull factors are the positive factors that encourage women to decide to embark on the entrepreneurial journey. These include the need for self-actualization, being independent, standing on their own feet, being their own boss, achieving success, helping others, gaining social status, building a strong communication network, being creative, having power, and earning a good income (Feng et al., 2023; Nişancı & Ödemiş, 2025, p. 46; Serinikli, 2019; Soysal, 2010).

In most countries of the world, the factors that lead women to entrepreneurship vary from country to country. In some countries, push factors are more influential, whereas in others, pull factors are more influential (Erkol Bayram, 2018, p. 59). In most developing countries, women start entrepreneurial activities to improve their socioeconomic status, satisfy their sense of achievement, or enhance their social status. Sometimes, rather than being their first choice, women are forced to become entrepreneurs due to poor economic conditions, the loss/death of the family breadwinner, or social discrimination (Feng et al., 2023). In Türkiye, women generally turn to entrepreneurship under

the influence of push factors. It is stated that one of the main reasons driving women to become entrepreneurs in Türkiye is the effort to reduce the negative effects of the country's macroeconomic conditions on household income (Çabuk et al., 2015, p. 426). Therefore, the primary reasons for women becoming entrepreneurs in Türkiye are to contribute to family income and meet family needs. In addition, women who experience the glass ceiling or queen bee syndrome in the workplace are also seen to decide to start their own businesses. Apart from push factors, some women in Türkiye also turn to entrepreneurship under the influence of pull factors. These include practicing their profession, realizing their ideals, being independent, being beneficial to others, proving themselves, the desire to succeed, being their own boss, making good use of their time, not being dependent on their families, having a wide social network, and having work experience in the private sector (Keskin, 2014).

2.1. Problems Faced by Women Entrepreneurs in Türkiye

Although the challenges/barriers faced by women entrepreneurs are generally similar around the world, they may vary from country to country. This variation is influenced by the socio-cultural structures of countries, their geographical location, government policies, and macroeconomic conditions (Gãåven, 2021, p. 381). Women face more problems than male entrepreneurs because they are women. This is because entrepreneurship is generally perceived as a male domain. Especially in patriarchal societies, women are less likely to engage in entrepreneurship. Since a woman's place is considered to be the home and her primary responsibility is her family, it is often not possible for her to start a business without the permission of her husband or other family members. Therefore, patriarchal societies constitute a major barrier to women's entrepreneurial activities (Erkol Bayram, 2018, p. 60; Panda, 2018).

Women entrepreneurs face various barriers/challenges both while establishing their businesses and after their businesses start operating. These include difficulty in obtaining capital, limited access to financial resources, scarcity of raw materials, generally low levels of education, complicated bureaucratic procedures, legal and bureaucratic barriers, inadequate infrastructure, inability to compete, society's expectations of failure, and gender-based discrimination (Manolova et al., 2020; Panda, 2018; Raghuwanshi & Dhengle, 2026). Women entrepreneurs operating in Türkiye also experience these challenges faced by women entrepreneurs worldwide. In addition, women entrepreneurs in Türkiye face challenges such as being unable to collect their receivables on time, low internet usage, lack of mentors, lack of knowledge and skills in business management, lack of business experience, having few customers, difficulty in finding low-cost and high-quality raw materials, inadequate marketing strategies, lack of knowledge of e-commerce, and work–life conflict. Because of these challenges faced by women entrepreneurs, the growth and development of their businesses become quite difficult (Çabuk et al., 2015, p. 428; Keskin, 2014; Nişancı & Ödemiş, 2022, p. 47; Soysal, 2010, p. 97; Serinikli, 2019).

3. The Impact of Artificial Intelligence on Women's Entrepreneurship

We are at the beginning of a new industrial revolution. This revolution, called Industry 4.0, refers to the transition from a production approach in which machines only perform routine tasks to digital production in which machines can communicate with each other, manage and control themselves, and collaborate autonomously. In this new revolution, Artificial Intelligence (AI) plays a key role. AI creates advantages on the one hand and disadvantages on the other. Therefore, while benefiting from the advantages of AI technologies (in terms of new occupations, new opportunities, and productivity increases), it is necessary to avoid their disadvantages (in terms of rising unemployment, the disappearance of occupations, job losses, and income inequality) (Giuggioli & Pellegrini, 2023). Developments in AI technologies are reshaping traditional business models and strategies and playing an important role in the development of digital-based entrepreneurship and related business models. AI provides support to entrepreneurs by reducing entrepreneurial risk, increasing labor productivity, creating more effective entrepreneurial models, and generating new business demands (Özcan & Yılmaz, 2023, p. 26). In addition, AI applications enable entrepreneurs to create new opportunities, make better predictions and therefore make more informed decisions, optimize business processes, and overcome financial complexities more easily (Almheiri et al., 2025, p. 35; Giuggioli & Pellegrini, 2023). Therefore, AI is not a dangerous enemy for entrepreneurs but a facilitating assistant (Giuggioli & Pellegrini, 2023).

AI is a powerful and promising technology that can improve the performance and competitiveness of micro, small, and medium-sized enterprises. Therefore, AI is particularly important for women entrepreneurs, who generally own micro and small-sized enterprises. In particular, the development of women entrepreneurs, who have faced various challenges throughout history, has often been hindered, and their contribution to the global economy has remained limited. At this point, AI and AI applications offer a unique opportunity to reduce or eliminate, to some extent, the barriers/challenges faced by women entrepreneurs (YongGang et al., 2025, p. 2).

AI helps empower women entrepreneurs, reduce gender inequality, and overcome traditional business barriers (Almheiri et al., 2025, p. 35). AI brings both opportunities and challenges for women entrepreneurs. While AI creates opportunities by enabling women entrepreneurs to overcome traditional barriers, it also creates challenges due to potential biases in AI systems and unequal access to advanced technologies (Ding & Xing, 2026). In addition, lack of infrastructure, the high installation costs of AI, low digital literacy, and the digital divide are the main challenges faced by women entrepreneurs in adopting AI. In particular, the "digital divide" affecting women entrepreneurs in rural areas of developing countries still persists. Limited digital literacy and inadequate infrastructure in these areas hinder the effective adoption and use of AI technologies (Aiswarya & Sangeetha, 2023, p. 48).

AI is a powerful tool for creating equal opportunities for women entrepreneurs. AI makes positive contributions to women entrepreneurs in every

aspect, from helping them make informed decisions to facilitating business operations, and from managing their businesses to growing them (Seibert, 2024). Women entrepreneurs can now use AI to grow and compete in various sectors (YongGang et al., 2025, p. 2). AI applications can increase the creativity, productivity, and output of women entrepreneurs; enable them to access emerging markets and financial resources (Aiswarya & Sangeetha, 2023, p. 41); increase women's employment rates; and reduce gender inequality (Kumar, 2024, p. 19). In addition, AI can facilitate and automate essential tasks such as accounting operations, including inventory management and invoicing, as well as social media, financial management, and marketing (Seibert, 2024). AI algorithms can analyze large datasets to identify market trends, customer preferences, and potential new customers, make demand forecasts, and automate customer interactions. Therefore, AI has a positive effect on helping women entrepreneurs make strategic decisions, reducing market risks, increasing customer loyalty, and enhancing competitiveness (YongGang et al., 2025, p. 3). Previous studies have also shown that AI has a positive effect on women's entrepreneurship (Aiswarya & Sangeetha, 2023; YongGang et al., 2025; Almheiri et al., 2025).

4. Examples of Women Entrepreneurs on the Impact of Artificial Intelligence on Women's Entrepreneurship

The use of AI among women entrepreneurs is increasing rapidly. Women entrepreneurs use AI platforms to enter international markets by benefiting from AI applications for language translation, obtaining cultural information, and conducting market analysis. Thus, through AI, women entrepreneurs are able to enter international markets that were previously difficult to access and benefit from the opportunities offered by these markets (Seibert, 2024).

In 2026, the research report *Adopted not Embedded: AI, Productivity and Uneven Gains for Women Entrepreneurs* was prepared through the collaboration of the Cherie Blair Foundation for Women, Intuit, Team Lewis Foundation, and the World Bank. The report was based on a survey of 3,072 women entrepreneurs in 66 low- and middle-income countries. According to the report, it was concluded that the use of AI is widespread among women entrepreneurs and provides tangible benefits. While the rate of AI use among women entrepreneurs in low- and middle-income countries was 38% in 2024, it increased to 82% in 2025. In addition, while the proportion of women entrepreneurs who stated that they were not familiar with technology was 24% in 2024, it decreased to 2% in 2025. It was found that 69% of women entrepreneurs stated that AI saves time, allowing them to devote more time to household responsibilities. Furthermore, according to the report, 60% of women entrepreneurs use AI for marketing activities, 55% for learning, 54% for design, 35% for accounting, and 33% for operational activities (https://cherieblairfoundation.org/what-we-do/research/women-entrepreneurs-ai/).

Women entrepreneurs operating in a wide range of fields, from healthcare to digital fashion, from creative tools to enterprise software and science, have gained many opportunities by using AI and AI technologies in the businesses they

have established. Examples of women-led enterprises established in different countries and still operating include the AI-based consulting company *Agentiiv*, founded by Karla Congson in 2023; the AI software company *Aily Labs*, founded by Bianca Anghelina in 2020; and *Biobot Analytics*, founded in 2020 by Mariana Matus Garcia and her colleagues to detect infectious diseases and harmful substances; *Corrity Inc. (Palgee)*, founded by Sabrina Palme, aims to facilitate AI performance evaluation processes for companies providing financial services (Gonzalez, 2026). In addition, there are companies established by women entrepreneurs in the field of AI. These include the digital software company *Hearsay Social*, founded by Clara Shih in 2009; the AI company *Anthropic*, founded by Daniela Amodei and her brother in 2021; and the AI-based venture *Amini*, founded by Kate Kallot to develop AI-supported solutions by providing detailed data on various environmental factors in Africa (Muradoğlu, 2024). The women entrepreneurs who constitute the subject of this study are those who established their businesses in Türkiye, continue to operate in different sectors, and use AI applications;

Işıl Melisa Işık: Işıl Melisa Işık is the co-founder and CTO of *Toffu*, a venture that provides digital content and AI solutions for the architecture and design industry. Toffu was founded in Istanbul in 2018 to provide high-quality visualization content (human figures, plants, objects, graphic assets, etc.) used by architects and designers in their projects through a single platform. Toffu develops its own generative AI (GenAI) models to accelerate design processes. Since its establishment, Toffu has served architecture firms by contributing to more than 100,000 projects in over 100 countries. In addition to Toffu, Işıl Melisa Işık is also the co-founder of *Archade*, an AI-based platform for architecture and design. In 2025, she received the "Technology-Based Woman Entrepreneur" award at the "Producing Women Competition" organized by Halkbank (https://kadingirisimci.gov.tr; https://www.linkedin.com/company/toffuco/; https://www.linkedin.com/in/melisaisik/).

Zeynep Balca Yılmaz: Zeynep Balca Yılmaz co-founded *Werover* with her colleagues in 2018. As a co-founder of Werover, she has led the company's global expansion, commercial strategy, and business development, and has supported the implementation of its technology in many countries. Werover is a wind turbine blade intelligence company headquartered in London and operating in Türkiye, Europe, the Middle East, and Australia. The company develops smart monitoring and maintenance solutions for wind turbines. In the renewable energy sector, blade failures are often detected late, resulting in increased costs. Traditional inspections provide only snapshots, causing blade failures to be identified too late. By using AI and Internet of Things (IoT) digital technologies, Werover enables the early detection of blade failures, prevents critical blade failures, and reduces costs. The company operates in 10 countries. In 2022, it received the *Successful Woman Entrepreneur of the Year* award from Microsoft Women in Technology Leaders, and in 2025, it received the *Sustainability and Zero Waste Award* at the *Producing Women Competition* organized by Halkbank (https://www.werover.com/company#about; https://kadingirisimci.gov.tr/basari-hikayeleri/).

5. Conclusion and Recommendations

Women entrepreneurs face many challenges in almost all countries, both during the establishment of their businesses and after they are established. These include insufficient capital, lack of access to finance, low levels of education, inadequate business knowledge, and lack of knowledge of marketing and e-commerce. Women entrepreneurs operating in Türkiye also face similar challenges. Although the number of women entrepreneurs in Türkiye has increased over the years, they still lag behind male entrepreneurs both in number and in terms of business size. AI and AI applications can provide many opportunities for women entrepreneurs who struggle with these challenges/barriers and strive to ensure the sustainability of their businesses. For example, AI provides many advantages, such as enabling women entrepreneurs to reach suppliers and customers more easily, increasing customer loyalty, supporting women in making strategic decisions by providing accurate and timely information, and facilitating access to finance. However, low digital literacy and the digital divide in Türkiye reduce the active use of AI applications by some women entrepreneurs, especially those in rural areas. This situation may reduce the competitiveness of women entrepreneurs. Public institutions, universities, non-governmental organizations, and chambers of industry provide training for women entrepreneurs on entrepreneurship, marketing, e-commerce, digital literacy, and AI. These training programs should be expanded, and the necessary measures should be taken to reduce the digital divide in some regions.

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GLOBALIZATION AS A DRIVER OF COMPETITIVE DYNAMICS: EMPIRICAL EVIDENCE FROM NORTH MACEDONIA

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Abstract

Globalization transforms the competitive environment of markets, by increasing the number of competitors, bringing new foreign players with innovative products/services, higher - quality products, lower prices, the emergence of new strategic partnerships and collaborations between competitors. Companies are facing increased pressures, which imposes the need for their rapid and appropriate adaptation. In response to these challenges, organizations are developing strategies to maintain and increase their competitive position by improving the quality of products and services, reducing prices, innovative activities, digital transformation and implementing sustainable practices.

The paper aims to analyze the impact of globalizations on the competitive dynamics of companies in the Republic of North Macedonia and determine the relationship between competitive pressures and their strategic, technological and innovation responses. For this purpose, a survey on 220 Macedonian companies was conducted. In the analysis of the results, descriptive statistics were used to show general trends, correlation analysis to determine the dependencies between perceived competitive pressures and the reactions of companies, and χ^2 - test to examine the relationship between categorical variables, using Microsoft Excel and SPSS.

The results provide insight into how globalization is shaping the competitive dynamics of the Macedonian market and the findings indicate how companies are adapting their strategies, and technological and innovation activities under conditions of increased competition.

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Keywords: globalization, competition, strategic responses, innovation, technology.

1. Introduction

The modern world economy is characterized by an intensive growth, primarily dictated by the globalization, which has fundamentally changed the rules of market competition, dismantled traditional geographic boundaries and introduced companies to a new era of speed, transparency, and unpredictability. (WFO, 2025)

Globalization refers to the integration between the world's nations, markets, and social and political systems. It links distant locations in such a way that events in one place may affect or become affected by events in other locations around the world. The phrases "global village" and "compression of the world" are often used to reflect the interconnected nature of modern life, where technologies such as digital media and the internet allow people to communicate and share information immediately (Alkharafi & Alsabah, 2025)

The term international business refers to any business that includes activities related to the exchange of products, services, or resources that take place across national borders between two or more countries (Boshkoska, Gjorgjioska, Risteska-Jankuloska & Odzaklieska, 2026). International business may be advantageous in terms of economic contribution globally but also comes with certain risks. The fact that every nation is governed by its own system of laws; its own legal and regulatory framework; its own cultural norms and customs; and its own official languages means a company will have to make an assessment of whether the potential rewards of conducting business on an international basis are worth the associated risk (Stobierski, 2021)

In today's fast-changing digital marketplace and globalizing business environment, new technologies play a greater role than before in a company's ability to function successfully and compete on a global scale. Innovations in artificial intelligence (AI), Internet of Things (IoT), big data, blockchain and digital platforms have dramatically changed how companies do business across borders. This change happens in a world of increasingly integrated supply chains and multinational corporations, making the global economy ever more connected. The increased globalization of trade has made it much harder for companies to compete; therefore, the speed with which companies can implement innovative technologies and strategically adjust their technology-based strategies is going to be the key factor for companies to succeed globally (Firdaus, 2023). The efficient functioning of the supply chain in any company contributes to the growth of its competitiveness and profitability in both domestic and international markets (Gligorovski, Jankuloska, Dichovska, 2023). With today's globalized supply chain network, an increasing number of global companies have faced rising levels of risk, both geographically and throughout their supply chains. As a result, global companies must now navigate multiple layers of cultural differences, trade restrictions and political instability when attempting to enter or operate within foreign markets. Therefore, by necessity global firms must utilize new product/service localized offerings, diversified supply chain structures and new

technologies to support their long-term success and sustainability. The examples of leading global firms provide evidence that successful globalization through local market adaptations can be a key element for sustaining competitiveness in today's global marketplace (Jin, 2025).

Globalization enables greater opportunities for international exchange of knowledge and information; however, it is also evident that its benefits are not evenly shared across all nations and businesses (especially those from developing economies). The adaptation and integration of the advanced technologies is a complicated process that is influenced by numerous factors. Modern models of technology acceptance, such as the Technology Acceptance Model (Schorr, 2023), the Unified Theory of Acceptance and Use of Technology (Momani, 2020), and the Diffusion of Innovations (García-Avilés, 2020), are dynamic and subject to continuous change, which further complicates the ability of companies to react quickly and effectively.

Globalization also intensifies international competition, which further emphasizes the necessity of a high degree of technological acceptance and a developed innovation capacity among companies (Skare & Soriano, 2021). The concept of competitiveness is a complex and multidimensional which is why it has gained increasing importance in recent decades in today’s interconnected global economy.

The necessity for sustainable competitiveness has driven organizations to concentrate upon creating/developing both unique and sustainable forms of competitive advantage so as to enhance long term competitive positioning and adaptability within an ever changing competitive landscape (Ogrean & Herciu, 2021). Therefore companies will be required to create new competitive strategies; modify their current marketing orientations; make investments into technological advancements and innovations; adhere to global regulatory requirements and standards (Boshkoska, Angeloska-Dichovska, Gjorgjioska, Janeska & Gligorovski, 2026).

Companies based in developing economies (such as the Republic of North Macedonia) experience a number of additional challenges within this context which relate to the limitations imposed by their available resources but also require a significant amount of technological development. Hence, there is a need for a more detailed empirical understanding of how domestic companies actually perceive these pressures and what strategic responses they undertake.

The paper focuses on an empirical analysis of the Macedonian business sector through a survey conducted on a sample of 220 companies. The main goal is to determine the relationship between perceived global competitive pressures and the appropriate strategic, technological and innovation responses of companies. In this regard, the research analyzes key structural characteristics of the companies, such as their size (by number of employees) and period of operation and primary activity.

The initial part of the paper presents the introduction with a review of literature related to the topic of the paper. This is followed by the second part, where the research methodology used is elaborated. The third part presents the data used in the empirical analysis and discusses the empirical findings. The last

part of the paper includes the concluding observations with recommendations, as well as recommendations for future research.

2. Methodology

For the purpose of achieving the goal of the research, the survey method alongside with closed-ended questions and a Likert scale were used. The questionnaire was anonymous, created with Google Forms and sent via e-mail to the respondents. Two hundred and twenty (220) respondents answered the questionnaire. The questionnaire consists of three parts. The first part consists of five questions that relate to the general characteristics of the companies (activity, number of employees, number of years of company's operation, market in which the products/services are put on and market from which raw materials are procured). The second group of questions is designed to assess the impact of globalization on competitive challenges. The third group of questions is designed to obtain data on practices applied by the companies to the competitive challenges they face. Descriptive statistics (calculation of arithmetic mean and standard deviation), correlation analysis and χ^2-test were applied in the processing of the results. The obtained answers were analyzed using the Microsoft Excel software package.

3. Analysis of the research results

3.1 General characteristics of the researched companies

The research covered companies with different characteristics in terms of their size, period of operation and primary activity, the market in which they place their products and the market from which they procure their raw materials. In order to ensure clarity and conciseness in the presentation of this data, they are presented through selected graphical displays and cross-tabulations.

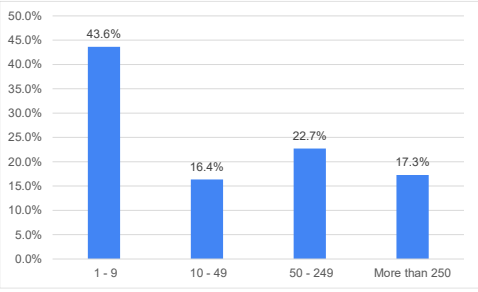


Fig 1. Structure of Companies by Number of Employees
Source: Authors' calculations.

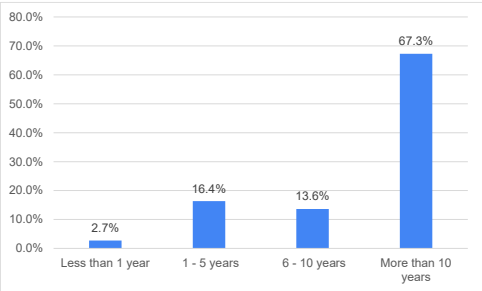


Fig. 2 Structure of companies by years of operation
Source: Authors' calculations.

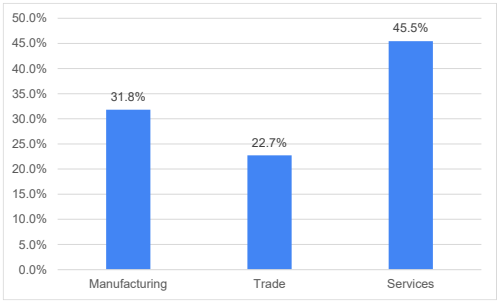


Fig 3. Structure of Companies by Primary Activity

Source: Authors' calculations.

Charts 1, 2 and 3 refer to the key structural characteristics of the companies, such as: number of employees, period of operation and primary activity. These variables were selected because they represent relevant factors that can influence the perception of global challenges and the responses of the companies, and they are further used as a basis for testing the hypotheses set by applying the χ^2 test.

Table 1. Cross-tabulation of number of employees and market for sourcing raw materials

	Markets for sourcing raw materials			**sum**
Number of employees	**Domestic and International**	**Domestic**	**International**	
1-9	16.4%	19.1%	8.2%	43,6%
10-49	8.2%	5.5%	2.7%	16,4%
50-249	11.8%	2.7%	8.2%	22,7%
More than 250	9.1%	5.5%	2.7%	17.3%
sum	45.5%	32.7%	21,8%	100%

Source: Authors' calculations

Table 2. Cross-tabulation of number of employees and market placement

	Market Placement			**Sum**
Number of employees	**Domestic and International**	**Domestic**	**International**	
1-9	6.4%	36.4%	0.9%	43.6%
10-49	6.4%	8.2%	1.8%	16.4%
50-249	9.1%	6.4%	7.3%	22.7%
More than 250	10.0%	0.0%	7.3%	17.3%

sum	31.8%	50.9%	17.3%	100%

Source: Authors' calculations

Table 3. Years of operation by market for sourcing raw materials

	Markets for sourcing raw materials			
Years of operation	**Domestic and international**	**Domestic**	**International**	**Sum**
Less than 1 year	0.9%	0.9%	0.9%	2.7%
1-5 years	2.7%	8.2%	5.5%	16.4%
6-10 years	3.6%	8.2%	1.8%	13.6%
More than 10 years	38.2%	15.5%	13.6%	67.3%
sum	45.5%	32.7%	21.8%	100%

Source: Authors' calculations

Table 4. Years of operation by market of product/service placement

	Market Placement			
	Domestic and international	**Domestic**	**International**	**Sum**
Less than 1 year	0.9%	1.8%	0.0%	2.7%
1-5 years	2.7%	8.2%	5.5%	16.4%
6-10 years	5.5%	4.5%	3.6%	13.6%
More than 10 years	22.7%	36.4%	8.2%	67.3%
sum	31.8%	50.9%	17.3%	100%

Source: Authors' calculations

From the company size chart, it can be seen that the majority of the sample is made up of micro companies with up to 9 employees, while the rest are distributed in the categories of small, medium and large companies. In terms of the period of operation, companies with more than 10 years of experience dominate. According to the primary activity, the sample includes manufacturing, trade and service companies, with service companies having the largest share.

The cross-analysis between the number of employees and the raw material procurement market shows that micro companies (1–9 employees) are predominantly oriented towards the domestic market (19.1%), but a significant part also uses a combined approach (16.4%), while small, medium and large companies are predominantly oriented towards the combined approach. Overall, the results indicate that the internationalization of supply does not depend linearly

on the size of the company, but rather manifests itself through a combination of domestic and international sources.

The cross-analysis between the number of employees and the market for the products/services shows clear differences depending on the size of the company. Micro and small companies are predominantly oriented towards the domestic market, while medium and large companies show a dominant participation in the domestic and international markets, with a significantly higher participation in the international market compared to micro and small companies. These results indicate that larger companies are more intensively involved in the processes of globalization.

The cross-analysis between the period of operation of the companies and the raw material procurement market indicates significant differences depending on their maturity. Companies with less than one year of operation have a minimal share in all categories, which is expected given their early stage of development and limited capacities. Companies operating from 1 to 5 years mainly procure from the domestic market (8.2%), but at the same time show a certain percentage of procurement from the international market (5.5%), which indicates a gradual inclusion in international flows. Companies operating from 6-10 years, unlike the previous ones, use the international market for procurement of raw materials less, but use the combined approach (domestic and international) in a higher percentage. Companies with more than 10 years of operation dominate in all categories, especially in the combined approach (38.2%). They show a significant percentage of procurement from both the domestic (15.5%) and the international market (13.6%), which indicates a higher level of integration in global supply chains.

The cross-analysis between the period of operation of the companies and the market of placement of the products/services indicates that companies with less than one year of operation are almost completely oriented towards the domestic market (1.8%) and have no presence on the international market, which is expected given their early stage of development. Companies with 1–5 years of operation show a dominant orientation towards the domestic market (8.2%), but also a relatively higher participation on the international market (5.5%) compared to companies with 6–10 years of operation. Companies with 6–10 years of operation show a lower participation on the international market (3.6%), which indicates that the process of internationalization does not proceed evenly with increasing experience. Companies with more than 10 years of operation dominate in all categories, but have the largest participation on the domestic market (36.4%) and a significant participation in the combined placement (22.7%).

3.2 Results of the descriptive statistics

The following tables present the results of the descriptive statistics. Based on the values of the arithmetic mean and standard deviation for each individual variable (indicator), conclusions have been drawn.

Table 5. Descriptive Statistics (M and SD) of Global Competitive Challenges

Factors	M	SD
GP1 The number of foreign competitors has significantly increased.	3.47	1.11
GP2 New types of competitors have emerged, offering innovative or unique products/services.	3.63	1.04
GP3 Competition has intensified in terms of prices and the availability of products/services.	3.75	0.99
GP4 Competition has intensified in terms of quality and innovation.	3.66	1.09
GP5 New partnerships and collaborations have emerged among competitors.	3.54	1.04
GP6 There have been no significant changes in the number and types of competitors.	2.66	1.19
Arithmetic Mean and Standard Deviation	**3.45**	**1.08**

Source: Authors' calculations.

From the table above it can be seen that the highest mean value is the indicator GP3 (M = 3.75), which indicates that price pressure as a challenge is one of the most pronounced effects of globalization. The other indicators also have higher values than the arithmetic mean, with the exception of the indicator GP6, which indirectly confirms that most companies still perceive changes in the competitive environment. The average value for all factors (M = 3.45) additionally indicates that globalization has a moderate to significant impact on competitive challenges. From the results of the standard deviation, it can be concluded that the respondents have relatively consistent attitudes regarding the factor GP3 (SD = 0.99), GP5 (SD = 1.04) and GP2 (SD = 1.04). Otherwise, the factor GP6 has the highest SD value (1.19), which indicates divided perceptions and greater variability in attitudes. As a general conclusion from the previous table, the GP3 indicator has the greatest importance and the greatest consistency, indicating that this challenge is key and widely recognized by companies. On the other hand, the GP6 indicator has the lowest average value and the greatest variation, meaning that its importance is not universally accepted and there are different perceptions among companies.

Table 6. Descriptive Statistics (M and SD) of Companies' Responses to Competitive Challenges

Factors	M	SD
GR1 There has been a need to reduce prices in order to remain competitive.	3.33	1.25
GR2 There has been a need to improve the quality of products/services.	3.78	1.22

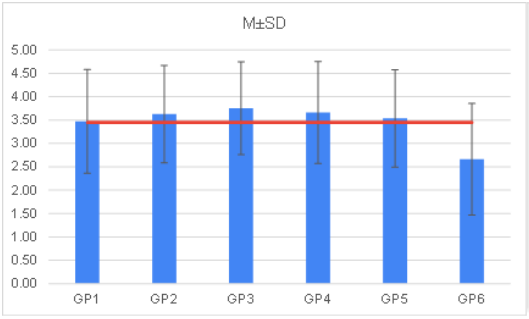
GR3 There has been a need for innovation and the development of new products.	3.95	1.03
GR4 There has been a need to place greater emphasis on digital transformation and marketing.	4.01	1.00
GR5 There has been a need for greater efficiency and resource optimization.	3.23	1.08
GR6 There has been a need for stronger compliance with and implementation of green business practices.	3.47	1.11
Arithmetic Mean and Standard Deviation	**3.63**	**1.12**

Source: Authors' calculations.

In terms of the companies' responses, the results show that the highest mean values are observed for indicators GR4 (M = 4.01), GR3 (M = 3.95) and GR2 (M = 3.78). This indicates that companies recognize that in order to remain competitive, they need to place greater emphasis on digital transformation and marketing, invest in technological development, innovation and improvement of organizational processes. The lowest mean value is for indicator GR5 (M = 3.23). The average value of the responses (M = 3.63) shows that companies are significantly responding to globalization challenges through a combination of strategic, technological and innovation activities. The analysis of the standard deviation values shows that the greatest variability in attitudes is found in GR1 (SD=1.25) and GR2, which indicates divided perceptions among the respondents. The most consistent and clearly recognized responses to the challenges are GR4, GR3, GR5 and GR6. A general conclusion regarding the analysis of the arithmetic mean and standard deviation of the companies' responses to global challenges would be that the highest average values and at the same time the lowest SD have GR4 and GR3, which indicates the great importance of these indicators and low variability in the respondents' responses.

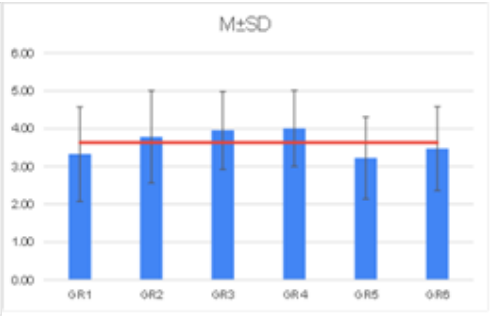
The relationship between the arithmetic means and standard deviations of the two groups of indicators is presented in the following charts:

Fig. 4. Graphical presentation of the results (Mean ± SD) for the GP group



Source: Authors' calculations.

Fig. 5. Graphical presentation of the results (Mean ± SD) for the GR group



Source: Authors' calculations.

The vertical lines (error bars) in the columns illustrate the variability in the responses – the longer the line, the greater the difference in opinions. The red horizontal line shows the average arithmetic mean in the corresponding group. The comparative analysis between the two groups shows that the GP group has 5 out of 6 higher arithmetic means than the average, while in the GR group only 3 out of 6 have higher arithmetic means than the average. The standard deviation in both groups (GP and GR) is in a similar range, which indicates a moderate and relatively equal variability of the responses.

3.3 Testing Internal Consistency and Correlation Analysis

In continuation of the analysis, a check of the internal consistency, i.e. the reliability of the applied indicators within each group was carried out. The assessment of the internal consistency was carried out using the Cronbach alpha test. In order to be considered reliable and thus justify continuing with the analysis, the value of this test, i.e. the Cronbach alpha coefficient, must be at least 0.7 (Hulin, Netemeyer & Cudeck 2001). The results of the analysis showed that the value of this coefficient for the investigated indicators together in both groups of indicators is 0.85, separately in the GP group is 0.73, and in the GR group is 0.86, which indicates internal consistency (high internal consistency and coherence of all 12 indicators) of the indicators and reliability of the findings separately in each group. Accordingly, it is justified to continue with further analysis.

The following table shows the results of the correlation analysis and, based on the values of the Pearson coefficient, the degree of dependence between the indicators was determined:

Table 7. Correlation Matrix of Global Competitive Challenges and Companies' Responses

	GP1	GP2	GP3	GP4	GP5	GP6	GR1	GR2	GR3	GR4	GR5	GR6
GP1	1.00											
GP2	0.50	1.00										
GP3	0.42	0.63	1.00									
GP4	0.51	0.66	0.65	1.00								
GP5	0.43	0.47	0.46	0.65	1.00							
GP6	-0.02	-0.16	-0.09	0.01	-0.03	1.00						
GR1	0.09	0.21	0.12	0.06	0.17	0.01	1.00					
GR2	0.33	0.39	0.32	0.43	0.35	-0.07	0.24	1.00				
GR3	0.25	0.43	0.44	0.43	0.33	0.01	0.31	0.62	1.00			
GR4	0.21	0.34	0.39	0.36	0.28	0.11	0.30	0.45	0.66	1.00		
GR5	0.31	0.39	0.39	0.37	0.27	0.15	0.34	0.29	0.36	0.43	1.00	
GR6	0.11	0.33	0.38	0.37	0.29	0.12	0.37	0.19	0.41	0.44	0.41	1.00

Source: Authors' calculations.

The complete correlation matrix provides comprehensive insight into the relationships between global competitive challenges and companies' responses.

Within the group of global challenges (GP), moderate to relatively strong positive correlations are observed, especially between GP2, GP3 and GP4 ($r \approx 0.63–0.66$), as well as between GP4 and GP5 ($r = 0.65$). This indicates that these factors are interconnected and are often perceived as complementary aspects of the competitive challenges. On the other hand, GP6 shows very weak or negative correlations with the remaining indicators, indicating that this challenge stands out and is not consistently related to the others, which is in line with the previous results of the descriptive analysis and internal consistency.

Within the responses of companies (GR) to global challenges, the correlations are moderate and consistent, with the strongest correlations observed between GR3 and GR4 ($r = 0.66$), as well as between GR2 and GR3 ($r = 0.62$). This suggests that companies tend to apply more interconnected and complementary strategies in response to competitive challenges. These results are consistent with the higher value of Cronbach's Alpha for this group.

The correlations between global challenges and companies' responses show moderate positive values, indicating the existence of a logical connection between the perception of competitive challenges and the implementation of appropriate strategies. The connections between GP2, GP3 and GP4 with GR2, GR3 and GR4 stand out in particular ($r \approx 0.32–0.44$). In contrast, the factor GP6 does not show a significant connection with any of the responses, which further confirms that its influence on companies' responses is limited.

The results indicate that, although there is a clear relationship between certain competitive challenges and companies' responses, this relationship is not uniform across all factors, indicating a selective and strategic approach by companies in adapting to global competitive conditions.

3.4 Results of Hypothesis Testing

For testing the hypotheses, indicators were selected whose arithmetic mean was higher than the average value for the group, and the standard deviation was lower than the average, thus ensuring a focus on factors that have the relatively highest perceived importance and the highest degree of agreement of attitudes. Meanwhile, when selecting the variables for testing the hypotheses, emphasis was placed on those factors that directly reflect the exposure of

companies to globalization flows (market of placement and market of procurement), as well as on selected structural characteristics, in order to ensure a relevant and focused analysis.

The paper sets four (4) separate hypotheses:

H01: There is no statistically significant relationship between the market in which companies place their products /services and the perception of the competitive challenge in terms of prices and availability of products/services (GP3).

H02: There is no statistically significant relationship between the market in which companies place their products /services and the application of digital transformation and marketing (GR4) as a response to competitive challenges.

H03: There is no statistically significant relationship between the market from which companies procure raw materials and the emergence of new competitors with innovative or unique products/services (GP2) as a competitive challenge.

H04: There is no statistically significant relationship between the size of the company (number of employees) and the need for innovation and development of new products (GR3) as a response to competitive challenges.

Test results are shown in Table 8.

Table 8. Summary of Hypothesis Testing Results

Independent variable	Dependent variable	χ^2(calc)	df	p	C	χ^2(table)	Acceptance/Rejection of the hypothesis
Market placement	*GP3*	13,14	8	0,107	0,24	15,51	The hypothesis is accepted
Market placement	*GR4*	2,12	6	0,907	0,1	12,59	The hypothesis is accepted
Market for sourcing raw materials	*GP2*	33,45	8	5,12E-05	0,37	15,51	The hypothesis is rejected
Company size	*GR3*	35,52	12	0,0004	0,37	21,03	The hypothesis is rejected

Source: Authors' calculations.

A conclusion can be drawn from the table that there is no statistically significant relationship between the market for placement and the perception of the competitive challenge in terms of prices and availability. The p value indicates that the differences in the answers are not statistically significant. The value of the contingency coefficient indicates a weak relationship. Hence, the first null hypothesis is accepted. The results of the second separate hypothesis indicate that there is no statistically significant relationship between the market for placement and the application of digital transformation and marketing. The p value indicates that the differences in the answers are not statistically significant. The contingency coefficient indicates a very weak relationship, which means that the second null hypothesis is also accepted (df value is 6 because all answers on the "strongly disagree" scale were zero). The results of the third separate hypothesis show a statistically significant relationship between the raw material procurement market and the perception of the emergence of new competitors. The p value indicates that the differences obtained are statistically significant and are not the result of chance. The contingency coefficient indicates a moderate association,

which means that the third null hypothesis is rejected. The results of the fourth separate hypothesis show that there is a statistically significant association between the size of the company (the number of employees in the company) and the need for innovation and development of new products. The p value indicates that the obtained differences are statistically significant. The contingency coefficient indicates a moderate association, which means that the fourth null hypothesis is rejected.

Based on the conducted analysis of the tests, it can be concluded that the impact of globalization on competitive challenges and companies' responses is not uniform for all analyzed factors. The results showed that the market for placing products/services is not a significant factor in increasing competition due to prices and availability of products, as well as in terms of the application of digital transformation and marketing as a strategic response of companies to competitive challenges. The market for purchasing raw materials, on the other hand, proved to be a significant factor in the emergence of new competitors as a competitive challenge, and the size of the company as a significant factor for innovation and development of new products as a response of companies to competitive challenges.

These results indicate a selective influence of factors related to globalization challenges and companies' responses.

4. Conclusion

Globalization generates complex and multifaceted impacts on the operations of companies in various sectors, with even those that are not directly involved in international supply and distribution flows being exposed to indirect implications through the globalized external environment, which points to the need to systematically take these impacts into account in their own analyses and strategic business decision-making processes, especially in companies that are directly integrated into international markets, given their significant impact on competitive and market position.

The analyses confirmed that globalization has a significant but different impact on competitive challenges and companies’ responses. Descriptive statistics showed that companies largely agree that globalization leads to increased competition, especially in terms of prices, quality and the emergence of new competitors with innovative or unique products/services. Namely, companies most often respond by improving product quality, introducing innovations and digital transformation. The results of the correlation analysis show that within the group of global challenges, moderate to relatively strong positive correlations are observed, especially between the emergence of new competitors with innovative products/services, price competition and competition in terms of quality and innovation, as well as between competition in terms of quality and innovation and the emergence of new partnerships and collaborations between competitors. This indicates that these factors are interrelated and are often perceived as complementary aspects of competitive challenges. Within the responses of

companies to global challenges, the correlations are moderate and consistent, with the strongest connection being observed between the need for innovation and development of new products and the need for digital transformation and application of marketing, as well as between the need to improve the quality of products/services and the need for innovation and development of new products. The correlations between global challenges and the responses of companies show moderate positive values, indicating the existence of a logical connection between the perception of competitive challenges and the application of appropriate strategies. Particularly noteworthy are the connections between the emergence of new competitors with innovative or unique products, price competition and quality competition and innovation with the need to improve product quality, the need for innovation and development of new products and the need for greater digital transformation and application of marketing.

The results indicate that not all structural characteristics of companies have the same impact. The distribution market did not prove to be a statistically significant factor, while the raw material procurement market and the size of the company have a statistically significant impact.

Based on the foregoing, several recommendations emerge for Macedonian companies to strengthen their strategic focus in order to adapt to global challenges in a timely and appropriate manner:

- intensifying of innovation activities in order to strengthen and maintain a competitive position, continuous focus on improving the quality of products and services and development of new products/services,
- accelerating digital transformation, especially in the area of marketing and communication with consumers, as a key response to modern market trends,
- creating a clearly defined strategic approach that will enable systematic and coordinated management of key business activities. Such an approach implies the integration of innovation, digital transformation, quality management and market orientation into a single strategic framework, with clearly set goals, measurable indicators and mechanisms for monitoring performance,
- it is necessary to proactively monitor competitive movements, the emergence of new trends and innovative players on the market in order to adapt to market changes in a timely and effective manner.

Future research should cover multiple aspects related to globalization, in order to obtain a broader picture of the impact of globalization on the operations of companies in the Republic of North Macedonia. It is necessary to examine the effectiveness of an integrated strategic approach, especially in the area of the synergy between innovation, digital transformation and quality management, and/or develop and test specific strategic models or frameworks that would help companies more effectively integrate key business functions and improve their competitive position in the dynamic global environment. It is also advisable for future analyses to include a sectorial and comparative perspective, in order to identify specificities in different industries and company sizes. It would be

particularly important to explore the role of organizational culture, leadership and human capital as factors that determine the degree of adaptation to global challenges.

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COST MANAGEMENT AS A BASIS FOR STRATEGIC DECISION-MAKING IN PRICING

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Abstract

In the context of intense global competition, dynamic markets, and increasing efficiency requirements, cost management is emerging as a key instrument for ensuring the long-term competitive advantage of enterprises.
This paper aims to explore the role of modern cost management methods in the pricing process, with special emphasis on three significant approaches: Activity-Based Costing, Target Costing and Kaizen Costing. Through conceptual analysis and a comparative approach, the principles, mechanisms, and practical implications of these methods are examined, as well as their ability to provide relevant information for managerial decision-making.
The Activity-Based Costing (ABC) method enables more precise allocation of indirect costs by identifying activities and cost drivers, thereby providing a more realistic picture of the profitability of products and services. Target Costing, on the other hand, is a proactive, market-oriented approach, where the price is defined based on demand and competitive conditions, and the allowable costs are determined as the difference between the market price and the desired profit. Kaizen Costing, on the other hand, focuses on continuously reducing costs in the production phase through small, incremental improvements, encouraging an organizational culture of efficiency and innovation.
Through a comparative analysis, the paper identifies the advantages and limitations of each of the methods, as well as the conditions under which their application is most appropriate. Additionally, their impact on pricing strategies is analyzed, including cost-plus, value-based, and competitively oriented approaches.

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In this regard, the paper concludes that the integration of modern cost management systems into the pricing decision-making process is a necessary prerequisite for the successful functioning of enterprises in the modern business environment. In doing so, the need for continuous education, technological support and adaptation of organizational processes is emphasized in order to maximize the potential of these methods.
Keywords: *cost accounting, pricing, strategic decision-making, manufacturing enterprises.*

1. Introduction

In the modern conditions of a globalized economy, with increased competition and constant technological changes, companies are faced with the need to make increasingly complex and critical business decisions. One of the most important decisions that directly impacts the company's market success and financial sustainability is setting product and service prices. The price is not only an expression of the product's value but also a strategic instrument by which the company defines its competitive position, profitability, and long-term development. In this regard, cost management is gaining a central place in the strategic decision-making process. Costs are no longer just historical categories recorded in accounting reports, but dynamic and management elements that need to be actively planned, controlled, and optimized. Modern cost accounting, as part of management accounting, is transforming from a traditional system of records into a proactive instrument for supporting decision-making. Traditional approaches to pricing, such as the cost-plus method, are based on adding a margin to total costs. Although this approach is relatively simple and widely used, its limitations are seen in the insufficient consideration of market conditions, competitive prices, and consumer perception of value. In modern markets, where buyers have access to information and alternatives, such approaches often lead to uncompetitive prices and loss of market share.
Therefore, modern cost management methods are being developed and applied that allow for deeper analysis and greater precision in the pricing process. Among them, Activity-Based Costing (ABC), Target Costing, and Kaizen Costing stand out, which are an integral part of strategic management. These methods not only provide more accurate information about the structure and cost drivers, but also enable their active management in accordance with market requirements and the strategic goals of the enterprise.

In addition, the modern business environment imposes a need for integration of cost management with other functions of the enterprise, such as marketing, production, logistics and product development. Such an interdisciplinary approach allows for synchronized decision-making and achieving an optimal balance

between costs, quality and value for consumers. Namely, the role of cost management as a basis for strategic decision-making in pricing aims to determine how different cost management methods affect the pricing process and how their application can contribute to improving the competitiveness and profitability of enterprises.

2. Theoretical framework of cost management and pricing

Cost management is a systematic process of planning, measuring, analyzing, controlling, and optimizing costs in order to support managerial decision-making and achieve the strategic goals of the enterprise. Within the framework of management accounting, cost management has a dual role: providing relevant information for decision-making and influencing the behavior of the organization through control and motivation. In the traditional approach, costs are treated as a result of the activities performed, i.e., as historical data. However, the modern concept of cost management treats costs as a management category, which can be planned and optimized even at the stage of product design, technology selection, and process organization. This approach allows for a transition from reactive to proactive management.
The importance of cost management is especially evident in conditions of limited resources and increased price sensitivity in the market. Effective cost management not only contributes to reducing costs, but also to increasing value for customers, which is a key factor for competitiveness.

3. Costs in the function of decision-making

For the purposes of managerial decision-making, costs are classified according to various criteria, with each classification having a specific analytical value:

- According to the behavior in relation to the volume of production:
  - o fixed costs,
  - o variable costs,
  - o semi-variable (mixed) costs.
- According to the possibility of control:
  - o controllable,
  - o uncontrollable costs.
- According to the relevance for decision-making:
  - o relevant costs (those that change depending on the decision),
  - o irrelevant costs (already incurred or unchangeable).
- According to the function in the enterprise:
  - o production costs,

o administrative costs,
o sales and distribution costs.

Particularly important for the process of price formation are relevant and marginal costs, since they directly affect short-term decisions and profit optimization. Correct classification of costs allows for better analysis and rational decision-making.

4. The relationship between costs and pricing

Price setting is a complex process that integrates internal factors (costs, capacities, strategies) and external factors (market demand, competition, regulation). Costs represent a lower limit of price, below which a company cannot survive in the long run.

There are three basic approaches to pricing:

- Cost-based pricing: The price is determined based on total costs increased by a certain profit margin. This approach is simple, but does not always reflect market reality.
- Market-based pricing:
  The price is formed according to demand and competitive conditions, with costs having to be adjusted to the market-acceptable level.
- Value-based pricing:
  The price is based on the perceived value of the product by consumers, which requires the integration of marketing and financial analyses.

Modern companies increasingly combine multiple approaches, with cost management playing a key role in ensuring flexibility and adaptation.

5. Modern concepts of cost management

The development of industry, automation, and the increased share of indirect costs have led to limitations of traditional cost calculation systems.

In response to these challenges, modern concepts are being developed that enable more precise analysis and strategic management:

- Activity-Based Costing (ABC):
  It is based on the identification of activities as the main cost drivers. It enables more precise allocation of indirect costs and better analysis of profitability.

- Target Costing:
  It starts from the market-determined price and the desired profit, with the allowable costs being determined in advance. This concept is strongly oriented towards customers and the market.
- Kaizen Costing:
  It focuses on continuous cost reduction in the production phase through small, gradual improvements.

These concepts are not mutually exclusive, but complementary and are often applied in an integrated manner within the framework of strategic management.

6. The role of cost management in strategic decision-making

Cost management plays a significant role in supporting strategic decisions, such as:

- product portfolio selection,
- product introduction or withdrawal decisions,
- process optimization,
- determining a competitive strategy (cost leadership or differentiation).

By providing accurate and timely information, cost management systems enable managers to evaluate alternatives and make decisions that will maximize the value of the enterprise. In this context, cost management is not only an operational function, but also a strategic instrument.

7. Activity-Based Costing (ABC) as a modern method for cost management

Activity-Based Costing (ABC) is a modern approach to cost calculation and management, which is based on the identification and analysis of activities as the main cost drivers. Unlike traditional methods, which allocate costs based on the volume of production (for example, labor hours or machine hours), the ABC method focuses on the cause-and-effect relationship between activities and costs. This method was developed in response to the increased share of indirect costs in total costs, especially in conditions of automation and technological development. Traditional systems often lead to incorrect allocation of costs, which results in an inaccurate assessment of the profitability of products.

- The ABC method is based on the following basic principles:
- Activities consume resources, and products consume activities.

– Costs should be allocated based on real causes (cost drivers).
– More precise allocation leads to better quality management decisions.

The process of implementing the ABC method usually includes several steps:

- Identification of the main activities (e.g., procurement, production, quality control).

– Formation of cost centers for each activity.
– Determination of appropriate cost drivers (cost drivers).
– Allocation of costs to products based on the use of activities.

Advantages and limitations of the ABC method
Advantages:

– Provides a more accurate calculation of costs per product.
– Enables identification of inefficient activities.
– Supports strategic decisions (pricing, portfolio, outsourcing).
– Improves transparency in the cost structure.

Limitations:

– Complexity in implementation.
– High costs for introduction and maintenance.
– Need for detailed data and continuous updating.
– May be inapplicable for small enterprises with limited resources.

The ABC method plays an important role in the pricing process, as it allows a realistic assessment of the costs per product or service.

With it, enterprises can:

– avoid undervaluing or overvaluing products,
– identify unprofitable products,
– make decisions for portfolio optimization,
– apply precise pricing strategies.

It is especially important in conditions of diversified production, where different products use different activities and resources.

The application of the ABC method enables: better segmentation of customers and products, detection of "hidden" costs, support for lean management, improvement of competitive strategy. Companies that successfully implement the ABC method have a greater ability to adapt and make informed decisions in a dynamic business environment.

8. Target Costing as a Strategic Approach to Cost Management and Pricing

Target Costing is a modern, market-oriented approach to cost management that starts from the external market rather than internal costs. Its basic logic is that the market determines the price, and costs must be adjusted to achieve the desired profit.

Unlike the traditional approach, "costs + margin = price,"

Target Costing uses the reverse approach:

Price - Profit = Allowable costs

This concept emphasizes the need for proactive cost management even at the design and development stage of the product, when most of the costs are "locked in".

Target Costing is based on several key principles:

- Market orientation: the price is determined according to demand and competition.
- Customer focus: the product must meet the needs and expectations of consumers.
- Integrated approach: involving different functions (design, production, marketing).
- Cost control at an early stage: the greatest savings are achieved before production starts.
- Continuous optimization: costs are constantly analyzed and reduced.

The Target Costing process takes place in several stages:

- Market analysis and determination of the selling price
  - Competitors, demand, and value for customers are analyzed.
- Determination of desired profit
  - The company defines a target profit margin.
- Calculation of allowable costs
  - Allowable costs = Market price – Target profit
- Product design and development
  The product is designed to fit within the allowable costs.
- Cost gap analysis
  - The estimated and allowable costs are compared.
- Implementation of cost reduction measures
  - (redesign, process improvement, material selection)

Advantages and limitations of Target Costing

Advantages:

- Strong market and customer orientation,
- Improved competitiveness,
- Cost control at an early stage,
- Encourages innovation and efficiency.

Limitations:

- High complexity in implementation,
- Need for precise market information,
- Can create pressure on quality if abused,
- Requires strong coordination between departments.

Target Costing directly influences the pricing strategy because:

- the price is determined in advance (market-based),
- costs are adjusted to the price,
- profits are planned proactively.

This approach is especially important in industries with high competition and standardized products, where the room for maneuver with prices is limited. The application of Target Costing allows:

- better alignment of products with market requirements,
- reducing the risk of unsuccessful products,
- increasing profitability,

developing a long-term competitive strategy.

This method transforms the role of costs — from a constraint to a strategic instrument for creating value.

9. Kaizen Costing as a concept for continuous cost improvement

Kaizen Costing is a modern approach to cost management based on the principle of continuous, gradual improvement (kaizen) in the production process. Unlike Target Costing, which is applied in the product design phase, Kaizen Costing focuses on reducing costs during current production. Namely, the basic idea of Kaizen Costing is that costs should never be considered fixed or given. Still, there is always the possibility of their further reduction through small but continuous improvements in processes, organization, and resource use.

Kaizen Costing includes the following principles:

- Continuous improvement: constantly seeking ways to reduce costs.
- Involvement of all employees: from management to operational level.
- Focus on processes: optimization of activities instead of only final results.
- Small, gradual changes: instead of radical and expensive transformations.

– Elimination of losses (waste): unnecessary activities, time, and resources.

Kaizen Costing Implementation Process

The Kaizen Costing process includes:

1. Setting cost reduction goals

(for example, reducing by 3–5% per year),

2. Identification of process inefficiencies

(wastes in time, materials, energy),

3. Suggesting improvements by employees,

4. Implementing small changes,

5. Continuous monitoring and measuring results.

Advantages:

– Continuous cost reduction,
– Improvement of efficiency,
– Increased employee motivation,
– Support for lean management.

Limitations:

– Results are gradual, not immediate,
– An organizational culture of improvement is required,
– Can be difficult to implement without management support.

Role of Kaizen Costing in Pricing

Although Kaizen Costing does not directly determine the price level, it has a significant indirect impact:

– enables cost reduction → greater flexibility in pricing,
– increased profit margin,
– enables maintenance of competitive prices in the long term.

In conditions of price pressure, Kaizen Costing is a key instrument for maintaining profitability.

The application of Kaizen Costing contributes to:

– development of a culture of continuous improvement,
– increased operational efficiency,
– long-term competitiveness, as well as
– better adaptation to market changes.

This approach transforms the organization into a system that constantly learns and improves.

10. Conclusion

The modern business environment, characterized by intense competition, rapid technological changes, and high consumer price sensitivity, imposes a need for systematic and strategic cost management. In such conditions, traditional approaches to cost calculation and control prove insufficient to support complex managerial decisions, especially in the pricing process.
This paper confirmed the thesis that cost management is a fundamental basis for strategic decision-making in pricing. Through the analysis of modern methods — Activity-Based Costing (ABC), Target Costing and Kaizen Costing — it was determined that each of them has a specific role, but also that their true value comes to the fore through integrated application.
The ABC method provides a high level of accuracy in cost allocation and enables in-depth analysis of the profitability of products, activities and customers. Thus, it is an important instrument for identifying inefficiencies and making informed decisions. On the other hand, Target Costing sets the price as a result of market conditions, with costs being adjusted to a predefined profit target. This approach emphasizes the proactive nature of cost management and its close connection to strategy and marketing. Kaizen Costing, on the other hand, enables continuous process improvement and cost reduction in the production phase, contributing to long-term efficiency and sustainability.

In terms of pricing, the paper asserts that modern enterprises must go beyond the simple logic of "cost + margin" and approach pricing as a strategic process that integrates costs, market conditions, and the perceived value of products. In that context, cost management is not only a control instrument, but a key factor in creating a competitive advantage. Cost management is an integral part of modern strategic management. Enterprises that manage to establish an effective cost management system and integrate it into the pricing process will have a significant advantage over competitors and ensure long-term profitability and sustainable development.

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THE IMPACT OF ARTIFICIAL INTELLIGENCE ON REAL-TIME CONSUMER PERSONALIZATION IN E-MARKETING

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Abstract

The development of digital technologies and artificial intelligence (AI) has significantly transformed e-marketing by enabling companies to analyze consumer behavior and adapt marketing communication in real time. This paper examines the role of AI-supported personalization in consumer behavior, purchasing decisions, brand trust, and business performance.

The study combines a review of relevant literature with quantitative empirical research based on a survey of 250 active e-commerce users. Descriptive statistics and Pearson correlation analysis were used to examine the relationships between preference for personalized recommendations, purchasing behavior, and brand trust. In addition, a comparative analysis of quarterly sales data for companies using and not using AI technologies was conducted.

The survey results indicate that 78% of respondents prefer personalized recommendations, 65% report purchasing more frequently when receiving personalized offers, and 72% perceive personalization as contributing to greater trust in the brand. Pearson correlation analysis indicates statistically significant positive associations between personalization, purchasing behavior, and brand trust ($p < 0.01$). The comparative sales analysis also indicates higher sales growth for the group of companies using AI.

The findings suggest that AI-supported personalization is positively associated with consumer purchasing behavior and perceived brand trust and may contribute to improved business performance. However, the correlational nature of the consumer analysis and the characteristics of the sample do not allow causal conclusions to be drawn. The study also highlights the importance of transparency, responsible data use, privacy, and ethical considerations in AI-driven personalization.

Keywords: *artificial intelligence, e-marketing, personalization, consumer behavior, brand trust, purchasing behavior, machine learning, digital transformation*

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Introduction

Artificial intelligence (AI) has become an increasingly important technology in digital marketing because it enables organizations to process consumer information, identify behavioral patterns, and support more individualized marketing communication. AI-based applications can include machine learning, predictive analytics, recommendation systems, automated communication, and other tools that support data-driven marketing decisions (Ravaliya, 2025; Salesforce, 2026).

E-marketing provides an environment in which these technologies can be applied at scale. Websites, search engines, social media, email marketing, and other digital channels enable organizations to communicate with consumers and measure their interactions in real time. The data generated through these interactions can be used to improve targeting and personalize marketing content (Kaur, 2025; IT Grow, 2026).

Real-time personalization represents a further development of this process. Instead of relying exclusively on predefined customer segments, digital platforms can use information such as browsing activity, searches, clicks, and previous purchases to adapt recommendations and communication to the individual consumer. Such applications are increasingly associated with personalized digital experiences and data-driven customer engagement (Derinkok, 2026; Association for E-Commerce, 2025).

At the same time, the use of consumer information for personalization creates important questions concerning transparency, privacy, security, and consumer autonomy. Personalization can provide value when consumers receive relevant information, but insufficient transparency or excessive data collection may negatively influence trust and acceptance. Consequently, AI-supported personalization should be considered not only from the perspective of marketing effectiveness but also from the perspective of responsible data use (Association for E-Commerce, 2025; Camden, 2026).

The purpose of this paper is to examine the relationship between AI-supported personalization and selected dimensions of consumer behavior, particularly preferences for personalized recommendations, purchasing behavior, and brand trust. The study also provides a descriptive comparison of quarterly sales performance between companies using AI technologies and companies not using such technologies.

The empirical research is based on a sample of 250 active internet users and e-commerce buyers. The findings are interpreted as evidence of associations within the surveyed sample and not as proof of causal effects.

1. Research Objectives

The primary objective of this study is to examine the role of artificial intelligence in real-time consumer personalization in e-marketing and to assess its

relationship with selected dimensions of consumer behavior and business performance.

The specific objectives are to:

1. examine the role of AI-supported technologies in e-marketing personalization;
2. analyze consumer preferences regarding personalized recommendations;
3. examine the relationship between personalized offers and purchasing behavior;
4. analyze the relationship between personalization and brand trust;
5. compare observed quarterly sales growth between companies using AI technologies and companies not using such technologies; and
6. identify key privacy, ethical, transparency, and security considerations associated with AI-driven personalization.

The objectives are addressed through a combination of literature analysis, descriptive statistics, Pearson correlation analysis, and descriptive comparison of quarterly sales data.

2. Research Questions

The empirical research is based on the following research questions:

RQ1: Do consumers prefer personalized recommendations?

RQ2: Are personalized offers positively associated with purchasing behavior?

RQ3: Is personalization positively associated with brand trust?

RQ4: Do companies using AI technologies demonstrate higher observed quarterly sales growth than companies not using AI technologies?

RQ5: What privacy and ethical considerations should be addressed when AI is used for real-time consumer personalization?

2.1 Research Hypotheses

H1: More than 70% of surveyed consumers prefer personalized recommendations.

H2: Positive evaluations of personalized offers are positively associated with more frequent purchasing.

H3: Positive evaluations of personalization are positively associated with brand trust.

H4: Companies using AI technologies demonstrate higher observed quarterly sales growth than companies not using AI technologies.

The hypotheses are assessed using descriptive evidence, Pearson correlation analysis, and comparative sales analysis. Because the study is observational and the sample is not probability-based, the results are interpreted cautiously and do not establish causality.

3. Theoretical Framework

3.1 E-Marketing

E-marketing refers to the use of digital technologies and internet-based channels to promote products and services, communicate with consumers, and support marketing activities. It includes websites, search engines, social media, email marketing, digital advertising, and other online channels through which organizations interact with their target audiences (Ravaliya, 2025; Kaur, 2025).

An important characteristic of e-marketing is its ability to support measurable and data-driven communication. Digital interactions generate information that can be analyzed to evaluate consumer engagement and marketing performance. This enables organizations to adapt campaigns and communication more rapidly than in many traditional marketing environments (IT Grow, 2026).

E-marketing also enables greater personalization. Consumer interactions with websites, applications, social networks, and online stores can provide information that supports audience segmentation and the delivery of more relevant content and offers. Personalization therefore represents an important connection between digital marketing and artificial intelligence.

The main advantages of e-marketing include global reach, interactivity, measurable performance, targeted communication, scalability, and the possibility of continuous optimization (Rankpill, 2025).

However, digital marketing also creates challenges. Organizations must consider data protection, privacy, transparency, cybersecurity, and the responsible use of consumer information. These issues become particularly important when marketing activities rely on AI-supported profiling and personalization.

3.2 Artificial Intelligence in Marketing

Artificial intelligence in marketing refers to the use of computer systems and algorithms capable of analyzing data, identifying patterns, learning from information, and supporting or automating marketing decisions. AI applications can assist organizations in customer analysis, content generation, predictive analytics, personalization, and automated customer communication (Ravaliya, 2025; Salesforce, 2026).

One important application of AI is predictive analytics. By analyzing historical and behavioral data, AI-supported systems can identify patterns that may be useful for marketing decisions. Recommendation systems similarly use available information to suggest products, services, or content that may be relevant to individual users.

AI can also support marketing automation. Routine communication, customer service interactions, audience targeting, and campaign optimization can be partially automated, allowing marketing teams to focus on strategic and creative activities (Salesforce, 2026).

In personalization, AI can process information such as searches, clicks, browsing behavior, and purchase history and use these signals to adapt marketing

communication. This can include personalized product recommendations, targeted advertising, and individualized email communication (Association for E-Commerce, 2025).

The potential benefits of AI in marketing include improved targeting, more relevant communication, automation of repetitive activities, improved customer understanding, and enhanced user experience. Nevertheless, the effectiveness of these applications depends on data quality, implementation, consumer acceptance, and responsible data governance.

3.3 Real-Time Personalization

Real-time personalization in e-marketing refers to the process of adapting digital content, recommendations, offers, or communication to a consumer while the consumer is interacting with a digital platform. The approach relies on current behavioral and contextual information and can be supported by artificial intelligence and data analytics (Derinkok, 2026).

Real-time personalization may use signals such as browsing activity, searches, clicks, purchase history, and other forms of digital interaction. These signals can be analyzed to determine which products, services, or messages are potentially relevant to an individual consumer.

Examples include dynamic website content, personalized product recommendations, triggered email communication, abandoned-cart messages, and targeted promotional offers. Such applications allow digital platforms to respond to consumer activity rather than relying exclusively on static marketing segments (Association for E-Commerce, 2025).

The potential value of real-time personalization lies in relevance. Consumers may find products and information more efficiently when digital platforms reduce irrelevant content and present recommendations related to their interests.

However, personalization can also become intrusive if consumers do not understand how their information is being used. Consequently, effective personalization should be accompanied by transparency, appropriate privacy safeguards, and consumer control (Camden, 2026).

Real-time personalization should therefore be understood as both a technological and managerial process in which the benefits of relevance must be balanced with privacy, transparency, trust, and consumer autonomy.

4. Research Methodology

The research methodology of this paper on e-marketing represents a systematic approach to collecting, analyzing, and interpreting data in order to understand digital marketing activities, consumer behavior, and the effects of online strategies. It encompasses a combination of quantitative and qualitative methods, as well as the use of digital tools for data analysis:

1. **Qualitative methods:**

- Analysis of scientific literature,
- Case studies of companies.

2. **Quantitative methods:**
- Consumer surveys,
- Statistical analysis.

3. **Sample:**
- 250 active internet users,
- Active e-commerce buyers.

4. **Methods of analysis:**
- Descriptive statistics,
- Correlation analysis,

5. AI Personalization and Consumer Behavior

Artificial intelligence plays a key role in understanding and shaping consumer behavior by personalizing content, offers, and communication across digital channels. AI enables the analysis of large volumes of data and their transformation into actionable insights for marketing decisions. AI personalization represents the automated adaptation of marketing content to the individual needs, interests, and behaviors of each consumer, based on machine learning algorithms and real-time data analysis.

By applying artificial intelligence, companies can deliver more tailored product recommendations, improve customer service, and gain deeper insights into their clients Асоцијација за е-трговија (2025).

1. AI-driven personalization has the potential to revolutionize the way companies communicate with their customers, enabling them to provide highly personalized experiences that foster customer loyalty and increase sales.
2. Consumers are more likely to remain engaged when presented with relevant content, including products similar to those they have purchased in the past. This data-driven approach helps create a more customized experience, eliminating irrelevant options and allowing customers to find exactly what they are looking for.
3. **The benefits of AI personalization include:**
- Collection of valuable consumer data,
- Generation of product recommendations,
- Improved customer understanding,
- More effective marketing campaigns,
- Reduced operational costs through automation,
- Enhanced customer interactions, e.g., via chatbots,
- Better overall customer experience.

4. Modern consumers increasingly expect personalized experiences.

Research shows that more than 70% of buyers prefer brands that offer customized communication.

AI systems analyze:

- Searches,
- Clicks,
- Purchase history,
- Time spent on websites.

These data are used for:

- Product recommendations,
- Targeted advertisements,
- Personalized email campaigns.

5. AI personalization influences consumer behavior by providing:

- Improved user experience,
- Faster decision-making,
- Greater trust in brands,
- Higher relevance of offers,
- Increased conversion rates.

AI personalization also leads to changes in consumer behavior:

- Consumers become more digitally dependent,
- They expect instant and personalized service,
- Impulse buying increases,
- The influence of algorithm-based recommendations grows.

6. Empirical Research

The empirical research was conducted during the period from March to May 2026, over a duration of three months, using a sample of 250 active internet users and e-commerce buyers.

Research objective. The objective of the research is to determine the impact of applying artificial intelligence (AI) in the personalization of offers on consumer behavior, their trust in the brand, and the sales performance of companies.

Research tasks. To achieve the stated objective, the following tasks were defined:

- Examine whether consumers prefer personalized recommendations;
- Determine how often consumers purchase products based on personalized offers;
- Investigate whether personalization increases trust in the brand;
- Analyze the impact of AI application on sales performance;
- Compare companies that use AI with those that do not.

Research questions. The research is based on the following questions:

- Do consumers prefer personalized recommendations?
- Do personalized offers influence purchasing decisions?
- Does AI increase trust in the brand?
- Do companies that use AI achieve better sales performance?

Hypotheses:

- **H1:** More than 70% of consumers prefer personalized recommendations.
- **H2:** Personalized offers positively influence purchasing decisions.

- **H3:** Personalization contributes to greater trust in the brand.
- **H4:** Companies that use AI achieve higher sales growth compared to companies that do not use AI.

Analysis of Results

Survey:

Question 1. Do you prefer personalized recommendations?

- Yes = 195 (78%)
- No = 55 (22%)

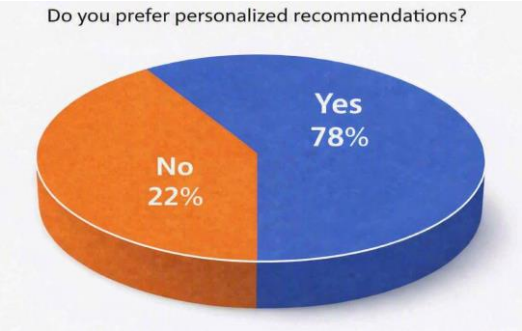


Figure 1. Survey results for the Question 1

The results show that 78% of respondents prefer personalized recommendations, while 22% do not. Thus, the sample provides descriptive support for H1.

Question 2. Do you purchase more often with personalized offers?

- Yes = 163 (65%)
- No = 87 (35%)

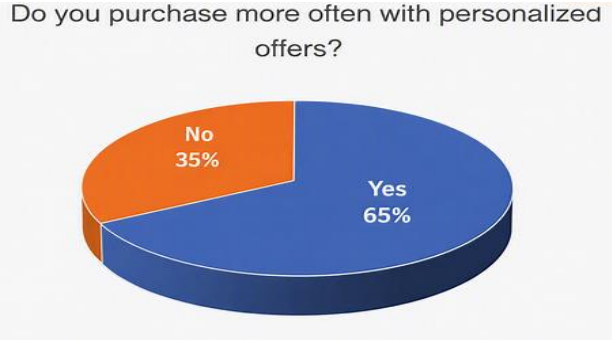


Figure 2. Survey results for the Question 2

The findings indicate that 65% of respondents report purchasing more frequently when receiving personalized offers. This provides descriptive evidence in support of H2, while the correlation analysis provides additional evidence of a positive association between personalization preference and purchasing behavior.

Question 3. Does trust in the brand increase?

- Yes = 180 (72%)

- No = 70 (28%)

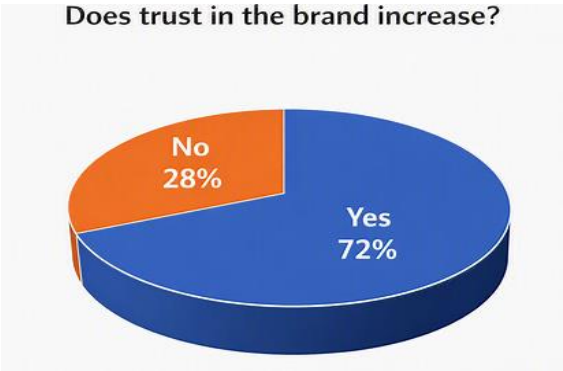


Figure 3. Survey results for the Question 3

The results indicate that 72% of respondents perceive personalization as positively related to trust in the brand. This provides descriptive support for H3.

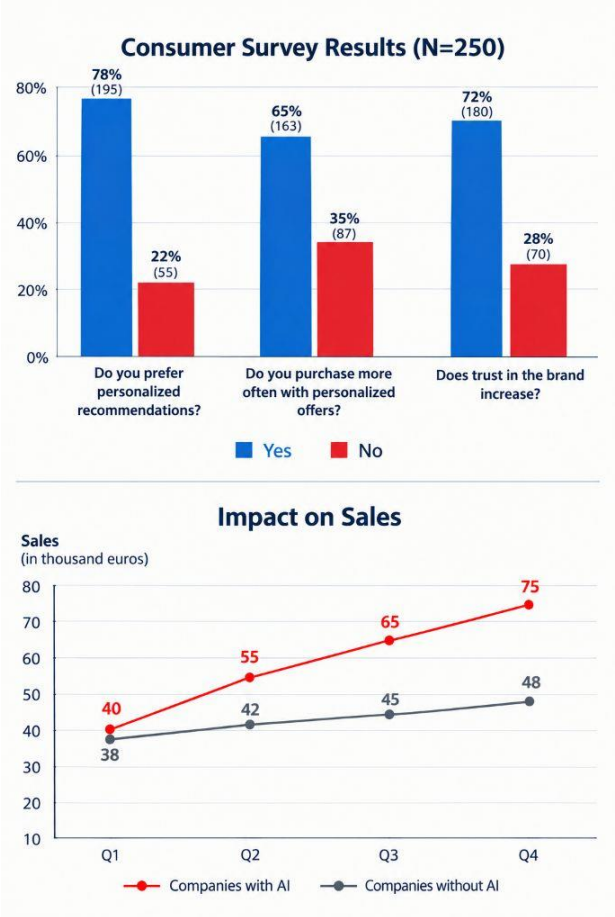


Figure 4. Consumer survey results and impact of sales

The results indicate that personalization is a significant factor in building trust.

Sales Analysis

The second part of the empirical analysis compares quarterly sales figures for companies using AI technologies with those of companies not using AI technologies.

Table 1. Quarterly Sales Results: AI vs. Non-AI Companies

Quarter	Companies using AI	Companies not using AI
Q1	€40 thousand	€38 thousand
Q2	€55 thousand	€42 thousand
Q3	€65 thousand	€45 thousand
Q4	€75 thousand	€48 thousand

For the group of companies using AI technologies, sales increased from €40 thousand in Q1 to €75 thousand in Q4, representing an increase of €35 thousand, or 87.5%.

For the group of companies not using AI technologies, sales increased from €38 thousand in Q1 to €48 thousand in Q4, representing an increase of €10 thousand, or approximately 26.3%.

The descriptive comparison therefore indicates substantially higher sales growth for the AI group during the observed period. However, this comparison alone does not establish that AI adoption caused the difference in sales performance. Other factors, including company characteristics, market conditions, product mix, marketing expenditure, and consumer demand, may also influence sales outcomes.

Correlation Analysis

To examine the relationships among personalization preference, purchasing behavior, and brand trust, Pearson correlation analysis was conducted. The analysis included three variables:

- X_1 – preference for personalized recommendations;
- X_2 – more frequent purchasing due to personalized offers;
- X_3 – brand trust associated with personalization.

Table 2. Correlation Matrix: AI Personalization Variables

Variable	X_1	X_2	X_3
X_1 Personalized recommendations	1.000	0.71**	0.68**
X_2 More frequent purchasing	0.71**	1.000	0.76**
X_3 Brand trust	0.68**	0.76**	1.000

*Note: **$p < 0.01$.*

The results indicate statistically significant positive correlations among all three variables ($p < 0.01$).

The strongest association was observed between more frequent purchasing and brand trust ($r = 0.76$). A strong positive association was also found between preference for personalized recommendations and more frequent purchasing ($r = 0.71$). Finally, preference for personalized recommendations was positively associated with brand trust ($r = 0.68$).

These results indicate that respondents who evaluate personalization more positively also tend to report more frequent purchasing and higher perceived brand trust. However, the correlations represent associations between the variables and should not be interpreted as evidence of causal relationships.

Overall, the correlation results provide empirical support for H2 and H3 and are consistent with the proposed relationship between AI-supported personalization, purchasing behavior, and brand trust.

Confirmation of Hypotheses

The empirical findings provide support for the proposed hypotheses, subject to the limitations of the research design.

H1: More than 70% of surveyed consumers prefer personalized recommendations.

Supported descriptively. 78% of respondents answered positively.

H2: Positive evaluations of personalized offers are positively associated with more frequent purchasing.

Supported. The survey results show that 65.2% of respondents report purchasing more frequently when receiving personalized offers, while the correlation between personalization preference and purchasing behavior is positive and statistically significant ($r = 0.71$, $p < 0.01$).

H3: Positive evaluations of personalization are positively associated with brand trust.

Supported. 72% of respondents report a positive relationship between personalization and brand trust, while the correlation between personalization preference and brand trust is positive and statistically significant ($r = 0.68$, $p < 0.01$).

H4: Companies using AI technologies demonstrate higher quarterly sales growth than companies not using AI technologies.

Descriptively supported. The AI group increased sales by €35 thousand from Q1 to Q4, compared with €10 thousand for the non-AI group. However, the available comparison does not by itself establish a causal effect of AI adoption on sales growth.

7. Ethical and Data Privacy Considerations

The increasing use of artificial intelligence in real-time personalization creates important ethical and data privacy challenges. Personalization depends on the collection and analysis of consumer information, including browsing behavior, search activity, purchase history, and other behavioral signals. While such data can improve the relevance of marketing communication, excessive or insufficiently transparent data collection may negatively affect consumer trust.

First, transparency is essential. Consumers should have understandable information about how their data are collected and used and, where applicable, how automated systems contribute to personalized recommendations.

Second, organizations should apply appropriate data minimization and security practices. Only information that is necessary for legitimate marketing purposes should be processed, and appropriate technical and organizational measures should be used to protect consumer information.

Third, AI-driven profiling can create risks related to algorithmic bias and unfair treatment. Recommendation systems may reproduce existing biases in the

data on which they are trained, potentially resulting in unequal or inappropriate marketing outcomes.

Fourth, excessive personalization may reduce consumer autonomy. When algorithms continuously predict and influence consumer choices, there is a risk that personalization becomes intrusive rather than useful. Therefore, responsible AI marketing should preserve consumer choice and avoid manipulative practices.

Finally, privacy and personalization should not be treated as opposing objectives. Effective AI-driven marketing should seek a balance between relevance, transparency, consumer control, data security, and trust. Ethical implementation is therefore an important condition for sustainable use of AI in e-marketing.

8. Impact of AI Personalization on Company Success

AI-supported personalization can contribute to improved customer engagement, more relevant recommendations, and more efficient marketing communication. Its potential business benefits include improved targeting, automated customer interaction, and better use of consumer data. However, the magnitude of these effects depends on the quality of data, implementation, industry characteristics, consumer acceptance, and the broader market environment.

9. Vision for the Future of E-Marketing

The future of e-marketing is shifting from fragmented campaigns toward always-active operating systems, driven by AI-powered personalization and conversational search. Marketing is evolving from a transactional tool into a seamless, automated flywheel where brands and consumers engage in real-time environments with privacy at the forefront. The roadmap for the future of e-marketing rests on several foundational pillars that redefine how brands connect with consumers Camden (2026):

1. AI-Driven Operating Systems

Marketing is no longer about owning a package of separate software tools. Artificial intelligence has taken over continuous A/B testing, audience targeting, and routine content generation. Since intelligent algorithms now dictate how users discover information, marketing functions more like an always-active operating system that learns from customer signals in real time.

2. Conversational Discovery and Generative SEO

With the rise of AI chatbots and virtual assistants, traditional search is evolving. Marketers optimize for **Answer Engine Optimization (AEO)** to ensure their products and services are recommended by AI agents, not just ranked on standard search engine results pages (SERPs).

3. Privacy First

With tightening data regulations, the future demands absolute transparency and consent. Marketers rely on building robust first-party data strategies. Trust

and ethical data handling are now critical competitive differentiators, not merely regulatory hurdles.

4. Predictive marketing

Algorithms will anticipate purchases before users even search.

10. Discussion

The empirical findings provide evidence of a positive relationship between AI-supported personalization and several dimensions of consumer response. The survey results show that 78% of respondents prefer personalized recommendations, indicating a strong positive attitude toward individualized digital experiences within the surveyed sample.

The findings also show that 65% of respondents report purchasing more frequently when receiving personalized offers. This result is consistent with the positive correlation between personalization preference and purchasing behavior ($r = 0.71$, $p < 0.01$). The strength and statistical significance of this relationship indicate that consumers who evaluate personalized recommendations more positively also tend to report more frequent purchasing.

Brand trust represents another important dimension. Seventy-two percent of respondents report a positive relationship between personalization and trust in the brand. This finding is consistent with the positive correlation between personalization preference and brand trust ($r = 0.68$, $p < 0.01$). The strongest correlation in the analysis was observed between purchasing behavior and brand trust ($r = 0.76$, $p < 0.01$), suggesting that these two dimensions are closely associated within the surveyed sample.

The comparative sales analysis provides additional descriptive evidence. Companies in the AI group increased sales from €40 thousand in Q1 to €75 thousand in Q4, while the non-AI group increased from €38 thousand to €48 thousand. Although the AI group recorded substantially higher growth during the observed period, this result should be interpreted cautiously because the analysis does not control for other factors that may affect sales performance.

The findings therefore support the general proposition that AI-supported personalization is relevant to consumer behavior and business performance. However, they should not be interpreted as proof that AI personalization directly causes higher purchasing, greater trust, or increased sales. The survey is based on self-reported consumer responses, while the sales comparison is descriptive.

From a managerial perspective, the results suggest that companies can benefit from using personalization when it provides relevant and useful consumer experiences. However, personalization should be implemented together with transparent data practices, appropriate privacy safeguards, and mechanisms that preserve consumer trust and autonomy.

11. Limitations and Future Research

This study has several limitations that should be considered when interpreting the findings.

First, the consumer survey included 250 respondents limits the extent to which the findings can be generalized beyond the surveyed sample. Future studies should use larger and, where possible, probability-based samples.

Second, the survey relies on self-reported consumer responses. Reported preferences and purchasing behavior may differ from actual observed behavior. Future research could combine survey responses with behavioral data from e-commerce platforms.

Third, the cross-sectional nature of the survey limits the ability to determine changes in consumer attitudes over time. Longitudinal research could provide stronger evidence concerning how personalization affects consumer behavior over longer periods.

Fourth, the correlation analysis identifies statistically significant associations but does not establish causality. Future research could use experimental designs, longitudinal data, or more advanced multivariate models to examine causal relationships.

Finally, the sales comparison should be interpreted cautiously because the available data do not establish whether the observed differences are attributable exclusively to AI adoption. Future studies should control for company size, industry, marketing expenditure, product characteristics, market conditions, and other relevant factors.

12. Conclusion

Artificial intelligence is becoming an important component of contemporary e-marketing by enabling companies to analyze consumer information and adapt marketing communication to individual needs. Real-time personalization represents one of the most relevant applications of AI because it allows digital platforms to respond to consumer behavior and provide more relevant recommendations, offers, and content.

The empirical findings of this study indicate that personalized marketing is positively associated with consumer responses within the surveyed sample. A total of 78% of respondents prefer personalized recommendations, while 65% report purchasing more frequently when receiving personalized offers. In addition, 72% perceive personalization as positively related to trust in the brand.

The Pearson correlation analysis confirms statistically significant positive associations among personalization preference, purchasing behavior, and brand trust. The strongest association was identified between purchasing behavior and brand trust ($r = 0.76$), followed by the relationship between personalization preference and purchasing behavior ($r = 0.71$) and between personalization preference and brand trust ($r = 0.68$).

The comparative sales analysis also shows higher growth for the group of companies using AI technologies during the observed period. However, these findings should be interpreted as descriptive evidence rather than proof of a direct causal effect of AI adoption on sales performance.

The study therefore concludes that AI-supported personalization has considerable potential to improve the relevance of e-marketing communication and is positively associated with important aspects of consumer behavior and perceived brand trust. At the same time, successful implementation requires responsible management of consumer data, transparency, privacy protection, security, and respect for consumer autonomy.

Future research should employ larger and more representative samples, longitudinal or experimental research designs, and more detailed company-level data in order to provide stronger evidence concerning the causal effects of AI-driven personalization on consumer behavior and business performance.

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A CORPORATE GOVERNANCE MODEL ORIENTED TOWARD ACHIEVING THE SUSTAINABLE DEVELOPMENT GOALS

Angel Sarov[1], Filip Elenov[2]

Abstract

This paper examines the relationship between corporate governance and the Sustainable Development Goals (SDGs) and proposes a conceptual model for integrating sustainability principles into strategic management processes. Contemporary companies are increasingly required to balance economic performance with environmental protection and social responsibility, necessitating the transformation of traditional corporate governance models. The study argues that the Board of Directors plays a pivotal role in strategy formulation, risk management, stakeholder engagement, and oversight of Environmental, Social, and Governance (ESG) policies. The proposed model integrates corporate governance structures, strategic management processes, ESG principles, and sustainability performance indicators into a unified governance framework. The model consists of five interconnected stages: institutional input factors, strategic management, governance mechanisms, performance measurement, and the achievement of the Sustainable Development Goals. It emphasizes the integration of ESG factors into corporate decision-making, supported by continuous monitoring through key performance indicators (KPIs). The expected outcomes include improved corporate performance, enhanced competitiveness, stronger stakeholder confidence, and increased long-term organizational sustainability. The proposed framework contributes to both corporate governance theory and practice by providing organizations with an integrated approach to sustainable value creation and responsible strategic management.

Keywords: corporate governance; sustainable development; ESG; Board of Directors; corporate strategy; stakeholders

1. Introduction

In today's market-oriented economy, the importance of corporate governance in agribusiness has increased significantly. The growing need for efficient and effective organizational performance, together with globalization and rapidly changing market conditions, has made corporate governance an essential

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component of sustainable business development. Corporate governance in agribusiness encompasses the system of relationships among the board of directors, executive management, shareholders, and all stakeholders within an agricultural enterprise. It establishes the framework through which corporate objectives are defined and the means for achieving them are determined.

According to the strategic management literature, the hierarchy of corporate strategy comprises several interconnected levels, including corporate, business, functional, and operational strategies (Omar & Kilika, 2018; Porta et al., 2002). Corporate governance determines the overall corporate strategy and provides the direction for its implementation (Wojcik, 2001). It represents the institutional framework through which an organization defines its responsibilities, objectives, and governance mechanisms (Porter & Kramer, 2011).

The primary purpose of corporate governance is to provide entrepreneurial leadership, establish and implement corporate strategy within an effective system of internal controls, and ensure the efficient utilization of organizational resources while creating value for stakeholders (Babu, 2012). In essence, corporate governance is concerned with designing effective mechanisms for strategic decision-making (Oman, 2001). The implementation of appropriate corporate strategies (Adams, 2010; Freeman, 2010) enables organizations to improve productivity, profitability, competitive advantage, technological leadership, employee relations, and corporate social responsibility (McColgan, 2001).

A review of the existing scientific literature reveals that most corporate governance models treat governance and sustainable development as relatively independent management domains. However, the increasing importance of ESG principles and the global commitment to achieving the Sustainable Development Goals highlight the need for a more integrated approach. This creates a clear research gap and justifies the development of a conceptual model that combines corporate governance, strategic management, ESG factors, and the Sustainable Development Goals within a single governance framework.

The objective of this study is therefore to develop a corporate governance model oriented toward achieving the Sustainable Development Goals by integrating sustainability principles into corporate strategy, governance mechanisms, and organizational performance evaluation.

2. Methodology

The present study applies a comprehensive methodological approach aimed at developing an integrated corporate governance model aligned with the Sustainable Development Goals (SDGs). The research methodology consists of four complementary stages.

First, a systematic review of the scientific literature was conducted to examine the theoretical foundations of corporate governance, Environmental, Social and Governance (ESG) principles, sustainable development, and strategic management. Particular attention was paid to internationally recognized governance frameworks, including the G20/OECD Principles of Corporate Governance, the United Nations 2030 Agenda for Sustainable Development, and

recent studies addressing the integration of ESG factors into corporate decision-making.

Second, a comparative analysis of existing corporate governance models was performed to identify their principal characteristics, strengths, and limitations. This analysis revealed that traditional governance models primarily emphasize shareholder value maximization and. financial performance, while giving limited consideration to sustainability objectives and stakeholder interests.

Third, the research employed conceptual modelling to establish the relationships among the Board of Directors, corporate strategy, stakeholders, ESG policies, and sustainability performance indicators. The proposed framework integrates these elements into a coherent governance system designed to support sustainable value creation.

Finally, the study adopted a systems approach, viewing corporate governance as a dynamic and interconnected management system in which governance structures, strategic planning, organizational processes, and performance measurement continuously interact to achieve sustainable organizational development.

3. Results

3.1 A Conceptual corporate governance model oriented toward achieving the sustainable development goals

The findings indicate that the traditional corporate governance model should be expanded through the systematic integration of sustainability principles into all managerial processes. Rather than focusing exclusively on financial performance and shareholder interests, contemporary corporate governance should simultaneously address environmental protection, social responsibility, and long-term organizational resilience.

The proposed conceptual model consists of five interconnected components: institutional input factors; strategic management; corporate governance mechanisms; performance measurement; achievement of the Sustainable Development Goals.

The model considers the Board of Directors as the central strategic body responsible for integrating ESG principles into corporate governance and ensuring that sustainability objectives are embedded within corporate strategy.

The institutional input factors include: corporate governance structure; composition and competencies of the Board of Directors; corporate governance policies; stakeholder expectations; regulatory requirements; ESG reporting standards.

Strategic management focuses on:defining the corporate vision and mission; establishing strategic objectives; integrating the Sustainable Development Goals into corporate strategy; enterprise risk management; ESG governance.

Corporate governance mechanisms include: transparency; accountability; independent oversight; ethical leadership; stakeholder engagement; a Sustainability Committee operating under the Board of Directors.

The proposed framework identifies the Board of Directors as the principal strategic mechanism responsible for embedding ESG considerations into corporate decision-making. Continuous monitoring through Key Performance Indicators (KPIs) enables organizations to assess progress toward achieving the Sustainable Development Goals and to improve governance effectiveness.

The theoretical analysis demonstrates that conventional corporate governance models, largely based on agency theory and shareholder protection, are no longer sufficient to address the complexity of today's business environment. Globalization, digital transformation, climate change, increasing regulatory requirements, and growing societal expectations have substantially expanded the responsibilities of corporate governance.

In addition to ensuring economic efficiency, organizations are expected to promote transparency, accountability, ethical conduct, and the sustainable use of natural resources. Consequently, corporate governance has evolved from a financial control mechanism into a comprehensive strategic framework for sustainable organizational development.

The growing adoption of Environmental, Social and Governance (ESG) principles and the United Nations Sustainable Development Goals (SDGs) has fundamentally transformed the philosophy of corporate governance (Table 1). The Board of Directors is no longer responsible solely for monitoring management performance but has become the principal strategic body responsible for defining the organization's sustainability vision, managing ESG-related risks, and balancing the interests of multiple stakeholder groups.

This transformation requires governance systems capable of integrating sustainability into strategic planning, organizational decision-making, performance evaluation, and long-term value creation.

Table 1. Relationship Between Corporate Governance Components and the Sustainable Development Goals (SDGs)

Corporate Governance Component	Primary Functions	Related SDGs	Expected Impact
Board of Directors	Strategy formulation, oversight and supervision	SDG 16, SDG 17	Good governance and institutional sustainability
Independent Directors	Independent oversight and transparency	SDG 16	Increased investor confidence
Audit Committee	Risk management and accountability	SDG 16	Financial stability and transparency
Sustainability	Integration of ESG	SDG 12,	Improved environmental and

Committee	policies	SDG 13	social performance
Corporate Strategy	Long-term organizational development	SDG 8, SDG 9	Sustainable growth and competitiveness
Risk Management	Identification and mitigation of ESG risks	SDG 13, SDG 16	Enhanced organizational resilience
Corporate Social Responsibility	Stakeholder engagement	SDG 8, SDG 10, SDG 11	Social value creation and public trust
Code of Ethics	Integrity, transparency and anti-corruption practices	SDG 16	Reduced governance risk
ESG Reporting	Sustainability and non-financial reporting	SDG 12, SDG 13	Enhanced corporate reputation
Innovation and Digitalization	Technological development	SDG 9	Higher productivity and operational efficiency
Human Capital Management	Competence development and occupational safety	SDG 4, SDG 8	Improved human capital
Stakeholder Partnerships	Cooperation among business, government and society	SDG 17	Accelerated achievement of the SDGs

Source: Adapted by the authors based on OECD (2023), United Nations (2015), Omar and Kilika (2018).

3.2 Institutional Input Factors

The first stage comprises the institutional and organizational factors that shape the corporate governance environment. These factors determine the quality of strategic decisions and influence the organization's capacity to integrate sustainability into its governance system.

A fundamental component is the corporate governance structure, which defines the relationships among shareholders, the Board of Directors, executive management, and other stakeholders. A well-designed governance structure

facilitates a clear allocation of responsibilities, minimizes conflicts of interest, and improves the effectiveness of strategic decision-making.

Another essential factor is the composition and competence of the Board of Directors. International best practices demonstrate that effective boards are characterized by diversity of expertise, independence, and professional competence in finance, risk management, sustainability, and digital transformation. A competent board significantly increases the organization's ability to integrate ESG considerations into corporate strategy.

Corporate governance is further influenced by corporate policies, which establish internal governance rules, ethical standards, control mechanisms, and decision-making procedures. These policies should comply with national legislation while simultaneously reflecting internationally accepted governance and sustainability standards.

Equally important are stakeholder expectations, including those of investors, employees, customers, suppliers, local communities, governmental institutions, and non-governmental organizations. Modern corporate governance increasingly emphasizes creating value for all stakeholders rather than focusing exclusively on shareholder interests.

The final component of the institutional environment consists of regulatory requirements and ESG standards, which increasingly determine corporate governance practices worldwide. Within the European Union, these include the Corporate Sustainability Reporting Directive (CSRD), the European Sustainability Reporting Standards (ESRS), and the International Sustainability Disclosure Standards (IFRS S1 and IFRS S2).

3.3. Strategic Management

Based on the institutional input factors, the Board of Directors develops the corporate strategy by integrating sustainability principles into long-term organizational planning.

The strategic process begins with the formulation of the organization's vision and mission, which define its long-term direction. Increasingly, corporate mission statements incorporate commitments to sustainable development, social responsibility, and environmental stewardship.

The next step involves defining strategic objectives that simultaneously promote economic performance, environmental sustainability, and social well-being.

A central element of the proposed model is the integration of the Sustainable Development Goals (SDGs) into corporate strategy. Organizations identify those SDGs that are most relevant to their operations and develop measurable performance indicators for monitoring implementation.

Strategic management also encompasses enterprise risk management, extending beyond traditional financial risks to include climate-related, social, technological, regulatory, and reputational risks. ESG-related risks have become a fundamental component of modern corporate strategy.

Another essential element is ESG governance, which integrates environmental, social, and governance considerations into all organizational processes. This integration strengthens organizational resilience, enhances competitiveness, and contributes to sustainable long-term value creation.

3.4 Corporate Governance Mechanisms

The successful implementation of corporate strategy requires an effective system of corporate governance mechanisms that ensures accountability, transparency, ethical conduct, and sustainable value creation.

The first governance mechanism is transparency, which guarantees that stakeholders have timely access to reliable, accurate, and relevant information regarding the organization's operations, strategic objectives, financial performance, and sustainability initiatives. Transparency strengthens investor confidence, facilitates informed decision-making, and enhances corporate credibility.

The second mechanism is accountability, through which the Board of Directors assumes responsibility for achieving strategic objectives, ensuring the efficient allocation of organizational resources, and maintaining compliance with legal and ethical standards. Accountability also establishes clear responsibilities among directors, executive management, and other governance bodies.

Another essential mechanism is independent oversight, exercised through internal audit functions, external auditing, independent directors, and specialized board committees. Independent supervision improves governance quality, strengthens internal controls, reduces agency conflicts, and contributes to organizational integrity.

A further component is ethical governance, which promotes integrity, fairness, anti-corruption practices, and responsible corporate behaviour. Ethical governance requires organizations to implement comprehensive codes of ethics, conflict-of-interest policies, whistleblowing procedures, and mechanisms for protecting stakeholder rights.

The proposed model also emphasizes stakeholder engagement as an integral governance mechanism. Continuous dialogue with investors, employees, customers, suppliers, regulators, and local communities enables organizations to better understand stakeholder expectations, identify emerging risks, and strengthen corporate legitimacy.

An important innovation within the proposed governance framework is the establishment of a Sustainability Committee operating under the Board of Directors. The committee is responsible for coordinating ESG policies, monitoring sustainability performance, evaluating progress toward achieving the Sustainable Development Goals, and preparing periodic sustainability reports. By institutionalizing sustainability governance at board level, organizations can integrate ESG considerations into strategic decision-making more effectively.

3.5 Performance Measurement

The effectiveness of corporate governance should not be evaluated solely on the basis of financial performance. Contemporary governance systems require a multidimensional performance measurement framework that reflects economic, environmental, social, and governance outcomes.

The first group of indicators consists of financial performance measures, including profitability, return on equity, economic value added, productivity, operational efficiency, and market capitalization. These indicators assess the organization's ability to create economic value while maintaining financial stability.

The second group comprises environmental indicators, including greenhouse gas emissions, energy efficiency, renewable energy utilization, water consumption, waste management, resource efficiency, and environmental compliance. These measures evaluate the organization's contribution to environmental sustainability and climate resilience.

The third category includes social performance indicators, focusing on occupational health and safety, employee development, workforce diversity, equal opportunities, staff training, employee satisfaction, and social responsibility initiatives. These indicators assess the organization's capacity to generate sustainable social value and develop human capital.

The fourth group consists of governance indicators, measuring the quality of corporate governance through ESG ratings, transparency, board effectiveness, innovation capacity, regulatory compliance, investor confidence, and corporate reputation.

The integration of these performance indicators enables organizations to establish a comprehensive monitoring system capable of evaluating progress toward sustainable development while simultaneously supporting strategic decision-making and continuous organizational improvement.

3.6. Achieving the Sustainable Development Goals

The final outcome of the proposed corporate governance model is the achievement of sustainable organizational development through the balanced integration of economic, environmental, and social objectives.

The implementation of the model contributes to sustainable economic growth, improved organizational competitiveness, efficient resource utilization, reduced environmental impact, stronger corporate reputation, and increased investor confidence. Furthermore, organizations become more resilient to external shocks by strengthening risk management capabilities and enhancing their capacity for long-term value creation.

The proposed governance framework primarily supports the achievement of the following Sustainable Development Goals:

- SDG 8: Decent Work and Economic Growth;
- SDG 9: Industry, Innovation and Infrastructure;
- SDG 12: Responsible Consumption and Production;

- SDG 13: Climate Action;
- SDG 16: Peace, Justice and Strong Institutions;
- SDG 17:Partnerships for the Goals.

By integrating these objectives into corporate governance processes, organizations can transform governance from a traditional control function into a strategic instrument for sustainable development at organizational, national, and international levels

4. Conclusion

Contemporary corporate governance extends far beyond its traditional role of protecting shareholder interests and has evolved into a strategic mechanism for creating sustainable value for all stakeholders. The integration of the Sustainable Development Goals into corporate strategy enhances organizational resilience, improves risk management, strengthens investor confidence, and provides a foundation for sustainable competitive advantage.

The conceptual model proposed in this study demonstrates the feasibility of integrating the principles of good corporate governance, strategic management, ESG practices, and sustainable development into a unified governance framework. Unlike traditional governance models that primarily emphasize financial performance and shareholder value, the proposed model recognizes corporate governance as a comprehensive system for balancing economic, social, environmental, and institutional objectives.

The scientific contribution of this research lies in the development of an integrated conceptual framework that combines classical corporate governance principles with contemporary ESG practices and the Sustainable Development Goals. The model expands existing governance theory by incorporating sustainability into every stage of strategic management and organizational decision-making.

From a practical perspective, the model can support organizations in designing corporate strategies, implementing ESG governance systems, evaluating corporate sustainability performance, and developing key performance indicators for monitoring progress toward the Sustainable Development Goals. It is particularly relevant for publicly listed companies, as well as medium-sized and large enterprises adapting to the evolving European regulatory framework concerning sustainable corporate governance and sustainability reporting.

The proposed framework also provides a foundation for future empirical research aimed at validating the model across different industries and institutional contexts. Further studies may develop quantitative assessment tools and governance maturity models that facilitate the practical implementation of sustainable corporate governance principles in organizations worldwide.

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BANK-SPECIFIC AND MACROECONOMIC DETERMINANTS ON MARKET CAPITALIZATION: EVIDENCE FROM MACEDONIAN LISTED BANKS

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Abstract

This study investigates the determinants of market capitalization of listed banks on the Macedonian Stock Exchange over the period 2023–2025. Using a balanced panel dataset consisting of seven banks, the research examines the impact of bank-specific financial indicators and macroeconomic variables on market valuation. Two econometric models are estimated. The first model analyzes the determinants of return on assets (ROA), while the second and main model focuses on the determinants of market capitalization measured in logarithmic form. The explanatory variables include profitability (ROA), financial leverage (total liabilities to total assets), and macroeconomic factors such as GDP growth and inflation. The empirical results indicate that ROA is the only statistically significant determinant of market capitalization, suggesting that profitability is the primary factor influencing bank valuation in the Macedonian banking sector. In contrast, leverage and macroeconomic variables are found to be statistically insignificant within the observed period. The results further show that ROE is highly correlated with ROA, indicating potential multicollinearity and reinforcing the decision to exclude it from the final market valuation model.
Overall, the findings suggest that bank market capitalization is predominantly driven by internal performance indicators rather than macroeconomic conditions. The study contributes to the literature on banking sector valuation in emerging markets by providing empirical evidence from the Macedonian Stock Exchange.

Key words: *Market Capitalization, Banking Sector, Panel Data Analysis, Financial Performance, Macedonian Stock Exchange*

1. Introduction

The banking sector plays a crucial role in the financial system of any economy, as it facilitates capital allocation, supports investment activity, and contributes to overall economic growth. In emerging markets, such as North Macedonia, the banking sector represents one of the most developed and stable segments of the financial system, with listed banks on the Macedonian Stock

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Exchange serving as key institutions for financial intermediation and investment opportunities. Understanding the factors that influence the market valuation of these banks is therefore of both theoretical and practical importance.

Market capitalization is widely used as a key indicator of firm value, reflecting investor perceptions of current performance and future growth potential. In the case of banks, market capitalization is influenced by a combination of internal financial performance indicators and external macroeconomic conditions. While profitability and capital structure are expected to play a central role in determining bank value, macroeconomic variables such as GDP growth and inflation may also affect investor expectations and market dynamics.

Despite the importance of the banking sector in North Macedonia, empirical research on the determinants of bank market capitalization remains limited. Most existing studies focus either on bank profitability or macroeconomic stability, while fewer integrate both dimensions in a unified econometric framework. This study addresses this gap by examining both bank-specific and macroeconomic determinants of market capitalization for listed banks on the Macedonian Stock Exchange.

Research objective:

The main objective of this study is to investigate the key determinants of market capitalization of listed banks in North Macedonia, with particular emphasis on the role of profitability, financial leverage, and macroeconomic conditions.

Specifically, the study aims to:

- examine the impact of bank profitability (ROA) on market capitalization,
- assess the influence of financial leverage on bank market value,
- evaluate the effect of macroeconomic variables (GDP growth and inflation) on market capitalization,
- and provide empirical evidence on the relative importance of internal versus external determinants of bank valuation.

Research hypotheses:

Based on theoretical considerations and previous empirical literature, the following hypotheses are formulated:

H1: Bank profitability (ROA) has a positive and statistically significant effect on market capitalization.

H2: Financial leverage (total liabilities to total assets) has a negative effect on market capitalization.

H3: GDP growth has a positive impact on market capitalization of listed banks.

H4: Inflation has a negative impact on market capitalization of listed banks.

Contribution of the study:

This study contributes to the existing literature by providing empirical evidence from an emerging European market using recent data from listed banks on the Macedonian Stock Exchange. By integrating both firm-specific financial indicators and macroeconomic variables within a unified econometric framework, the study offers a more comprehensive understanding of the determinants of bank market valuation in a small and highly bank-dependent economy.

2. Related Research

The relationship between market capitalization of listed companies and bank-specific and macroeconomic determinants has received considerable attention in the literature, particularly regarding the identification of causal relationships. A growing number of studies have been conducted on the effect of bank-specific and macroeconomic determinants on the market capitalization (firm value). Therefore, many researchers identify some bank-specific such as profitability, financial leverage, liquidity, and macroeconomic factors such as GDP growth, foreign direct investment, interest rate, exchange rate etc.

Market capitalization is understood as the total value of a firm's outstanding stocks, which describes the multiplication of the share volume with the closing market price (Fitrah *et al*., 2022). Market capitalization is a quick and easy approach to determining a publicly traded company's value by extrapolating what the market estimates it is worth (Ahmed Alarussi. (2023). For investors, understanding the worthiness and value of targeted corporations in the market is very important when it comes to investing their capital and determining the extension of the investment period (Kuvshinova & Zimmermannb, 2022). Thus, market capitalization is an important market indicator of the value of companies (Dias 2013) and, as a result of its significance, much research has been carried out in different countries to analyze the factors that influence it.

Phan and To (2025) examined the determinants of the market capitalization of listed companies through evidence from an emerging country. Their findings reveled that intellectual capital, sales growth, profit, leverage and crises are positively linked to market capitalization; meanwhile, foreign direct investment, inflation and gross domestic product negatively affect market capitalization. They conclude that macroeconomic stability is very crucial for firms and financial stability. In another study, Aromolaran et al. (2024) explored the macroeconomic determinants of market capitalization within South Africa and found that broad money growth and GDP positively and significantly impact market capitalization, whereas repo rates and trade openness have a significant negative effect. Fitrah et al. (2022) provide evidence about positive and significant effect of earnings per share, PER, return of assets and return on equity on market capitalization. On the other side, return of investment and interest rate has a negative and significant effect on market capitalization. Bui N.T. (2023) investigates the determinants of stock market capitalization in emerging market and developing economies, including China, Indonesia, India, Sri Lanka, Malaysia, the Philippines, Thailand and Vietnam from 2008-2020. By applying

the Generalized Method of Moments (GMM), the author has defined inflation as a negative economic determinant of stock market capitalization. However, it positively correlates to the corruption control index and other economic factors, namely GDP per capita, domestic credit and trade. These confirm that the improvements in macro environments and corruption control play a vital role in the emerging market and developing economies in fostering their stock markets.

In the context of the Macedonian banking sector, Delova Jolevska and Karadjova (2025) demonstrated that green lending contributes positively to bank profitability, highlighting the importance of sustainable banking practices as a bank-specific determinant of financial performance. Dicevska et al. (2018) found that non-performing household loans have a significant negative impact on the financial performance of Macedonian banks, emphasizing the importance of credit risk management for maintaining bank value. Dichevska et al. (2018) analyzed the cooperation between banks and insurance companies and concluded that bancassurance offers both strategic benefits and operational challenges that may influence banks' competitiveness and long-term performance. Karadjova et al. (2024) examined the temporal dynamics and structural allocation of household bank credits in North Macedonia, providing evidence that changes in household lending patterns play an important role in banks' portfolio structure and financial development. Karadjova and Spaseska (2024) showed that inflation significantly affects household financial conditions through its impact on the minimum consumer basket, underlining the relevance of macroeconomic stability for the banking environment.

Considering all this studies, the literature suggests that market capitalization is determined by a combination of bank-specific financial determinants and macroeconomic conditions. While internal factors explain differences in individual bank performance, external economic variables shape the investment environment and influence market-wide valuations. Consequently, empirical analyses that integrate both categories of determinants provide a more comprehensive understanding of the factors affecting bank market capitalization.

3. Methodology, Data and Model Specification

Data description:

This study uses a balanced panel dataset comprising seven commercial banks listed on the Macedonian Stock Exchange over the period 2023–2025. The sample includes major banking institutions operating in North Macedonia, allowing for an analysis of both cross-sectional and time-series variation in financial performance and market valuation. The sample consists of seven commercial banks operating in the Republic of North Macedonia and listed on the Macedonian Stock Exchange. These include Komercijalna Banka AD Skopje, Stopanska Banka AD Skopje, NLB Banka AD Skopje, Halkbank AD Skopje, TTK Banka AD Skopje, UNI Banka AD Skopje, Alta Banka AD Skopje, and Centralna Kooperativna Banka AD Skopje. All selected institutions are publicly listed commercial banks and therefore subject to standardized financial disclosure requirements, ensuring data comparability across the sample. The dataset includes

both large and medium-sized banks, providing a representative cross-section of the Macedonian listed banking sector. Together, these banks account for the entire population of listed banking institutions on the Macedonian Stock Exchange, making the sample comprehensive rather than selective. The selection is based on availability of consistent financial data for the entire period 2023–2025.

The dataset consists of both bank-specific financial indicators and macroeconomic variables. Bank-level data were obtained from published financial statements, while macroeconomic variables were collected from official statistical sources. The final dataset includes 21 observations in total (7 banks × 3 years).

The variables used in the analysis are defined as follows:

- **Market Capitalization (Market Cap):** Market value of equity of listed banks. The variable is transformed using the natural logarithm to reduce skewness and mitigate the influence of extreme values. The natural logarithm of market capitalization is used in the empirical analysis in order to reduce skewness in the distribution, mitigate the influence of extreme values, and improve the linearity of the relationship between variables. In addition, the log-transformed dependent variable allows for a more economically meaningful interpretation of regression coefficients in relative (percentage) terms rather than absolute changes.
- **Return on Assets (ROA):** Net income divided by total assets, expressed in percentage terms, used as a measure of profitability.
- **Return on Equity (ROE):** Net income relative to shareholders' equity, expressed in percentage terms, also used as a profitability indicator.
- **Leverage Ratio (Total Liabilities / Total Assets):** A proxy for financial risk and capital structure.
- **GDP Growth:** Annual real GDP growth rate, used as a proxy for macroeconomic conditions.
- **Inflation Rate:** Annual inflation rate, capturing price level dynamics in the economy.

All financial ratios are expressed in their original form, while market capitalization is transformed into logarithmic form to ensure better statistical properties and linearity in the econometric model.

Econometric approach:

The empirical analysis is based on multiple linear regression models estimated using Ordinary Least Squares (OLS). This approach is widely used in financial econometrics for identifying linear relationships between dependent and explanatory variables.

Two separate regression models are estimated:

Model 1: Determinants of bank profitability

$$ROA = \beta_0 + \beta_1 ROE + \beta_2 LEV + \beta_3 GDP + \beta_4 INF + \varepsilon$$

This model examines the internal and external factors affecting bank profitability, measured by ROA.

Model 2: Determinants of market capitalization

$$\ln(MarketCap) = \beta_0 + \beta_1 ROA + \beta_2 LEV + \beta_3 GDP + \beta_4 INF + \varepsilon$$

This model represents the main specification of the study and investigates the impact of profitability, leverage, and macroeconomic conditions on bank market valuation.

Rationale for variable selection:

The selection of explanatory variables is based on financial theory and empirical literature on bank performance and valuation. Profitability (ROA and ROE) is included as a key indicator of financial performance, while leverage captures the risk profile and capital structure of banks. Macroeconomic variables, such as GDP growth and inflation, are included to account for broader economic conditions that may influence banking sector performance and investor behavior.

A logarithmic transformation of market capitalization is applied to improve normality, reduce heteroscedasticity, and allow for interpretation of results in relative terms.

Multicollinearity and model specification considerations:

Prior to the estimation of the main model, correlation analysis is conducted to examine potential multicollinearity among explanatory variables. The results indicate a very high correlation between ROA and ROE, suggesting potential redundancy between these two profitability measures. As a result, ROE is excluded from the main market capitalization model to avoid multicollinearity bias and improve model stability.

Additionally, variance inflation concerns are addressed by selecting a parsimonious model specification that prioritizes interpretability and statistical robustness.

Estimation technique and limitations:

The models are estimated using Ordinary Least Squares (OLS) regression. While OLS provides efficient and unbiased estimators under standard assumptions, the analysis is subject to certain limitations. These include a relatively small sample size (21 observations), which may limit the statistical power of the estimations, and the short time horizon, which may reduce variability in macroeconomic indicators.

Despite these limitations, the model provides meaningful insights into the determinants of bank market capitalization in an emerging market context.

4. Empirical evidence on the determinants of bank market capitalization

This section presents the empirical findings of the study, based on descriptive statistics, correlation analysis, and econometric regression models. The analysis aims to identify the key determinants of bank profitability and market capitalization in the Macedonian banking sector over the period 2023-2025. The

results are structured in a sequential manner, beginning with descriptive statistics, followed by correlation analysis, and concluding with regression models that examine both internal financial indicators and macroeconomic influences.

Descriptive statistics

This subsection presents descriptive statistics of the variables used in the empirical analysis, providing an overview of their central tendency, dispersion, and distribution characteristics.

Table 1. Descriptive statistics of the variables

Variable	Mean	Std. Dev.	Min	Max
ln(Market Capitalization)	15.465	2.055	12.144	17.987
ROA (%)	1.52	1.19	-1.70	3.11
ROE (%)	10.95	8.48	-11.22	23.64
Total Liabilities / Total Assets	0.860	0.032	0.800	0.910
GDP Growth (%)	3.03	0.38	2.60	3.50
Inflation Rate (%)	4.03	0.34	3.60	4.40

Source: Authors' calculations based on financial statements of listed banks on the Macedonian Stock Exchange and macroeconomic data

The descriptive statistics of the variables used in the empirical analysis are presented in Table 1. The mean value of the natural logarithm of market capitalization is 15.465, with a standard deviation of 2.055, indicating a moderate level of dispersion in the size of listed banks on the Macedonian Stock Exchange. The observed range between 12.144 and 17.987 suggests substantial heterogeneity in market capitalization across the sampled institutions, although the use of the logarithmic transformation reduces the influence of extreme values and improves data comparability.

In terms of profitability, the average return on assets (ROA) is 1.52%, while the average return on equity (ROE) is 10.95%, indicating generally positive performance of the banking sector during the observed period. However, the presence of negative minimum values for both ROA (−1.70%) and ROE (−11.22%) reflects periods of financial underperformance for certain banks within the sample.

The average leverage ratio, measured as total liabilities to total assets, is 0.860, with very low dispersion (standard deviation = 0.032), suggesting a relatively homogeneous capital structure across the banking sector. This is consistent with the regulatory and operational characteristics of commercial banks, which typically operate with high leverage ratios.

Regarding macroeconomic conditions, the average GDP growth rate over the sample period is 3.03%, while the average inflation rate is 4.03%. Both variables exhibit low variability since they represent common annual macroeconomic conditions affecting all banks equally within each year.

Overall, the descriptive statistics indicate sufficient variation in firm-specific variables, particularly profitability and market capitalization, which

justifies further econometric analysis of the determinants of market value in the Macedonian banking sector.

Correlation analysis

This subsection presents the correlation matrix of the main variables, aiming to identify preliminary relationships among bank-specific and macroeconomic indicators and to assess potential multicollinearity issues.

Table 2. Correlation matrix

Variable	ln(Market Cap)	ROA	ROE	Leverage	GDP	Inflation
ln(Market Cap)	1.000	0.842	0.807	-0.369	0.081	0.091
ROA	0.842	1.000	0.957	-0.241	0.069	0.159
ROE	0.807	0.957	1.000	0.003	0.067	0.141
Leverage	-0.369	-0.241	0.003	1.000	0.024	-0.048
GDP Growth	0.081	0.069	0.067	0.024	1.000	0.567
Inflation	0.091	0.159	0.141	-0.048	0.567	1.000

Source: Authors' calculations based on dataset of listed banks on the Macedonian Stock Exchange

The correlation analysis presented in Table 2 provides initial insights into the relationships among the variables included in the empirical model. The results indicate a strong positive correlation between market capitalization and profitability measures, particularly ROA (0.842) and ROE (0.807), suggesting that more profitable banks tend to have higher market valuations.

Furthermore, a very strong correlation is observed between ROA and ROE (0.957), indicating a high degree of overlap between the two profitability indicators. This result confirms the presence of potential multicollinearity, which justifies the exclusion of one of these variables in the main regression model.

The leverage ratio exhibits a moderate negative correlation with market capitalization (-0.369), suggesting that higher indebtedness is associated with lower market valuation. However, correlations between macroeconomic variables and bank-specific indicators are relatively weak, reflecting the limited variability of macroeconomic conditions across the sample.

An exception is the moderate positive correlation between GDP growth and inflation (0.567), which is consistent with macroeconomic theory.

Overall, the correlation analysis supports the specification of the econometric model by confirming expected relationships among variables while also highlighting potential multicollinearity issues between profitability indicators.

Variance Inflation Factor (VIF) and Multicollinearity Diagnostics

To further assess the presence of multicollinearity among the explanatory variables, Variance Inflation Factors (VIF) were considered as an additional diagnostic tool. Multicollinearity is particularly relevant in this study due to the high correlation observed between profitability indicators, especially ROA and ROE.

Given the strong correlation between these variables (0.957), the inclusion of both in the same regression specification could lead to inflated standard errors and unstable coefficient estimates. Therefore, ROE was excluded from the main market capitalization model in order to improve model reliability and avoid redundancy among explanatory variables.

Although VIF values were not explicitly computed due to software limitations in Excel, the correlation matrix serves as a reliable preliminary indicator of multicollinearity. As a rule of thumb, correlation values above 0.8 suggest potential multicollinearity concerns, which is clearly observed in the dataset.

Consequently, the final model specification was designed to ensure parsimony and statistical robustness by retaining ROA as the primary profitability measure.

In similar empirical studies, ROA is commonly preferred over ROE in valuation models due to its higher stability and lower sensitivity to capital structure effects.

Model 1: ROA regression

This subsection presents the results of the first econometric model, where return on assets (ROA) is used as the dependent variable in order to examine the determinants of bank profitability.

Table 3. Regression results (Dependent variable: ROA)

Variable	Coefficient	Std. Error	t-Statistic	p-value
Constant	0.0779	0.0143	5.436	<0.001
ROE	0.1347	0.0056	23.937	<0.001
Total Liabilities / Total Assets	-0.0921	0.0150	-6.134	<0.001
GDP Growth	0.0195	0.1522	0.128	0.900
Inflation	0.0307	0.1714	0.179	0.860

Model statistics:
$R^2 = 0.975$ | Adjusted $R^2 = 0.969$ | F-statistic = 156.03 | Observations = 21
Source: Authors' calculations using Excel regression output

The regression results with ROA as the dependent variable indicate a very strong overall model fit, with an R^2 of 0.975 and an adjusted R^2 of 0.969. This suggests that the selected explanatory variables jointly explain a substantial proportion of the variation in bank profitability measured by return on assets.

Among the explanatory variables, ROE exhibits a strong positive and statistically significant relationship with ROA at the 1% significance level. This result is expected, given that both indicators capture closely related dimensions of bank profitability. The high magnitude and statistical significance of the coefficient suggest a strong internal consistency between the two profitability measures.

The leverage ratio (total liabilities to total assets) shows a statistically significant negative effect on ROA, indicating that higher levels of indebtedness

are associated with lower asset profitability. This finding is consistent with financial theory, which suggests that excessive leverage may increase financial risk and reduce efficiency in asset utilization.

In contrast, macroeconomic variables, namely GDP growth and inflation, are found to be statistically insignificant. This implies that within the observed short time horizon, bank profitability is primarily driven by internal bank-specific factors rather than macroeconomic fluctuations.

Methodological justification

This subsection provides the methodological rationale for the model specification and the selection of explanatory variables, with particular attention to multicollinearity and model robustness considerations.

Despite the strong explanatory power of the model, the inclusion of ROE alongside ROA raises concerns regarding multicollinearity and potential redundancy between profitability measures. As both variables capture closely related dimensions of bank performance, their simultaneous inclusion may lead to over-specification and artificially inflated explanatory power.

Additionally, the primary objective of this study is not to explain ROA as an accounting identity, but to examine the determinants of market valuation of banks. Therefore, profitability indicators are treated as explanatory variables in a separate econometric specification where the dependent variable is market capitalization.

For this reason, the analysis proceeds with a second model in which the dependent variable is the natural logarithm of market capitalization. This specification allows for a more appropriate assessment of the factors influencing the market value of listed banks.

Model 2: MAIN REGRESSION MODEL (ln(Market Cap) regression)

This subsection presents the main econometric model of the study, which examines the determinants of bank market capitalization measured in logarithmic form.

Table 4. Regression results (Dependent variable: ln(Market Capitalization))

Variable	Coefficient	Std. Error	t-Statistic	p-value
Constant	22.8218	7.4622	3.058	0.007
ROA	137.1201	22.0576	6.216	<0.001
Total Liabilities / Total Assets	-11.5563	8.3356	-1.386	0.184
GDP Growth	16.4229	67.7960	0.242	0.811

Model statistics:
R^2 = 0.738 | Adjusted R^2 = 0.692 | F-statistic = 15.997 | p(F) = 0.000034 | Observations = 21
Source: Authors' calculations using Excel regression output

The second econometric model examines the determinants of bank market capitalization, measured as the natural logarithm of market capitalization. The

model exhibits strong overall statistical significance, with an F-statistic of 15.997 and a p-value of 0.000034, indicating that the explanatory variables jointly have significant explanatory power. The model explains approximately 73.8% of the variation in market capitalization, as indicated by the R^2 value of 0.738, while the adjusted R^2 of 0.692 confirms a good model fit given the number of predictors and observations.

Among the explanatory variables, return on assets (ROA) emerges as the only statistically significant determinant of market capitalization at the 1% significance level. The positive coefficient suggests that more profitable banks tend to achieve higher market valuations, which is consistent with financial theory and investor expectations regarding profitability and firm value.

In contrast, the leverage ratio (total liabilities to total assets) is negatively related to market capitalization, although the effect is not statistically significant at conventional levels ($p = 0.184$). This implies that while higher leverage may be associated with lower market valuation, the evidence is not strong enough to confirm a statistically robust relationship within the sample.

Similarly, GDP growth does not appear to have a statistically significant impact on market capitalization ($p = 0.811$). This finding suggests that short-term macroeconomic fluctuations have limited explanatory power for bank market value in the Macedonian banking sector during the observed period.

Overall, the results indicate that bank profitability, measured through ROA, is the primary driver of market capitalization among listed banks, while leverage and macroeconomic conditions play a secondary or statistically insignificant role in explaining variations in market value.

Methodological interpretation

This model provides empirical evidence that internal performance indicators, particularly profitability, are the dominant determinants of bank market valuation. The statistical insignificance of macroeconomic variables may be attributed to the short time horizon of the dataset (2023–2025), which limits variability in macroeconomic conditions. Additionally, the relatively small sample size may reduce the statistical power for detecting weaker effects.

Nevertheless, the model demonstrates robust explanatory power and confirms that ROA is a key driver of market capitalization in the Macedonian banking sector.

5. Discussion: Determinants of bank market capitalization in emerging markets

The empirical results of this study provide clear evidence that bank-specific financial performance, particularly profitability, plays a dominant role in determining market capitalization in the Macedonian banking sector. Across the estimated models, return on assets (ROA) consistently emerges as the most important and statistically significant explanatory variable, confirming its relevance as a key indicator of market valuation.

The findings suggest that investors primarily rely on profitability measures when evaluating banking stocks, while macroeconomic variables such as GDP growth and inflation do not exhibit statistically significant effects. This indicates that, within the observed period, market participants in the Macedonian Stock Exchange place greater emphasis on firm-specific fundamentals rather than broader economic conditions.

The positive and statistically significant relationship between ROA and market capitalization aligns with established financial theory, which posits that more efficient and profitable firms tend to attract higher investor valuation. In contrast, the lack of significance of macroeconomic variables may be attributed to the relatively short time horizon and limited variability in macroeconomic conditions across the sample period.

Leverage, although negatively related to market capitalization, does not show statistical significance in the main model. This suggests that while capital structure is theoretically relevant for firm valuation, its effect in the Macedonian banking sector may be indirect or overshadowed by profitability considerations.

An important additional insight from the analysis is the strong correlation between ROA and ROE, which highlights potential multicollinearity issues and justifies the exclusion of redundant profitability measures from the final model specification. This reinforces the robustness of the selected econometric approach.

Overall, the results indicate that the valuation of listed banks in North Macedonia is predominantly driven by internal financial performance rather than macroeconomic conditions. This pattern is consistent with evidence from other small and bank-dominated financial systems, where investor behavior is largely guided by firm-level fundamentals.

6. Conclusion

This study analyzed the determinants of market capitalization of listed banks in North Macedonia over the period 2023–2025, using a balanced panel dataset and two econometric models estimated through Ordinary Least Squares (OLS). The analysis incorporated bank-specific financial indicators (ROA, ROE, leverage) as well as macroeconomic variables (GDP growth and inflation), in order to capture both internal and external drivers of bank performance and valuation.

The empirical results provide consistent evidence that bank profitability is the primary determinant of market capitalization. In the main model, return on assets (ROA) emerges as the only statistically significant variable influencing market value, indicating that more profitable banks tend to achieve higher market capitalization. This finding confirms that investors in the Macedonian Stock Exchange primarily rely on profitability indicators when valuing banking institutions.

In contrast, leverage shows a negative but statistically insignificant relationship with market capitalization, while macroeconomic variables do not exhibit statistically significant effects. This suggests that, within the observed

period, bank valuation is predominantly driven by internal financial fundamentals rather than broader macroeconomic conditions.

Overall, the findings highlight the dominance of firm-specific factors, particularly profitability, in explaining variations in bank market capitalization in an emerging market context.

Limitations of the Study:

Despite providing meaningful insights into the determinants of bank market capitalization in North Macedonia, this study is subject to several limitations.

First, the relatively small sample size (21 observations) limits the statistical power of the econometric analysis and may affect the generalizability of the results. Second, the short time horizon (2023–2025) restricts the variability of macroeconomic variables, potentially reducing their explanatory significance in the models.

Third, the analysis is based on a pooled Ordinary Least Squares (OLS) approach, which does not explicitly account for unobserved bank-specific heterogeneity that may influence market capitalization. The use of more advanced panel data techniques, such as fixed effects or random effects models, could provide more robust estimates in future research.

Finally, the study relies on publicly available accounting and macroeconomic data, which may not fully capture qualitative factors such as investor sentiment, governance quality, or market expectations.

Policy implications:

The results of this study have several important implications for bank management, investors, and policymakers in North Macedonia.

First, the strong and statistically significant role of profitability implies that bank management should prioritize operational efficiency and asset utilization in order to enhance financial performance and improve market valuation. Strengthening core banking activities and improving cost efficiency may directly contribute to higher investor confidence and market capitalization.

Second, the insignificance of macroeconomic variables suggests that short-term economic fluctuations have limited influence on bank valuation in the Macedonian context. This indicates that investors place greater emphasis on firm-level fundamentals rather than macroeconomic trends when making investment decisions in the banking sector.

Third, although leverage is not statistically significant in the market valuation model, its negative relationship with both profitability and market capitalization highlights the importance of prudent risk management. Regulatory authorities and bank managers should continue to monitor capital structure policies to ensure financial stability and sustainable growth.

Finally, from a policy perspective, improving transparency and disclosure of bank financial performance may further strengthen market efficiency. Enhanced financial reporting standards can reduce information asymmetry and support more accurate valuation of banking stocks in emerging financial markets.

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FINANCIAL AUTONOMY AND MUNICIPAL PERFORMANCE IN PRISHTINA BASED ON DOCUMENTARY EVIDENCE FROM 2015 TO 2025

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Abstract

This paper tries to look into the connection between the financial autonomy and the performance of Municipality of Prishtina in the term of 2015-2025. The study uses qualitative documentary case study approach using as sources for the document that are reports of execution of municipal budgets, annual financial statements, audit reports and other official documents of the institution. The goal is to determine if there has been any progress toward achieving better fiscal outcomes, such as in the collection of own-source revenue and capital investment delivery, as a result of the growth of formal fiscal capacity.

The results demonstrate that the fiscal capacity of the city of Prishtina has significantly increased during the study period. The municipal budget increased from EUR 71.40 million in 2015 to EUR 189.68 million in 2025 (+165.67%). Regardless of this growth, implementation of the program was uneven. The mean capital investment execution rate was 51.01% and mean own source revenue execution rate was 53.75% but both showed considerable improvement in the last years of the study period.

The findings prove that fiscal autonomy cannot be measured only in terms of the size of the municipal budgets or specifically granted financial powers. It is relevant to how municipalities turn available financial resources into realised revenues, executed expenditures, capital investments and accountable financial management. The study is relevant to the literature because it emphasizes the difference between formal fiscal capacity and effective fiscal capacity as two aspects of the analysis of the financial performance of municipalities.

Keywords: financial autonomy, municipal performance, budget execution, documentary analysis, Prishtina

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1. Introduction

A key factor for the effective functioning of local autonomy is the financial autonomy itself, which allows municipalities to raise financial resources, prioritize spending, and provide services based on local needs. Fiscal federalism theory suggests that local preferences vary from one jurisdiction to another, which leads to more efficient allocation of public resources in a decentralised system of government (Oates, 1999). But fiscal decentralisation can only work if the local governments have adequate financial resources, administrative capacity, and institutional structures to perform their duties.

In developing, transitional and post conflict countries, where the administrative capacity and institutional strength are often weak, the institutional dimension of financial autonomy becomes even more relevant. Experiences from Ukraine suggest that transferring delegated authority is not enough without also providing subnational governments with sufficient resources, administrative capabilities, coordination structures and effective monitoring systems (OECD 2018). According to Faguet (2014), good local governance and accountability are as important as the legal devolution of fiscal power for successful decentralisation. Similarly, Bahl (2006) states that financial resources and implementation capacity are crucial for decentralisation to reach its goals. Municipalities' financial autonomy should therefore be measured in terms of how well they can translate fiscal powers into financial results.

However, other economic factors also affect the performance of municipal finances. The macroeconomic context also affects the context in which the municipalities operate and impacts the capacity of the municipalities in public finances (Imami & Risteska, 2025).

The Law on Local Self-Government (Law No. 03/L-040, 2008) and the Law on Local Government Finance (Law No. 03/L-049, 2008) have been further reinforced with the Law on the Capital City (Law No. 06/L-012, 2018), which has also been continuously strengthened. These are the laws that establish municipal competencies, revenue streams, intergovernmental financial relations and institutional arrangements related to achieving financial autonomy.

The Municipality of Prishtina is a relevant case because it is the largest and the capital of Kosovo, and it has a wide fiscal base at the local level, and a large number of responsibilities in the delivery of public services and development of infrastructure. Its budget grew significantly in the 2015-2025 period, but the budget execution report shows that improved budget execution was not always accompanied by improved performance in its own-source revenue collection, capital investment execution, procurement management, and financial accountability. This begars the issue of whether or not there is a positive relationship between formal fiscal capacity and effective fiscal capacity.

In order to overcome this problem, this study has examined the financial autonomy and the performance of the Municipality of Prishtina within the period of 2015 – 2025, based on qualitative documentary case study. Following the method of Bowen (2009), the documentary analysis involved a set of municipal

budgets, annual financial statements, budget execution reports, audit reports and other official institutional documents.

The paper makes the case that financial autonomy should be measured not just in terms of municipal budgets or their legal capacity to raise own-source revenues, but also through the municipalities' capacity to transform their resources into realised revenues, undertaken expenditures, investments in capital, and effective financial management. It thus differentiates between legal availability of financial resources (fiscal capacity) and between fiscal authority (fiscal capacity) and its implementation in practice (effective fiscal capacity) of the municipality.

This study puts together the theory of fiscal decentralisation with the longitudinal narrative of the Municipality of Prishtina's formal fiscal capacities, based on which it is argued that there is no contradiction between significant increases in formal fiscal capacity and differences in implementation performance. By demonstrating that the effectiveness of financial autonomy relies not just on the legal and financial structure, it also on the institutional capacity needed to turn fiscal autonomy into measurable financial outcomes, it adds to the literature.

2. Institutional and Literature Context

The main argument of fiscal decentralisation is that subnational governments can better meet local preferences and service needs than can the central government. The decentralisation theorem suggests that local provision and allocative efficiency in the provision of public services may be beneficial when the benefits and costs of public services are geographically localized (Oates, 1999). But besides tasks being reallocated, there needs to be sufficient financial, decision-making and administrative resources.

Municipal financial autonomy is a reflection of the capacity of local governments in a legal and intergovernmental fiscal framework to collect revenues, manage resources, set priorities for spending and pay for municipal functions. It involves revenue autonomy, expenditure autonomy, a local reliance on own-source revenues and a degree of control over local tax and fee policies. Aside from the percentage of own-source revenues, fiscal autonomy is also related to municipalities' decision on how to collect those revenues, as Slack (2023) comments.

In this study, there are two components of financial independence. There are two types of fiscal capacity: formal fiscal capacity, which is the legal right, revenue instruments, transfers, and budgetary resources that municipalities have; and effective fiscal capacity, which is the ability of municipalities to mobilise their revenues, execute their expenditures, plan capital projects, and fulfil financial-management and accountability obligations. It also highlights the link to the larger debate on the notion of formal fiscal empowerment that has to gain practical meaning through the institutional and implementation capacity of subnational governments (Raich, 2005). In keeping with this distinction, empirical studies conducted in the Peruvian municipalities demonstrate that larger budgets are not necessarily translated into higher levels of budget execution, as

institutional capacity varies across municipalities and is needed to implement the budget. (Loayza et al., 2013) Thus, increases in legal authority and budget do not necessarily lead to higher performance in municipalities. Improved municipal performance does not always go hand-in-hand with legal authority and budget growth.

Municipal autonomy is largely outlined in the Law on Local Self-Government (Law No. 03/L-040, 2008) and the Law on Local Government Finance (Law No. 03/L-049, 2008), which is applicable to municipal revenues and funds, grants, transfers, borrowing and other financial resources. The Law on Public Financial Management and Accountability (No. 03/L-048 of 2008 amended) sets guidelines for the budgeting, expenditure control, financial reporting and accountability. However, the autonomy of the municipalities is not a free rein in public financial management, but rather is part of a system of public financial management that is regulated on the national level.

The Law on the Capital City (Law No. 06/L-012, 2018) further stresses on Prishtina's special status and wider responsibilities. Notwithstanding these new role functions, the municipality continues to be governed by the overarching law relating to local government, public finance, public procurement and external audit. The financial viability needs to be evaluated, therefore, against its capital-city obligations and the over-arching regulatory framework for all municipalities.

Formal fiscal autonomy does not necessarily lead to effective fiscal autonomy, as suggested in the literature. For decentralisation outcomes to be achieved, local actors need to have the power to make decisions, to be capable of administration, to be held to account, and to be given incentives, according to Faguet (2014). Similarly, Bahl (2006) notes that the allocation of expenditure, the allocation of revenues and institutional capacity need to move in harmony to be able to attain the goals of decentralisation. Capacity building of local governments is therefore crucial in achieving effective performance in administration and finance, and to ensure that the formally delegated powers are used well (Nemec et al., 2015).

Incentives to local revenue mobilisation can be undermined, intergovernmental transfers finance assigned responsibilities, but also can mitigate fiscal disparities. Transfer design will impact on local expenditure behaviour, fiscal responsibility, and fiscal accountability as demonstrated by Bird and Smart (2002). Likewise, Bergvall et al. (2006) show that the impact of transfers varies with their conditional vs. unconditional nature, predictability vs. discretion, and formula vs. negotiated nature.

The same applies to the own-source revenues. However, while the legal right to tax, charge, levy and collect taxes is 'formal revenue capacity', effective fiscal capacity depends on how the municipality administers its revenue collection processes, how well the municipality records taxpayers, how well it enforces its revenue collection processes, and how well the municipality predicts revenues, because effective revenue collection is about administrative capacity, not just legal capacity (Harbers, 2014). Under the Kosovo Law on Local Government Finance there are several categories of central government support, which are added to the municipal own-source revenues. The results obtained so far in the

field in Kosovo suggest that the gap between planned and realized revenues from own sources is an important indicator of the effectiveness of the revenue management and the financial performance of municipalities (Imami, 2022). This is a formal form of fiscal autonomy, but to look at the actual revenue collection, it would be a good indication of fiscal capacity.

Financial autonomy needs to be measured with expenditure performance as well. Growth in the budget increases the fiscal space granted by the formal budget but does not show the effectiveness of the policy implementation. A comparison of budgeted and actual expenditure is therefore an important measure of the municipalities' capacity to spend approved appropriations to meet the expectations of delivering public services and completed investments.

The execution of capital investment is especially interesting as this is a project that needs effective planning, budgeting, procurement, contracting, supervision and implementation. Ongoing budget and payment discrepancies can be a reflection of project preparation, procurement, contract management or institutional capacity issues.

The results of execution should be viewed in conjunction, however. Increased spending does not mean that it was efficient or effective. Financial performance must also be assessed by means of service quality, project completion, compliance with the rules of procurement and financial management, and accountability, by means of annual financial statements, audit reports, records of budget execution and other evidence of the institutions.

An integral part of successful financial autonomy is accountability. There must be transparency in budgeting, reliability in reporting, internal control, external audit and public oversight to achieve greater fiscal discretion. In cases of low effectiveness in these mechanisms there could be an overlapping of formal autonomy, inefficient spending and weak financial management (Faguet, 2014).

These relationships can be related on the basis of the Prishtina Municipality as the configuration of the strong capability in terms of revenues and high responsibilities in terms of services provide a good framework and basis for examining these relationships while at the same time the municipality has a vast implementation problem and has a comparatively high formal fiscal capacity. The research compares the formal capacity to the financial performance, as measured in municipal budgets and budget-execution data along with annual financial statements, audit reports and the relevant legislation, between 2015 and 2025.

Document analysis is suitable because it can be used to systematically analyse institutional documents over time. According to Bowen (2009) documentary evidence can give contextual information, show institutional decisions and can make comparisons between documents. This research therefore examines if there was a realisation of the fiscal autonomy in terms of financial performance, as authorised under the law.

The paper thus conceptualises effective financial autonomy as being the capacity of the municipality to raise revenues, allocate resources, make expenditures, carry out capital projects and meet accountability obligations. Autonomy is not assessed by the presence or absence of a specific law, or the increase or decrease of budgets but rather by whether there were any formal fiscal

opportunities that were realised into financial outcomes in Prishtina during 2015-2025.

3. Methodology and Documentary Corpus

This study uses a qualitative approach in the documentation case study method with the approach of the analysis of documentary financial evidence system. The case is institutionally, geographically and time limited with the scope of the Municipality of Prishtina, spanning the time period 2015-2025. The research does not aim at estimating statistical relationships or generalising about the situation at the municipal level; instead, it focuses on the evolution of formal fiscal capacity and financial implementation within a single situation of local government. Given its many budgetary obligations, significant own source revenue potential and the high level of infrastructure and service obligations, Prishtina, as the largest and capital city of Kosovo, is a suitable case to consider whether an increase in fiscal resources led to better financial performance.

The methodological approach involves a multi-method analysis (financial and documentary – qualitative). Documentary analysis can be used since official records can be used to prove institutional decisions, financial planning, achieved results and change over time. According to Bowen (2009), document analysis is a systematic way of reading and understanding the documentary record and deriving empirical understanding from the record. This study allows the legitimate fiscal capacity to be related to realised financial performance over the past 11 consecutive fiscal years.

The documentary corpus is made up mainly of the Municipality of Prishtina's annual reports on the budget execution for 2015-2025, along with the annual financial statements, approved budgets for the Municipality of Prishtina and the reports of the National Audit Office, as well as public financial management and municipal finance law, which regulates the financial management of the Municipality. Formal fiscal authority is provided by legislation; budgets record a planned capacity for financial resources; financial statements and budget-execution reports are prepared to document realised revenues and expenditures; and the audit reports are prepared to provide an independent body of evidence for financial management, procurement and compliance, financial internal control and accountability.

The empirical data was assembled based on the municipal budget documents from the last 12 years, for six budget blocks: total budget, goods and services, municipal expenditures, subsidies and transfers, capital investments and own-source revenues. The data set contains information on budgeted amount, realised amount and the execution rate for each category. A total of 66 values of the category-year data set (six financial categories, 11 fiscal years). Realised expenditure is the actual expenditure and realised own-source revenue the actual income. The amounts of money are given in € (euro).

Each year's report was checked on a case-by-case basis prior to the extraction of data, to ensure reliability. The values in the recorded data were checked for consistency with the original documents, the financial categories were

standardized during the study period, and the other categories were harmonized by using common analytical categories. The execution rate was determined by dividing realisation and budgeted amounts and multiplying by 100. If any differences were noticed the original accounts were reviewed to ensure that the figures in the accounts were correct.

This is descriptive and interpretative analysis and not econometric analysis. It is a comparison of planned and realised monetary values over time in order to measure whether a formal fiscal capacity was successful in being realised into effective fiscal capacity. Formal fiscal capacity includes budgeted expenditures, legally available revenues, and assigned financial resources; while realised revenues, realised expenditures, capital investment payments, and audit evidence are examples of effective fiscal capacity.

There are three analytic dimensions that guide the analysis. Firstly, the expansion of the formal fiscal capacity is measured on the basis of the development of the total municipal budget. Second is own-source revenue execution which is a measure of how well the municipality can transform their legal revenue authority into realised revenue. Third, the municipality's ability to carry out capital investment projects is measured by capital investment execution. A comparison of actual values with authorised values thus gives an indication of the relationship between the fiscal capacity and the financial performance.

Any gaps in implementation are not necessarily viewed as administrative failures execution gaps are seen as a measure of implementation performance. They can be caused by the forecasting of revenue, the collection capacity, procurement, preparation of projects, implementation of contracts, administrative coordination, legal disputes or economic conditions. If weaknesses are found in the execution of the programme in the National Audit Office reports then these are used to explain the execution patterns. Similarly, execution figures are viewed with some suspicion as a high figure in itself doesn't mean an efficient, effective, timely or lawful outlay.

Data is presented descriptively, in tables and as comparisons in graphs. Average budgeting and realisation results are analysed to detect the long-term financial developments and overall assessment of implementation's results is provided by the average execution rates. The analysis differentiates three phases for interpretation: relative stability during execution (2015-2017), significant increase in budget and implementation gap (2018-2023) and better achievement of execution performance (2024-2025). The following phases are only used as a method of analysis and not as indications of a single causal process.

The methodology is based solely on official documentary evidence gathered over an 11 year period, includes a transparent and verifiable methodology and uses financial indicators and independent audit evidence. The results, however, are not statistically generalizable to other cities, aggregated financial data do not offer the possibility to make a project-level evaluation, and documents do not contain detailed information to cover all execution gaps. The methodology provides a suitable foundation to evaluate if the fiscal capacity of Prishtina has been strengthened and formalised in the period 2015-2025, through a

stronger revenue mobilisation and better expenditure execution and capital-investment implementation.

4. Findings

As it can be observed from the empirical evidence, the Municipality of Prishtina had a significant growth of its fiscal capacity in the period from 2015 to 2025. The total municipal budget grew by EUR 118.28 million from 2015 (EUR 71.40 million) to 2025 (EUR 189.68 million), or around 165.66%. The total payments grew by EUR 129.78 million (from EUR 49.09 million to EUR 178.87 million), or about 172.83%. The biggest growth in realised expenditure was in 2024–2025.

Table 1 provides an overview of the growth of the total municipal budget, total payments, own-source revenues and capital investments over the years. The findings show that the budgets and implementation progress were relatively stable during 2015-2017, budgets grew quickly with increased gaps in implementation during 2018-2023, and that implementation of revenues and expenditures was strengthened during 2024-2025.

Table 1. Annual Budget Execution Summary, Municipality of Pristina, 2015–2025

Year	Total budget	Total payments	OSR budget	OSR payments	OSR execution	Capital budget	Capital payments	Capital execution
2015	71.40	49.09	18.04	12.27	68.01	39.08	24.38	62.39
2016	69.83	47.38	24.24	16.39	67.63	33.95	19.75	58.17
2017	67.43	45.03	24.45	16.23	66.37	31.38	17.72	56.48
2018	84.51	46.52	28.54	14.70	51.50	38.49	16.73	43.46
2019	110.33	62.70	31.42	14.07	44.80	46.04	18.85	40.93
2020	115.17	50.66	27.03	8.71	32.22	49.80	16.35	32.82
2021	122.96	59.50	38.17	10.73	28.11	51.06	17.34	33.96
2022	138.38	66.50	34.65	11.83	34.14	65.98	18.37	27.84
2023	165.29	93.73	37.51	19.11	50.94	89.50	37.52	41.93
2024	164.77	116.99	36.95	22.67	61.35	89.23	56.36	63.16
2025	189.68	178.87	77.98	67.17	86.14	72.26	72.26	100.00

Note. Monetary values are expressed in EUR millions; execution rates are expressed as percentages

There was a significant rise in own-source revenues within the study period. Revenue is expected to grow from EUR 18.04 million in 2015 to EUR

77.98 million in 2025 – realised collections rose from EUR 12.27 million in 2015 to EUR 67.17 million in 2025. The performance of executing, however, was very variable. The average annual execution rate was 53.75% which was above 66% from 2015 to 2017, but then decreased between 2018 and 2022. The lowest execution rate was in 2021 (28.11%) with revenue performance improving from then on with 61.35% in 2024 and 86.14% in 2025.

The performance on the capital investments was also similar. Capital budget is projected to increase from EUR 39.08 million in 2015 to EUR 72.26 million in 2025 while capital payments are projected to increase from EUR 24.38 million in 2015 to EUR 72.26 million in 2025. However, only 51.01% of the execution rate is on average per year. Capital execution exceeded 56% during 2015–2017 but remained below 42% for most of 2019–2023, reaching its lowest level in 2022 (27.84%). In 2024, it saw improvements (63.16%) and in 2025, it was fully reported to have been executed.

The growth in capital investment approved and invested more than double the rate it was between 2018 and 2024, then narrowed significantly in 2024 and is projected to be closed in 2025 as shown in figure 1.

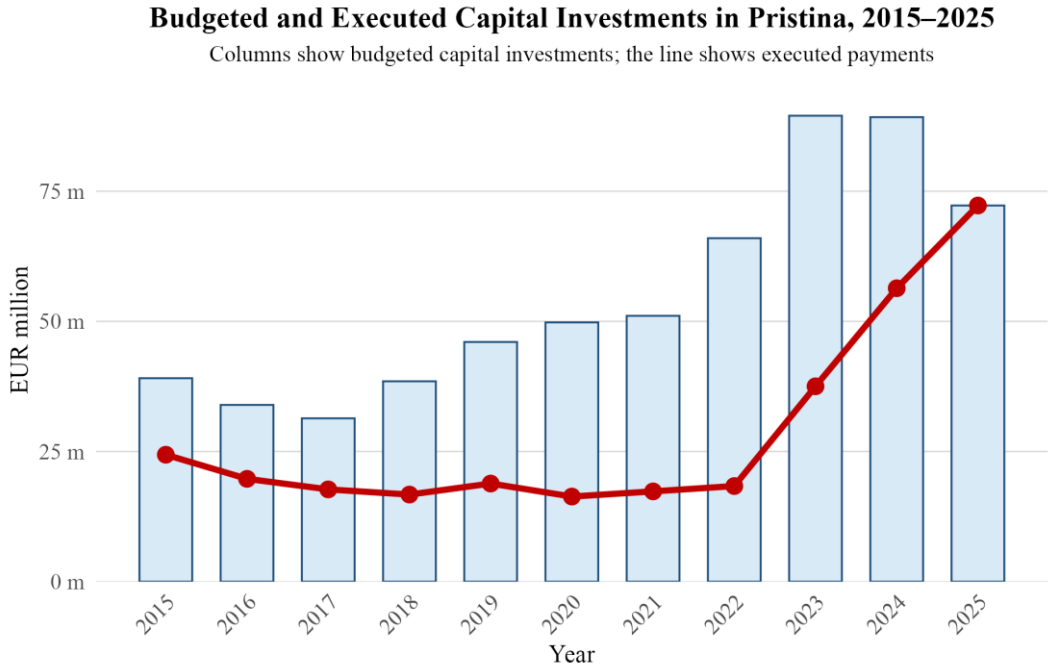


Figure 1. Budgeted and Executed Capital Investments in Pristina, 2015–2025

Table 2 shows that there are also differences in the implementation performance of municipal finances at the category level. Capital investments were the leading budget item on average with an average of 46.91% of the municipal budget, but an average of 37.67% realised payments, resulting in an average execution rate of 51.01%. Own-source revenues were used at an average rate of 53.75% to cover the planned budget (expenditure) and realised financial flows (income) of 29.48% respectively.

Table 2. Average Budget Structure and Execution by Category, Municipality of Pristina, 2015–2025

Category	Average budget EUR million	Average payments EUR million	Average budget share %	Average payment share %	Average execution rate %
Capital Investments	55.16	28.69	46.91	37.67	51.01
Own-Source Revenues	34.45	19.44	29.48	25.46	53.75
Goods and Services	19.83	18.75	16.11	25.89	94.08
Subsidies and Transfers	6.40	5.15	5.42	7.60	82.18
Municipal Expenditures	2.31	2.24	2.09	3.38	96.80

Municipal expenditures had the largest average execution rate (96.80%) followed by goods and services (94.08%) and subsidies and transfers (82.18%). The implementation challenges, on the contrary, were more focused on two aspects – capital investments and own-source revenues, with the lowest execution rates.

The results indicate that while Prishtina's formal fiscal capacity grew significantly in the period 2015–2025, there was a variable rate of transformation of the authorised resources into realised revenues and expenditures. Own-source revenue collection and capital-investment execution were found to be the key areas of weakness in the budget during the period 2018-2022 as they slowed down, whereas budget growth picked up pace after 2018 and attained a significant improvement in 2024-2025. The results for 2025 showed the highest implementation performance during the study period, but are based on only one year of results and should be seen with a pinch of salt.

5. Discussion

The results showed that the increase of financial resources of the municipalities does not necessarily lead to better financial implementation. The Municipality of Prishtina significantly raised its approved budget, projections of own-source revenue, and investment amounts in capital funds for the period of 2015-2025, but the implementation was not as swift as hoped, especially for the years 2018-2023. This is further evidence of the difference between formal fiscal capacity, in terms of the financial resources available in a municipality's legal frameworks, and effective fiscal capacity, which is essentially the municipality's capacity to mobilise the resources into realised revenues and carried out expenditure.

This interpretation is in line with the literature on fiscal decentralisation, which highlights administrative capacity, accountability, financial management, and institutional effectiveness in addition to decision-making power to be at the heart of fiscal decentralisation's effectiveness (Faguet, 2014). In the case of financial autonomy, this should be judged according to the ability of municipalities to use the fiscal resources available, and not only from the point of view of their legal powers or size of their budgets.

This is reflected in the capital investment performance. Capital investments were the largest part of the budget; however, spending on these items was not significantly higher than appropriations, especially after 2018 when the appropriations for capital investments increased significantly. This is similar to public investment management method, which stresses that project preparation, procurement, implementation, monitoring and evaluation are key to successful investment, not just the availability of the budget (Rajaram et al., 2010). The evidence from the documents does not specify the exact reasons why implementation gaps emerged but it suggests that there was a lack of growth in implementation capacity compared to formal fiscal capacity.

This improvement in 2024 and even more in 2025 shows that the institutional framework was under a considerable amount of implementation improvement that could be realized. But having a year of impressive results doesn't mean that any implementation hurdles of the past have been overcome, and future finances will give an indication of whether that improvement will last.

The results regarding the own source revenue also show this difference between financial autonomy and the fiscal powers which have been authorised. The realisation of the revenues varied considerably over the study period, though they were generally higher than in the past, especially in 2018-2022. The concept of projected revenues is only a public finance capacity projection from a public finance angle, and from a financial autonomy point of view, revenues are not financial autonomous unless they are collected and made available for financing the municipality's services and investments.

The institutional features of intergovernmental finance are consistent with this understanding. The aim of the transfers is to compensate for differences in local fiscal capacity, but the form of the transfer also can impact local fiscal behaviour and financial incentives (Bird & Smart, 2002; Bergvall et al., 2006). The Prishtina case indicates that higher level of own-source revenue mobilization leads to higher level of effective financial flexibility, while the differences between own-source revenue projections and its realisation over time leads to lower level of effective fiscal authority.

There was also variation in the implementation performance, by spending category. The execution of municipal expenditures, goods and services, and subsidies and transfers, were high over the entire period of the study while capital investments had significantly lower execution rates for most of the study period. The difference is due to the fact that investment projects are more complex involving administrative work in preparing the project, procuring the project materials, managing the contracts, technical supervision, and longer project implementation process. Hence, the aggregate of budget execution does not give a

full picture of the financial performance of municipalities as it is possible that the aggregate of the budget execution for recurrent expenditure is good while that for development is poor.

These are supported by the chronological pattern. While budgets have contracted in 2015-2017, and fiscal growth has been weak since 2018-2023, execution has nonetheless remained relatively stable during that time, and improved significantly in 2024-2025. This indicates that institutional capacity also grew at a lower rate than was available in fiscal resources in the beginning, but gradually rose over time. However, none of the documentation allows causal inferences to be drawn as to the reasons for these changes. These interpretations might be confirmed by further qualitative evidence that is not included in the documentary evidence of this study, but would need to be found if they were to be confirmed.

Results prove that financial autonomy is not only the ability to raise revenues legally, but also the growth of municipal revenues. Its usefulness lies on the capacity of the municipalities to convert available financial resources into realised revenues, realisations of expenditures, capital investments and control of financial management. The analysis of Prishtina's evidence shows that fiscal capacity has increased consistently over the last decade (2015-2025) at the formal level, while at the effective level fiscal capacity has increased somewhat less consistently, especially in the execution of capital investments and collection of own-source revenue. The findings underscore the need to examine fiscal autonomy of the municipalities both in the fiscal resources that are available to them and in their institutional capacity to put them into practice.

6. Conclusion

The aim of this study was to analyse the interconnection of financial autonomy and the performance of the Municipality of Prishtina in the period 2015-2025, in a qualitative way by examining the reports of the budget execution of municipalities. The analysis was limited to the process of building up the municipal budgets, the gathering of revenues from own sources, the implementation of capital investments, and between approved and realised financial resources.

The results indicate that the fiscal capacity of Prishtina has significantly grown within the course of the study period in terms of official capacity.The results reveal a significant increase in the fiscal capacity of Prishtina in formal capacity during the study period. The budgets of municipalities grew, the estimates of their own-source revenue rose and the amount of resources was enhanced for capital investments. But it did not go hand-in-hand with implementation. Own-Source Revenue collection was inconsistent with less than satisfactory level, while capital spending has often been lower than approved, especially during 2018-2023. The 2024 and 2025 years are a good improvement in execution, but are not enough to conclude that there is an institutional improvement that will endure.

These findings can be understood in the light of the distinction between fiscal capacity, formal and effective. Formal fiscal capacity is the financial resources and legal power of municipalities, while effective capacity is their capacity to collect the revenues they project and to approve and execute the expenditures. The evidence shows that Prishtina's ability to increase its fiscal capacity in the formal sector demonstrated greater success than its ability to increase its capacity to implement it.

These findings further show that there should not be a single criterion by which to measure financial autonomy for municipalities based on the size of their budgets or their legal authority to generate revenue. The development of autonomy requires equally administrative capacity, financial management and the ability to use available fiscal resources to achieve realised fiscal results (Bahl 2006). This is also reflected in the fact that the execution of recurrent expenditure is generally superior to the execution of capital expenditure, which does not give a full picture of the financial performance of municipalities.

This study is only for one Municipality and has been based mainly on primary sources of documentary data. As a result, the results cannot be extrapolated to every municipality in Kosovo and the facts presented in the documents do not necessarily give a complete picture of the procurement procedures, the administrative coordination, project implementation, and quality of completed investments.

There should be more research that integrates financial information with audit information, project-level evidence and interviews with municipal officials to further frame the issues on the implementation performance. Comparisons between cities and towns might also be done to explore the relationship between the ability to collect revenues and the execution of capital investments and administrative capacity, municipal size, transfer dependence, political conditions, and local economic structure.

The experience in Prishtina indicates that increases in fiscal space are not enough to boost the performance of municipalities. The financial autonomy comes into being only when the financial resources are also translated into realised revenue, implemented expenditures and effective use of public investments on a regular basis.

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QUALITATIVE RESEARCH METHODS IN BANKING RESEARCH: CONTENT ANALYSIS AND CASE STUDY

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Abstract

Banking system is one of the most significant sectors of study in economics because it has a significant role in supporting financial stability and economic development of a country. In banking research, quantitative methods have been traditionally applied, such as panel data models, regression analysis, and dynamic estimation methods, and have yielded a significant statistical outcome. Qualitative research methods, however, are becoming more popular and are emerging as a way of gaining a deeper understanding of complex banking phenomena, decision making processes, competitive challenges, digitalization and determinants of profitability.
This paper aims to provide a general overview of the impact of qualitative research methods in banking research, particularly the case study method and content analysis. The research will be conducted through a literature review in the field of banking sector.
The results of the research indicate that the use of qualitative research methods is an added value in the world of banking research for deep insights, for finding contextual relationships and for complementing the results obtained from quantitative research. Hence, the use of qualitative methods may help in assisting in the more knowledgeable academic research, the formulation of policies, and the decision making in the banking sectors.

Keywords: Banking Research, Qualitative Research, Case study, Content Analysis, Banking Sector.

1. Introduction

The banking system is an important component of the financial infrastructure of any country, influencing overall economic development and stability. In a time of new challenges and opportunities, banks must be able to adapt to challenges and risks to ensure that they continue to provide sustainable and efficient services to their customers. In this context, examining the banking

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system's performance, stability, and profitability is a crucial issue for any economy. Research on banking profitability has traditionally been dominated by quantitative approaches, including panel data models, regression analysis, and dynamic estimation techniques. While these methods provide valuable statistical evidence, they often fail to explain the underlying mechanisms through which profitability determinants influence banking performance.

This paper aims to reflect the contribution of two qualitative research methods, case study and content analysis, to banking sector research. Through a systematic review of methodological literature and empirical studies, the paper reflects on how these methods have been applied by different researchers and their value in complementing quantitative analyses.

The paper is structured as follows: section 2 provides a literature review of both methods, including their characteristics, steps, and application in banking research. Section 3 presents the methodology used. Section 4 presents the findings and discussions, as well as section 5 which presents the conclusions and recommendations of the paper.

2. Literature Review

2.1 Case Study Method

The case study is a qualitative research method that allows to investigate a specific topic using different sources of data. Such a research approach is important for research that requires the full study and interpretation of a specific case. The case study involves collecting data from multiple sources, including interviews, observations, video, papers, and reports, to develop a thorough comprehension of a case Woodside (2010). Also, Gerring (2004), highlights that a case study is an in-depth investigation of a only unit in order to understand a wider class of units, where the unit is a geographically confined phenomena seen at a specific moment in time or during a short period.

According to Yin (2014), who recommends a general analytical approach for case study analysis, which proposes three basic types of case study analysis: (a) evaluation based on theoretical suggestions, (b) analysis requiring consideration of different perspectives, and (c) analysis based on explanations and descriptive structures.

Interviews are important for comprehending complicated topics by studying the several ways in which individuals' knowledge, interpret, and develop their reactions to specific challenges Gerson & Horowitz (2002).

Such an approach can be used to address certain phenomena based on an interview guide as an important tool for conducting a case study. Dependent on how the interview is arranged, the guide might have dozens of extremely precise questions, numerous topic areas presented in no particular sequence, or something in between Merriam & Tisdell (2016).

2.1.1 Characteristics of the Case Study Method

 The case study as a widely used research approach has characteristics and steps for implementing it. According to Coombs (2022), the key characteristics of the case study approach include:

 The identification of the case is limited, which implies that the case being investigated can be defined or classified within specified parameters.

 A case study should give a thorough grasp of the situation.

 Data is gathered using a number of methods, including interviews, focus groups, field notes, papers, autobiographies, historical records, and films.

 Data analysis varies depending on the situation being studied, combining qualitative and quantitative methods.

 Identifying a topic is crucial for providing sufficient descriptions in research.

 Case studies include researchers' findings obtained from case studies, documents, books, etc.

Considering the above-mentioned characteristics which provide knowledge and guidance for researchers, equally important are the steps that must be followed in implementing this method. In this regard, according to Bunkar, Chauhan, Verma and Sirilakshmi (2024), the steps to follow for implementing this method include:

1. Case selection: Researchers pick a single or limited scenario that is relevant to the study topics.
2. Defining the research question: Research questions should be clearly defined in order to focus the research on certain elements.
3. Data collection: Researchers collect data through interviews, observations, document analysis, and surveys to create an overall picture.
4. Data analysis: In this step, the data is studied qualitatively to identify patterns, insights, classification, and coding of the data.
5. Interpretation: In this step, the researcher is required to interpret the data, respectively the research results, to answer the study questions and to develop conclusions, respectively their interpretation.
6. Reporting: The findings include a case study report which includes the methodology, data analysis, and conclusions.
7. Validity and reliability: To ensure the validity and reliability of research results, control and review are necessary.

Further more, Zikmund, Babin, Carr, & Griffin (2013) have presented the steps of the business research process:

Note: Diamond-shaped boxes highlight stages in the search process when one or more strategies must be selected. The dotted line represents an alternate approach that avoids exploratory search.

2.2 Application of the Case Study Method in banking research

Despite the challenges and the need for continual improvements, the banking system serves as a main source of financing for economic activity, thus impacting the stability and development of an economy. In times of new challenges and opportunities, banks must be able to adapt to new risks and transformations, such as digitalization, increased competition and regulatory changes, in order to continue to provide sustainable and efficient services. The sustainability of the banking system is reflected in maintaining appropriate levels of liquidity, the quality of the credit portfolio and sufficient capitalization. According to Casu, Girardone, & Molyneux (2006), bank performance is determined by ratio examination and analyzed through the objective of (1) observing historical and present tendencies and (2) defining coming estimations of bank accomplishments by assessing several parts of bank achievements, for instance, profitability, asset value, and solvency.

Numerous studies have been conducted on the banking sector, and in this regard, many researchers have used semi-structured interviews with experts in the field to achieve consistent results. In this way, according to Bocken & Yip (2017), applying the semi-structured interview confirmed a set of stable archetypes related to the banking industry; the discoveries regarding client attraction connected to archetypes will assist Hong Kong banks emphasize on the acknowledged archetypes to achieve greater performance. Also, Alnsour (2013) applied interviewing with marketing directors, senior managers, and direct managers of banks, as well as content analysis in his research regarding attracting and retaining bank customers. This is actually related to the profitability factors of banks, as the growth in the number of clients consequently affects the profitability of banks. Attracting customers by banks is of great importance in the performance of the banking system as a complete. However, special care should be taken with non-performing loans as they can have a major negative impact on the banking system. Also, Hassan (2022) in his research conducted semi-structured interviews with senior managers of loans at commercial banks in Pakistan to investigate the factors affecting non-performing loans. This research discovered that Pakistani bankers were aware of the techniques of credit sanctioning but had problems with their compliance. According to the author's findings, the examination of the elements of NPLs would support bankers and legislators to create instruments that would support and protect the banking sector from non-performing loans. In addition, according to Gill, Kazmi, & Ai (2022), in their research through semi-structured interviews with operational managers and business managers of Islamic banks, their findings resulted in that in addition to the profitability factors of the banking sector, the technological factors of e-banking and digital banking also positively influenced the profitability of the banking sector. On the other side, Abiodun & Nancy (2024) investigated the role of liquidity in maintaining bank solvency and performance through two methods: quantitative and semi-structured interviews, concluding that maintaining liquidity levels and implementing dynamic liquidity management practices are essential to supporting profitability

and competitive positioning for DFCU Bank. Also, Jamil, Amin, Rahman, & Wang (2024) the effects of digital technology, risk management, and non-interest income on commercial banks' revenue production and profit maximization. According to their results, digital transformations are the primary forces behind the interconnectedness of digital technologies, non-interest income, risk management, profit maximization, and commercial banks' revenue streams.

2.3. Content Analysis Method

Content analysis is a research technique that includes collecting and analyzing text, documents, media communications, or visual data in order to uncover designs, themes, or trends. Content analysis can provide insights into the broader reality since the content of communication represents all overall connections. Content analysis provides academics with a flexible, practical tool for building and increasing knowledge about the social experience with health and sickness Hsieh & Shannon (2005).

Data records may be useless and inappropriate for analysis unless the information they contain is carefully summarized and made comparable. An objective coding system should be applied to the records or data, a process known as content analysis. According to Miązek & Szczepańska (2020), material analysis involves four stages: data collection, coding, analysis, and interpretation of coded material.

The first stage, data collection, involves researchers selecting data sources to ensure that the sample is genuine. It is critical for researchers to grasp the links between source databases, sample features, and study questions.

In the second step, the found textual data is classified into multiple categories at several levels (recorded units): words, phrases, sentences, paragraphs, or subjects.

The third phase, content analysis, permits researchers to present their findings in a number of formats.

The fourth and final phase involves interpreting the data within a theoretical framework, depending on the study purpose: measurement, description, or conclusion.

2.3.1 Importance of Content Analysis in Qualitative Research

Content analysis as a powerful methodological strategy plays an important role in qualitative research for the purpose of evaluating and understanding complex data, its importance is underlined by these elements Gogoi & Bunkar (2024):

- In-Depth Understanding: It enables researchers to explore deeply into data to uncover key meanings, topics, and patterns.
- Systematic and Objective: It guarantees that data analysis is systematic and objective; researchers increase the trustworthiness of their findings by classifying and categorizing them rigorously.
- Proficiency in all disciplines: This analysis is useful in a variety of fields, the ability to examine many types of communication - such as text, photos, audio and video, makes this approach important for researchers.

- Contextual Analysis: Understanding context helps researchers grasp the importance of data by relating it to society trends and concerns.
- Theory Development and Validation: Content analysis gives current and trustworthy facts to support or contradict theoretical ideas by revealing fresh insights.
- Data Reduction and Synthesis: One of the benefits of content analysis is its capacity to aggregate and synthesize enormous volumes of information.
- Identification of Bias and Propaganda: Content analysis can show examples of prejudice, propaganda, and misinformation.
- Revealing Communication Gaps: This analysis helps identify communication gaps that may occur in different circumstances, thus improving communication tactics.
- Enhancing Media Literacy: Material analysis promotes media literacy by critically examining media content.
- Informing Policy and Practice: Policymakers and practitioners can make more informed decisions based on content analysis findings.

The systematic review presents four premises, and content analysis studies: 1) differ in execution and reporting; 2) have a propensity toward methodological ambiguity; 3) Do not use content analysis as the sole approach. 4) Are versatile, Vespestad & Clancy (2021).

Kim & Kuljis (2018), had illustrated the process of content analysis through nine steps, those are:

1. Theory and rationale - Define research questions or hypotheses.
2. Conceptualisations - Conceptually developed a collection of variables and their explanations.
3. Operationalisation - Define categories and units of measurement.
4. Coding scheme - Creating a code book for the classes and measures.
5. Sampling - Sample determination.
6. Training or pilot reliability - Training coders or assessing inter-coder consistency on each variable, and modification of the code book.
7. Final reliability - Calculate a dependability figure for respectively variable.
8. Coding - Coding data.
9. Analysis or reporting - Analyzing data and reporting conclusions.

2.3.2 Application of the Content Analysis Method in banking research

Content analysis is a qualitative research method used to analyze scientific articles, documents, reports, and other materials in order to extract structured and understandable information. In the framework of our research, content analysis can be applied to study the various elements that affect the profitability of the banking sector. According to this, via a comprehensive assessment of the literature on rules, profitability, and risk in the banking sector and the linkages among them (Bhimavarapu, Pinto, Sharma, & Rastogi, 2022), by applying content

analysis, they find that banking concentration, market strength, huge banks, and reduced competition all have a substantial impact on banks' financial stability, profitability, and risk. Also, Lajili, Mohsni, Polizzi, & Scannella (2022) conducted a methodical literature review study using the content analysis method, and they have built a theoretical framework for Canadian and Italian banks using important keywords from the Scopus database. They found that banking concentration, market strength, huge banks, and lesser competition had a major impact on banks' financial stability, profitability, and risk. On the other hand, Breton & Coˆte´ (2006) conducted a study on the Canadian banking sector, which has drawn a lot of criticism from customers due to its highest profits, little risk-taking, exorbitant fees, and lavish CEO reimbursement packages. The study's conclusions demonstrated that the Canadian banking industry's crisis was mild in scope and that it employed a justification strategy in its public discourse to enlighten and educate the Canadian people about the consequences of economic issues.

Based on research conducted by Osahon & Onoriode (2014), who studied another important factor in the banking system, namely electronic banking as a platform, to examine the impact of a cashless approach on the profitability of Nigerian banks compared to the present cash-based mode, where banks are famous for their high profits despite faced with of high operational expenses. The results showed that cashless economic policy positively affects the profitability of banks because electronic banking would reduce their operating costs. Also, according to Razak, Chowdhury, & Alam (2021), in their research, they use content analysis as a qualitative approach and GMM as a quantitative approach to evaluate the influence of banking performance on economic development. Based on their findings, a stable banking sector decreases the effect of crises on GDP growth, also the performance of banks positively influence economic growth.

According to research by Sinitin & Socol (2021), who investigated some of the financial indicator’s disclosures related to bank performance through bank profitability (ROE and ROA), bank characteristics, and the level of disclosure. The findings of their analysis propose that the development of bank performance indicators is affected by the size of banks and the level of discovery.

3. Methodology

This paper adopts a qualitative research design based on a systematic literature review. The primary objective is to examine how case study with semi-structured interviews and content analysis methods have been applied in banking research, and to argue for their value as complementary approaches to traditional quantitative analyses.

The literature review was conducted through a search of scientific publications covering studies related to banking research, qualitative research methods, case study, and content analysis.

4. Findings and Discussion

The systematic review of the literature reveals that both case study and content analysis methods have been successfully applied in banking research, each contributing unique insights that complement quantitative approaches.

Concerning the application of the case study method, studies have shown that semi-structured interviews with banking experts give important insights into the internal and external factors that impact bank performance. Studies by Bocken & Yip (2017), Hassan (2022) and Gill, Kazmi, & Ai (2022) demonstrate that managerial perceptions, institutional practices and processes for strategic decision-making that are difficult to address thru quantitative models can be more effectively examined thru case study research.

Furthermore, Abiodun & Nancy (2024) and Jamil, Amin, Rahman, & Wang (2024) demonstrate that case study findings can enrich quantitative analyses by providing contextual explanations for statistical results related to liquidity management, digital transformation, and risk management.

Regarding the application of content analysis, the reviewed studies show that this method is particularly effective for analyzing large volumes of documents, reports, and scientific literature related to banking performance. Bhimavarapu, Pinto, Sharma, & Rastogi (2022) and Lajili, Mohsni, Polizzi, & Scannella (2022) demonstrate that content analysis enables researchers to identify patterns and trends in banking regulation, profitability, and risk across different banking sector. Furthermore, Razak, Chowdhury, & Alam (2021) and Sinitin & Socol (2021) showed how content analysis can be combined with quantitative methods to achieve more comprehensive results regarding disclosure practices and banking performance.

Overall, the findings suggest that both methods offer significant contributions to banking research. The case study method is especially useful for exploring complex issues at the institutional level, while content analysis is more suited for investigating patterns within large amounts of literature or documents. When applied together, these two methods provide a comprehensive qualitative framework that enhances the explanatory power of banking research.

5. Conclusions and Recommendations

This paper has examined the applicability of two qualitative research methods, case study and content analysis in banking sector research. Based on the literature review, we can conclude that the case study method and content analysis are important and applicable approaches in scientific investigation related to the banking sector. These methods provide valuable and complementary insights going beyond what quantitative approaches can provide.

The review concludes that the case study method, specifically thru semi-structured interviews with banking experts, enables researchers to investigate managerial perceptions, institutional practices, and processes for strategic decision-making that influence the banking sector. Meanwhile, content analysis provides a

systematic and objective tool to examine patterns, trends and relationships in large volumes of banking documents, reports and scientific literature.

The findings of this review suggest that integrating qualitative methods into banking research can significantly enhance the explanatory power of financial analyses. Rather than replacing quantitative approaches, case studies and content analysis serve as complementary tools that contribute to a more comprehensive understanding of the banking sector.

Therefore, future researchers may be oriented towards applying these methods, as well as combining them with quantitative approaches to conduct research in the banking sector.

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THE ROLE OF EU FUNDS ON SUSTAINBLE DEVELOPMENT IN CROATIA – CASE STUDY ON KRAPINA ZAGORJE COUNTY

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Abstract

The accession of the Republic of Croatia to the European Union in 2013 opened numerous opportunities for utilizing EU funds. Initially on a smaller scale, but later to an increasingly significant extent, EU funds became a recognized and integral part of sustainable development. Projects that were previously unimaginable suddenly became reality. Over time, EU funds became a part of everyday life, supporting investments in infrastructure (roads and rail), agriculture, social services, and ultimately the economy, which serves as the key to the sustainable development of both the region and the nation. Today, it is rare to see a project implemented without the support of EU funds. The economy forms the foundation of all sustainable development, particularly regarding exports to foreign markets and keeping pace with the competition. Research conducted using Krapina – Zagorje County as a case study examining programs administered by HAMAG-BICRO as government agency for EU funds where enterprises are beneficiary and highlights the importance of EU funds for the economic development of this county, which is an economically developed and highly export oriented region. Operating in foreign markets necessitates constant investment in new technologies and development, as well as a commitment to sustainable business practices that boost the economic well-being of the local population. To boost sustainable development investments trough EU funds will be presented in public sector in which regional government of Krapina – Zagorje are beneficiary. Example of Krapina-Zagorje County clearly illustrates the role EU funds play in overall sustainable development. Investments in economy and the public sector are the cornerstone of sustainable development, and the role of EU funds is to foster such development across member states and their regions especially during these challenging times.

Keywords**:** EU funds, economy, sustainable development, HAMAG-BICRO, Krapina – Zagorje county

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1. Introduction

Giang it's independent in 1991, and after peaceful integration of all its territory in 1998 Croatia can finally focused on its economic development. Starting of process of EU integration for Croatia open a various opportunity of EU funds. First, it started with pre accession funds like IPARD which were used as an example of how EU funds are operating. When in on 1.7.2013. Croatia become a member of the EU there was a actual multiannual financial framework 2007 – 2013. Because it was early adopted by existing member states it didn't have a lot of financial opportunity for new member state as Croatia. As it was adopted new multiannual financial framework 2014 – 2020 a total of €10.676 billion from the ESI Funds was made available to the Republic of Croatia. The European Commission approved the Operational Programme Competitiveness and Cohesion on 12 December 2014. Programme implements the EU cohesion policy and contributes to the objective of Investment for growth and jobs by stimulating investment in infrastructure (in the areas of transport, energy, environmental protection, ICT) and supporting the development of entrepreneurship and research activities.

Within the Multiannual Financial Framework 2021 - 2027, Croatia has at its disposal slightly more than 14 billion euros. This fund opens a biggest opportunity for Croatia, especially continuing public investments. Within the Recovery plan which was an EU answer to a COVID crises, the European Commission published on 27 and 28 May 2020 a series of documents which, in addition to the multiannual financial framework for the period 2021-2027, also include a new instrument: the European Union Recovery Instrument (so-called Next Generation EU – NGEU/EU next generation) aimed at recovering from the economic and social damage caused by the outbreak of the COVID-19 pandemic. This new financial instrument was a supplement to budgetary resources and the future multiannual financial framework. An additional fund For the Republic of Croatia, was just over 11 billion euros from the EU Recovery and Resilience Facility New Generation (NGEU), of which the largest part comes from the Recovery and Resilience Mechanism, from which Croatia was allocated 6.31 billion euros in grants and 3.61 billion euros in loans. The remaining funds were allocated to REACT-EU, the European Agricultural Fund for Rural Development (EAFRD), and the Just Transition Fund (JTF).

Every multiannual financial framework is different. Priorities are changing, a member state must use all of its allocation to boost its development. Currently member states are having discussions about new EU budget for 2028-2034. From one side are the members who a mostly contributing like Germany, Holland and from other side are mostly less developed member states who a mostly receivers. Currently Ireland is presidency country, and talks are underway to find a solution,

because in European Union everything is about compromise. As always EU leaders will find compromise for multiannual financial framework on benefit of EU citizens.

As a country that come from war there was a significant regional difference in Croatia. City of Zagreb as a capital was economically very strong, Adriatic Croatia was mostly based on tourism, mostly on coast. Northern Croatia which includes Krapina – Zagorje County as a case study for this paper was not directly in war, but its industry is a very export-oriented, but in time of war and post war period lack of private and public investments industry in Northern Croatia industry was less competitive comparing with industry in Slovenia. Panonian Croatia which was mostly based on agriculture initially was less developed and was recovering from war. When Croatia join EU it opens a significant opportunity to make industry more competitive on EU and global markets.

2. Literal over
Economic impact of EU funds on regional development

Over the period, numerous studies have examined the impact of EU funds on regional economic performance, (Becker et al. 2010; Rodríguez-Pose and Garcilazo 2015; Dall'Erba and Fang 2017; Gagliardi and Percoco 2017). These studies implicate a significant implication of EU funds, especially grants on regional development, especially supporting SME-es. This kind of financial support indicates that combination of public and private funds brings sustainable regional development especially in less developed countries as Croatia.

This in line with the existing literature assigning a key role to socioeconomic dynamics in shaping Eurosceptic and populistic votes (Colantone and Stanig, 2018; Rodríguez-Pose, 2018; Guiso et al., 2017), a strong supports the idea that the economic development of local areas states mediates the role of EU funds. Regarding existing literature on the impact of Cohesion Policy (Mohl and Hagen, 2010; Becker et al., 2010, 2013, 2018), and more specifically the growing, yet still underexplored field of research linking EU funds with the public support for the European Union (Dellmuth and Chalmers, 2018; Bachtrögler and Oberhofer, 2018; Borin et al., 2018; Fidrmuc et al., 2019). In paper Regional Science and Urban Economic (Crescenzi, Di Catalado and Giua 2020) authors for example and case studies take Wales in time when UK was part of European Union as region in which EU funds make significant implications on regional development. This case study can be used in other regions.

3. Institutional background and data

As a member state and as a beneficiary country that uses EU funds Croatia had to make a legal regulation based on the EU funds. On a government proposition, Croatian Parliament adopted a law. The Law on the Institutional Framework for the use of European Union Funds in the Republic of Croatia was published in the *Narodne Novine* (No. 116/2021) and entered into force on 4 November 2021 (hereinafter: the Act). The Law establishes the institutional framework for the use of European Union funds under shared management, commencing with the 2021–2027 financial period; it addresses the Coordinating Body and programme bodies within the management and control systems for EU funds, and defines the implementation of capacity building activities for the institutional framework for the use of EU funds, as well as for beneficiaries, partners, and associates involved in projects financed by EU funds.

According to data from the Ministry of Finance (MFIN), from its accession to the European Union up to June 30, 2025, the Republic of Croatia paid €6.51 billion into the EU budget, while €23.26 billion (including the NPOO) was paid from the EU budget into the Croatian budget. The difference between the funds paid from the EU budget to the Croatian budget and the funds paid from the Croatian budget to the EU budget amounts to €16.75 billion (including the NPOO) or €12.26 billion (excluding the NPOO) in favor of the Croatian budget. The amount relating to the NPOO is €4.49 billion.

As a main EU funds the brigs opportunity for economy is the Competitiveness and Cohesion Programme 2021–2027 The Competitiveness and Cohesion Programme 2021–2027 (PKK 2021–2027) sets out objectives and priorities for the effective use of the European Regional Development Fund (ERDF) and the Cohesion Fund (CF) for the 2021–2027 period. The main goal of the supported interventions is to strengthen the economy, support the digital and green transition including digitalization for citizens and businesses improve connectivity and mobility throughout the Republic of Croatia and enhance the population's quality of life. The PKK 2021–2027 will be implemented within the framework of the European Union (EU) Cohesion Policy (CP) under the "Investment for jobs and growth" goal, and will contribute to achieving policy objectives 1 through 4 as defined in Article 5 of Regulation (EU) 2021/1060 of the European Parliament and of the Council.

According to the latest report on using EU funds from 2021 – 2027 Multiannual Financial Framework which was adopted by Croatian Parliament during the reporting period, 96 grant award procedures were launched with a total value of EUR 2.52 billion, representing 19.94% of the allocated funds. Projects worth EUR 1.72 billion or 13.63% of the allocated funds were contracted. Payments totaling EUR 503.23 million (3.99% of the allocated funds) were made to final beneficiaries and contractors. By 30 June 2025, a total of 313 grant award

procedures had been launched, with a total value of EUR 7.46 billion, or 59.11% of the allocated funds. A total of EUR 5.17 billion (40.97% of the allocated funds) was contracted, and a total of EUR 1.69 billion (13.37% of the allocated funds) was paid out; the total allocated funds for programmes in the 2021–2027 financial period amount to EUR 12.62 billion (EU funds). For using a PKK 2021 – 2027 and to support equal regional development of its regions and complying with EU regulations Croatia created a NUTS regions, from which private beneficiaries can receive a regional support in EU co-financing projects. NUTS is a statistical basis for effective management of regional development policy, preparation of socioeconomic analysis and achievement of social and economic cohesion goals. NUTS region a crucial element of EU funds. Every member state of the European Unio has its own NUTS regions. Croatia is one NUTS region on level 1, while its regions depend on their level of development are divided into 3 NUTS regions. Before PKK 2021 – 2027 there on level 2 there ware only 2 NUTS regions what was a problem mostly for continental part of Croatia because City of Zagreb with its development brigs lower intensities in regional support for SME-es.

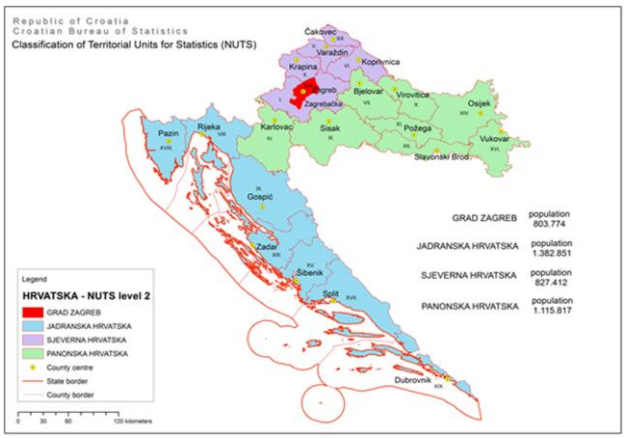


Figure 1. NUTS regions in Croatia. Source: https://razvoj.gov.hr/o-ministarstvu/djelokrug-1939/regionalni-razvoj/karta-regionalnih-potpora/karta-regionalnih-potpora-republike-hrvatske-za-razdoblje-od-2022-do-2027/5300.

Figure 1. shows NUTS regions on level 2 in Croatia which was adopted by the European Commission how Croatia is divided to support equal regional development especially of Panonian Croatia. NUTS regions reflect current differences in development between regions in Croatia.

STATISTIC REGION	INTENSITIES		
	Large enterprises	Medium enterprises	Smal enterprises

Grad Zagreb	40%	50%	60%
Northern Croatia	60%	70%	75%
Adriatic Croatia	50%	60%	70%
Panonian Croatia	60%	70%	75%
Sisak-Moslavina county	70%	75%	75%

Table 2. Regional Intensities. Source: https://razvoj.gov.hr/o ministarstvu/djelokrug-1939/regionalni-razvoj/karta-regionalnih-potpora/karta-regionalnih-potpora-republike-hrvatske-za-razdoblje-od-2022-do-2027/5300.

Table 1. shows in which less developed regions of Croatia and protentional beneficiaries can count how big support they can count for their projects. So, if the project is 100.000,00 € if the beneficiary is in Panonian Croatia and is medium enterprise it can count on 70 % of regional support the rest is his own financing. From the lowest support what's is in City of Zagreb what is 40 % for large enterprises to highest of 75% for small enterprises in Panonian Croatia.

For supporting process of EU funds Croatia created a system of regulative in which every public body has its roll in system of EU funds. As one this bodies is a HAMAG-BICRO a public agency which is main roll to support enterprises in Croatia.

The Croatian Agency for SMEs, Innovations and Investments (HAMAG-BICRO), acting as an Intermediate Body (Level 2), is the national body that under the responsibility of the Managing Authority performs delegated functions related to verifying whether funded products and services have been delivered, whether the project expenditures reported by the Beneficiary were actually incurred, and whether they comply with national and European Union rules throughout the project's implementation and duration. As an Intermediate Body Level 2 (PT2), HAMAG-BICRO plays an active role in the process and collaborates with the Ministry of Economy which is acting as the Intermediate Body Level 1 (PT1) on the preparation of procedures and the implementation of grant award phases. Within its scope of competence, it provides an opinion on the final version of the documentation for specific grant award procedures and bears full responsibility for monitoring the implementation of grant agreements related to the specified objectives. HAMAG-BICRO through EU funds gives grants, loans and guarantees towards banks for private investors.

All of these instruments are crucial for economy. In time of COVID -19 HAMAG-BICRO trough government policy created a financial instrument

COVID loans with maximum support for SME-es in amount 100.000,00 maximum for private beneficiaries with interest rate 0,25 %

4. Krapina – Zagorje County as a case study

Krapina - Zagorje County is located in the northwestern part of the Republic of Croatia and belongs to the region of Central Croatia. It constitutes a distinct geographical entity stretching from the peaks of Macelj and Ivančica in the north to Medvednica in the southeast. Its western border which also serves as the national border with the Republic of Slovenia is the Sutla river, while its eastern border is the watershed separating the Krapina and Lonja river basins. The area defined by these boundaries coincides with the natural region of Lower Zagorje.

Compering with other regions in Croatia, which are totally 21 regions, in number of populations an area Krapina – Zagorje County it among the smallest, for example Međimurje County is the smallest. General information: Area: 1,229 km² Population: 119.320 (latest data). Local self-government structure: 7 towns and 25 municipalities with 422 settlements. Unemployment: 1.197 people (latest data). As county is one of the highest numbers of population on square per km. No matter as one of the smallest counties geographically in Croatia, it has a strong industry, which is developing every day, coping with competition.



Figure 2. Position of Krapina – Zagorje County in Croatia

Figure 2. is showing geographically position of Krapina – Zagorje County in Croatia. Its neighboring with Slovenia, and Austria is only 2 h from border. This position is a great advantage for economy and finally regional development.

To absorb significant amounts of EU funds local governments, rely on regional development agency who specialize for EU fonds. In case were Krapina – Zagorje County as public body is beneficiary of EU funds it uses services of Zagorje Development Agency or ZARA, and as support to a private business it uses services of Entrepreneurial Centre of Krapina Zagorje County Ltd as firm but 100 % owned by public body of Krapina - Zagorje County.

The economy of Krapina – Zagorje is mostly based on high industrialization, and which has its roots in history. In Yugoslavia its economy was mostly based on textile, glass production and small crafts in metal industry based mostly on export while with time especially after war during rising economies in Slovenia and Austria it upgraded it industry with high value products. When first EU fund started to be open for Croatia it gives additional opportunities for SME-es in Krapina – Zagorje County especially for boosting its export capacities.

	2021.	2022.	2023.	2024.	2025.	INDEX 25/24
Exports, in 000 EUR	671.765	812.586	823.526	803.897	797.709	99,23
Import, u 000 EUR	382.492	521.400	550.648	575.718	601.306	104,44
Trade balance, u 000 EUR	289.273	291.186	272.878	228.179	196.403	86,07

Table 3. Exports of Krapina - Zagorje County. Source: Digital chamber: HGK-ŽK Krapina

Table 2. shows how investing in industry can boost export of goods and services for export-oriented county such as Krapina – Zagorje County from 2021 – 2025. when EU funds together with private funds started to give results in numbers. Even if reduce investment where only private funds are, still we have a big impact of EU funds on export of Krapina – Zagorje County.

As an export-oriented county Krapina – Zagorje County has been awarded the European Entrepreneurial Region (EER) title for 2025. The European Entrepreneurial Region award recognizes regions with outstanding and innovative entrepreneurial strategies, aiming to promote sustainable growth and create new jobs especially to boost export. In 2024, the Financial Times ranked Krapina-Zagorje County sixth on the list of the most promising small regions in Europe for attracting investment, while in 2025. the county was named one of the top four small European regions for attracting investment. Through its application Invest

in Zagorje provides information regarding business zones, sources of funding and other relevant information for private investors.

In projects where there is combination of private funds with EU funds and its contributing to sustainable development of Krapina – Zagorje County in creating more jobs and supporting significant roll has HAMAG-BICRO a government body with its roll in EU funds. This cooperation brings mutual benefit, because every grant, loan and guarantee multiply on national GDP and increases a employment rate, brings money to business what is a crucial goal of HAMAG-BICRO as agency and government.

Currently HAMAG-BICRO has more than 350 employes, which mostly are situated in Zagreb, where is central of Agency. To improve visibility and to be a daily support for local firms, potential and existing beneficiaries of EU fund HAMAG-BICRO has 21 local offices in all counties in Croatia. Main work is to be on disposal for beneficiaries, and to local government in areas regarding economic development of the counties. The office for Krapina – Zagorje County is in Krapina, a capital city of Krapina – Zagorje county.

ROLL OF HAMAG-BICRO IN KRAPINA – ZAGORJE COUNTY 2015 – 2026.

Year	Number of projects	Grants, loans, guarantees	Total investments	New employers
2015	14	3.020.987,08 €	7.431.828,89 €	152
2016	25	5.523.625,24 €	15.103.316,61 €	328
2017	86	7.679.434,06 €	17.365.175,18 €	362
2018	56	5.493.893,82 €	12.089.697,34 €	143
2019	77	5.209.825,39 €	8.983.612,43 €	131
2020	126	9.611.634,58 €	14.106.293,97 €	167
2021	117	12.427.486,08 €	32.093.210,35 €	200
2022	26	5.877.188,89 €	14.186.175,72 €	41
2023	97	19.528.760,28 €	39.140.201,62 €	195
2024	92	9.090.514,32 €	14.704.476,33 €	103
2025	88	13.841.903,89 €	25.776.010,91 €	296
2026	55	7.383.453,87 €	9.677.290,15 €	53

Total Krapina – Zagorje County	859	104.688.707,50 €	210.657.289,50 €	2.171
Percentage %	2,8%	3,0%	3,2%	5,0%
Total HAMAG-BICRO	30.384	3.491.889.034,80 €	6.502.576.997,09 €	43.579

Table 3. Roll of HAMAG-BICRO in supporting SME-es in Krapina – Zagorje County. Source: HAMAG-BICRO.

In table 3. it can be seen that Krapina - Zagorje County regardless of its small population and is a small by territory it's has a strong economy that is using EU funds in combination with private funds to boost its economy as part of sustainable development by reducing unemployment and supporting local infrastructure. This data shows that smart using EU funds is only correct path to boost exports, and to make products with high value for markets. But most importantly, creating new jobs.

When local government of Krapina – Zagorje County is EU fund beneficiary they have roll of improvements in schools, special hospitals and all institutions which they manage. This is a great opportunity for modernization, improving quality of life for local population. Currently local government of Krapina – Zagorje County for co-financing its projects is using EU funds from EU Recovery and Resilience Facility New Generation (NGEU). These funds open a opportunity for every county in Croatia to improve quality of life for its population, by building, reconstruction basic elements of live like education and healthcare. From period in which EU funds stared an Krapina – Zagorje County is EU fund beneficiary

To complete sustainable development where Krapina – Zagorje County as local goverment is a final beneficiary of EU funds, its main role is to use EU funds to build new and reconstructions of existing schools, preserving cultural heritage by adding them a new roll in this modern times and reconstruction of special hospitals such as hospitals in Stubičke Toplice, Krapinske Toplice. And finally, as unique, social and special project from EU funds is a building a new center in municipally of Krapinske Toplice for education and rehabilitation specially for children with disabilities what is most important EU project not only for local populations in Krapina – Zagorje County but also for all children with needs in Croatia. EU funds are very important funds for local governments to improve quality of life for its citizens.

Rank	County	Estimate population 2025	EU funds 2025	EU funds per resident in county
1.	Sisak – Moslavina County	134.008	25.779.432	192,37
2.	Krapina – Zagorje County	119.320	18.065.264	151,40
3.	Varaždin County	158.860	17.497.904	110,15
4.	Dubrovnik – Neretva County	116.393	11.512.369	98,91
5.	Karlovac County	109.561	7.720.393	70,47

Table 4. Number of EUR per resident in county. Source: https://zupan.hr/analize-top-5/zupanije-su-u-2025-godini-iz-eu-fondova-povukle-260-milijuna-eura-evo-koje-najvise/

In table 4. we can see 5 top counties in Croatia, where EU funds are best used for regional development which can be seen on daily basis, and in which local Population participates. As less developed county, Sisak – Moslavina County is great beneficiary of EU funds because is providing sustainable development what is crucial for its population. On the second place is Krapina – Zagorje County as beneficiary of EU funds. the difference between Sisak – Moslavina and Krapina Zagorje County is in possibilities to use EU funds, becose Sisak - Moslavina County in 2020 had a earthquake, and there were significant damages, and that open a possibility of using EU solidarity fund for reconstruction.

5. Discussion

European Union and its institutions are not perfect, but idea when its all started with European Coal and Steel Community in 1951 was to build Europe on prosperity, development and peace. Path to EU funds is not easy, Croatia which come from 4 year of war had to create a capacity especially in human resources to absorb so much EU funds, adjusting its law regulations, preventing frauds and to fulfil its obligations as a member state.

This paper shows that it's possible to achieve all goals when country is focused on its development and benefits for its population. Not just to create jobs or building infrastructure as EU project but to provide opportunities for personal

development which is most important for individuals. Some eurosceptics are trying to call European Union as a bureaucratic institution. Sometimes they are right, there is a problem with EU as institution as is trying to impose regulations that sometimes don't have reasonable meaning. They have rights to be against European Union, but many times they forget they are paid from EU as members of EU parliament. Sometimes rules and directives from European Commissions are not so easy to implicate in national regulations.

But is there an alternative for EU and for EU funds? Some people alternatives see it in strong states, connecting with U.S or China or maybe joining in BRICS. It's normal for member states to have different views on EU policy. Every member state has it owns interest what is normal. But when world is changing on daily basis it's very difficult to keep with those changes especially for smaller states. Europe's solidarity in helping member states with natural disasters and to candidate members. When UK exited from the European Union it was a happy day for eurosceptics and people of UK who voted to leave. But in time people realized that there are no more EU funds, cooperation, no more pay from EU. And finally, the leading people of the movement lost their careers and EU salaries.

European Union brings possibilities, development, stability and peace.

6. Conclusion

Job creation and unemployment reduction, supporting sustainable development trough building infrastructure, and supporting SME-es are the main goals of EU policies. These policies are idea that come from Robert Schuman as a father of European unification, based on strong Europe which can be competitive in economy with U.S. and in latest time with China. Therefore, citizens of member states daily can may view improvements in local labor market, local infrastructure especially in Croatia as a tangible way for EU projects to deliver concrete benefits and increasing live standards for its population.

As a member state Croatia supports the process of European integration of countries that strongly believe in strong Europe as a project. The possibilities of EU policies bring concrete benefits to be felt at the local level on daily basis. Therefore, impactful EU policies are a fundamental tool to favor citizens in the EU project. As a newest member state of European Union, coming out of war Croatia can be an example of using EU funds rising its development. Over the past ten years, Croatia has risen from 61–62 percent GDP of the European Union average in terms of GDP per capita to 78 percent which is a result of using EU funds to support investment in public and private sector. Areas most heavily funded by the EU tend to develop a more favorable view of Europe if (and only if) citizens observe visible socioeconomic improvements in their local communities

with potential personal benefits from EU intervention. In this perspective, future support for the process of European integration is highly dependent on the capacity of all EU policies to deliver concrete benefits to be felt at the local level on every day basis.

On example of Krapina – Zagorje County a small region where projects are most financed by the European Union in public and in private sector, we can see a favorable view of united Europe as project that brings prosperity to all. Citizens every dan observe visible socioeconomic improvements in their local communities with potential personal benefits from EU funds. Removing borders with Slovenia, Hungary open a much larger opportunities, improving quality of life especially of people who live on borders. If we analyze EU funds for private sector in Krapina – Zagorje County were coming to about 1.765,48 euro per resident. When is Krapina – Zagorje County as local government body beneficiary than we have 151,40 euro per resident. Totally we have 1.916,88 euro per resident which is significant money for such small county. Raising opportunities for its population on local level on daily basis is pure purpose of European Union.

Results in this paper suggest that public and private sectors who perceive or experience personal benefits from EU funds have improve there business and their infrastructure becoming a great supporters policy of EU and its promoters as we can see on Croatia which is strong supporter of European Union and enlargement towards new member states. There is a lot a public bodies and especially private enterprise that continually use EU funds, and that growing there business even outside Croatia and becoming a global player. Best results of EU funds are unemployment reduction and building an infrastructure for population creating stability and peace. This can be very important for candidate members for EU. This explanation fit within the utilitarian economic theory of European integration, stability, prosperity and peace.

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DOMESTIC TOURISM SEASONALITY: IMPACTS OF SCALE AND GEOGRAPHIC CONCENTRATION IN A SMALL ECONOMY

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Abstract

Tourism seasonality represents a structural characteristic of tourism systems with significant macroeconomic implications for employment stability, capacity utilization, and regional income distribution. This study examines the seasonal structure of domestic tourism in North Macedonia over the period 2011–2025, with a comparative focus on the Municipality of Ohrid and the national aggregate. Using multiplicative time-series decomposition and normalized seasonal indices, the analysis evaluates seasonal intensity through Peak-to-Trough Ratios and summer concentration shares, while also assessing the structural weight of Ohrid within national domestic tourism.

The results reveal pronounced spatial differentiation. At the national level, domestic tourism is strongly summer-oriented, with 56% of arrivals and 74.8% of overnight stays concentrated between July and September. However, seasonality is substantially more intense in Ohrid, where 63.4% of annual arrivals and 84.5% of overnight stays occur during the same period. Peak-to-Trough Ratios confirm extreme asymmetry, particularly for overnight stays. Furthermore, Ohrid consistently accounts for roughly one-third to two-fifths of national domestic arrivals and nearly half of domestic overnight stays. The findings suggest that domestic tourism does not uniformly function as a stabilizing force; instead, its impact varies across spatial scales and may amplify seasonal volatility at the destination level.

Keywords: Domestic tourism, Seasonality, Scale effects, Geographic concentration, Small economy

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1. Introduction

Seasonality represents one of the most persistent structural characteristics of tourism systems. Unlike cyclical fluctuations driven by macroeconomic shocks, tourism seasonality is embedded in climatic conditions, institutional calendars, and socio-cultural travel behavior. Its macroeconomic relevance extends beyond temporary demand volatility, as it affects employment stability, capital utilization, fiscal revenues, and regional income distribution.

While extensive literature documents the existence of tourism seasonality, empirical evidence remains predominantly concentrated at the national level and focused on international tourism flows. Tourism systems, however, are spatially heterogeneous, and aggregate indicators may obscure substantial intra-national asymmetries, particularly in countries where tourism activity is geographically concentrated.

Domestic tourism constitutes a specific analytical category within this framework. In macroeconomic discussions, domestic demand is often implicitly treated as a stabilizing component of tourism systems, capable of smoothing external shocks and reducing vulnerability to international market fluctuations. Yet, this assumption warrants closer examination. If domestic travel behavior is synchronized with the same climatic and institutional patterns that drive international tourism, it may reinforce rather than mitigate seasonal volatility.

This study addresses this analytical gap by examining the seasonal structure of domestic tourism in North Macedonia at two spatial levels: the Municipality of Ohrid and the national aggregate. The objective is not merely to measure seasonal intensity but to evaluate how seasonality differs across spatial scales and whether domestic demand functions as a stabilizer or amplifier within the tourism system.

The period under analysis (2011–2025) allows observation of long-term structural patterns, including recovery phases and demand reallocation episodes. By comparing arrivals and overnight stays, the analysis differentiates between visitor volume effects and length-of-stay amplification.

The central research questions guiding this study are:

1. How intense is domestic tourism seasonality at the national and local levels?
2. Does spatial aggregation conceal higher seasonal concentration at the destination level?
3. Does domestic tourism operate as a stabilizing or amplifying force within the tourism system?
4. What is the structural weight of Ohrid in national domestic tourism flows?

By adopting a macro-structural perspective, this study conceptualizes seasonality not as a descriptive calendar phenomenon but as a systemic property of tourism within a national economic framework. The findings contribute to understanding spatial differentiation in tourism dynamics and provide insights for regionally differentiated tourism policy design.

2. Literature Review and Theoretical Foundations

Tourism seasonality is widely recognized as a persistent structural feature of tourism systems, arising from climatic conditions, institutional calendars, and socio-cultural travel patterns rather than solely from economic cycles (Baron, 1976); (Allcock, 1989). Beyond temporary fluctuations, seasonality has macroeconomic implications for employment stability, capital utilization, fiscal revenues, and regional income distribution (Butler, 2001); (Baum & Lundtorp, 2001). These studies stress that seasonality is not merely a descriptive phenomenon but a systemic property of tourism, affecting both demand and the economic capacity of destinations.

The spatial dimension of tourism seasonality has been emphasized in the context of geographically concentrated or peripheral destinations. Baum and Hagen (Baum & Hagen, 1999) highlight that destinations with high spatial concentration, such as small towns or resort areas, experience more intense seasonal peaks, requiring adaptive strategies in infrastructure, marketing, and risk management. Jang (Jang, 2004) employs quantitative decomposition methods to demonstrate that domestic tourism can either mitigate or reinforce seasonal volatility, depending on its temporal alignment with broader tourism demand.

Domestic tourism, in particular, has been frequently cited as a stabilizing factor in tourism systems, capable of offsetting international demand shocks (Crouch & Ritchie, 2006); (Mathieson & Wall, 1996). However, empirical evidence from small economies suggests that domestic travel behavior often mirrors the same climatic and institutional drivers as international flows, thereby potentially amplifying rather than mitigating peak-season pressures (Karadjova & Dicevska, 2011); (Karadjova & Dičevska, 2014); (Karadjova & Dicevska, 2026). In the case of North Macedonia, studies demonstrate that domestic tourism is highly concentrated in both temporal and spatial terms, with Ohrid accounting for a disproportionately large share of national domestic arrivals and overnight stays (Karadjova & Dicevska, 2026); (State Statistical Office, 2025).

Several studies have examined structural and economic aspects of tourism in North Macedonia. Karadjova (Karadjova V. , 2012); (Karadjova V. , 2013); (Karadjova & Angelevska-Najdeska, 2013) explores the interplay between country risk, economic development, and regional disparities, emphasizing the role of tourism in local economic structures. Karadjova and Angelevska-Najdeska (Karadjova & Angelevska-Najdeska, 2013) and Biljan et al. (Biljan, Trajkov, & Karadjova, 2022) highlight the importance of natural and cultural resources in shaping destination competitiveness. Trajkov et al. (Trajkov & Karadjova, 2007); (Trajkov, Andreeski, & Karadjova, 2021) and Trajkov, Radovic Markovic & Karadjova (Trajkov, Radovic Markovic, & Karadjova, 2022) analyze the interconnection between transportation infrastructure, pandemic-induced shocks, and seasonality, demonstrating that domestic tourism flows are sensitive to both structural and external factors.

Methodological approaches to seasonality analysis are well established in the literature. Multiplicative time-series decomposition, normalized seasonal

indices, Peak-to-Trough Ratios (PTR), and seasonal concentration shares are recommended for capturing the intensity and structural impact of seasonal patterns (Baum & Lundtorp, 2001); (Jang, 2004); (Butler, 2001). Karadjova and and Simončeska (Simonceska & Karadjova, 2006); (Simonceska & Karadjova, 2010); (Simonceska & Karadjova, 2012) examine the planning and optimization of accommodation services, highlighting how domestic demand and spatial concentration affect the functional and economic efficiency of destinations.

Collectively, these contributions underline two central insights for the present study. First, tourism seasonality is a **scale-dependent and spatially heterogeneous phenomenon**, with intensity varying across national and local levels. Second, domestic tourism cannot be automatically assumed to stabilize the system; in concentrated destinations such as Ohrid, domestic demand may amplify seasonal peaks and shape the distribution of economic benefits across regions (Karadjova & Dicevska, 2026). This study builds on these premises, offering empirical evidence on the seasonal structure of domestic tourism in North Macedonia, the intensity of peaks and troughs, and the structural weight of Ohrid within the national tourism system.

3. Data and Methodological Framework

3.1 Data

The empirical analysis is based on monthly data on domestic tourist arrivals and domestic overnight stays covering the period from January 2011 to November 2025. The data were obtained from the State Statistical Office of the Republic of North Macedonia and are examined at two spatial levels:

- The Municipality of Ohrid (local level)
- The Republic of North Macedonia (national level)

This dual spatial framework enables subnational comparative analysis of domestic tourism seasonality and allows assessment of whether domestic demand functions as a stabilizing or amplifying component within the national tourism system.

Two core variables are analyzed:

- Domestic tourist arrivals
- Domestic overnight stays

The distinction between arrivals and overnight stays is analytically important, as seasonal fluctuations may operate not only through variations in visitor numbers but also through changes in the average length of stay. This differentiation permits identification of a potential length-of-stay amplification effect.

To complement the seasonal analysis, annual data are used to calculate the share of Ohrid in total national domestic tourism for both arrivals and overnight stays over the period 2011–2025. This indicator provides structural context regarding the relative weight of Ohrid within the national tourism system and enables evaluation of spatial concentration dynamics.

3.2 Methodological Framework

Seasonal patterns are estimated using multiplicative time-series decomposition. The multiplicative specification is appropriate for tourism flows characterized by proportional seasonal variation relative to the annual average level of activity.

The observed series Y_t is decomposed as:

$$Y_t = T_t \times S_t \times I_t \quad (1)$$

where:

- T_t represents the trend component,
- S_t denotes the seasonal component,
- I_t captures irregular fluctuations.

Seasonal indices are normalized such that their annual mean equals unity and their sum across the twelve months equals 12. This normalization ensures comparability across spatial levels and between arrivals and overnight stays.

Three indicators are employed to measure seasonal intensity:

1. **Normalized Seasonal Index**, expressing monthly deviations from the annual average;
2. **Peak-to-Trough Ratio (PTR)**, defined as the ratio between the maximum and minimum seasonal index;
3. **Summer Share (July–September)**, measuring the cumulative proportion of annual activity concentrated within the core summer quarter.

Additionally, the structural weight of Ohrid in national domestic tourism is calculated annually as:

$$\text{Share}_{\text{Ohrid}} = \frac{\text{Ohrid}}{\text{National}} \times 100 \quad (2)$$

for both arrivals and overnight stays.

The methodological approach is descriptive-structural rather than econometric. The objective is to evaluate the systemic seasonal architecture and spatial differentiation of domestic tourism flows rather than to estimate causal determinants. This approach is consistent with the study's macro-structural perspective on tourism seasonality as a scale-dependent phenomenon.

4. Empirical Results: Seasonal Intensity and Spatial Concentration

4.1 Seasonal Structure of Domestic Tourism in Ohrid

The estimated seasonal indices reveal a highly asymmetric intra-annual distribution of domestic tourism demand in Ohrid.

Table 1. Monthly Seasonal Indices for Domestic Tourism in Ohrid (Arrivals and Overnight Stays)

Month	Raw Seasonal Index		Normalized Seasonal Index		Final Seasonal Index (%)	
	Arrivals	Nights	Arrivals	Nights	Arrivals	Nights
January	0.269	0.111	0.267	0.111	26.7	11.1
February	0.209	0.086	0.207	0.085	20.7	8.5
March	0.279	0.102	0.276	0.101	27.6	10.1
April	0.461	0.169	0.457	0.168	45.7	16.8
May	0.889	0.341	0.882	0.340	88.2	34.0
June	0.762	0.403	0.756	0.402	75.6	40.2
July	3.162	4.511	3.135	4.492	313.5	449.2
August	3.590	5.175	3.559	5.152	355.9	515.2
September	0.920	0.499	0.913	0.497	91.3	49.7
October	0.741	0.333	0.735	0.332	73.5	33.2
November	0.443	0.177	0.439	0.176	43.9	17.6
December	0.377	0.145	0.374	0.144	37.4	14.4
Sum	**12.102**	**12.052**	**12.000**	**12.000**		
Mean	**1.009**	**1.004**	**1.000**	**1.000**		
Maximum (Normalized)			**3.559**	**5.152**		
Minimum (Normalized)			**0.207**	**0.085**		
Peak-to-Trough Ratio (PTR)			**17.18**	**60.42**		
Summer Share (July–September)			**7.607**	**10.141**		
Summer Share (%)			**63.4%**	**84.5%**		

Source: Author's calculations based on State Statistical Office of the Republic of North Macedonia data (2011–2025), Municipality of Ohrid. Domestic tourism only (State Statistical Office, 2025)

Methodological note: Normalized seasonal indices are adjusted so that their annual mean equals 1.000 and their sum equals 12. Final Seasonal Index (%) expresses normalized indices in percentage form (annual monthly average = 100). Peak-to-Trough Ratio (PTR) is calculated as the ratio between maximum and minimum normalized seasonal index.

The highest seasonal intensity is observed in August, with normalized indices of 3.56 for arrivals and 5.15 for overnight stays. This indicates that August domestic arrivals exceed the annual monthly average by approximately 256%, while overnight stays exceed it by more than 415%.

The lowest seasonal intensity occurs in February, with normalized indices of 0.21 for arrivals and 0.09 for overnight stays. Winter demand levels are therefore between 79% and 91% below the annual benchmark.

Peak-to-Trough Ratios confirm the magnitude of seasonal asymmetry:

- PTR (arrivals): 17.18
- PTR (overnight stays): 60.42

The extremely high PTR for overnight stays indicates that seasonal concentration is strongly amplified through length-of-stay dynamics. Domestic tourists not only arrive in substantially larger numbers during summer but also remain significantly longer.

The cumulative July–September share accounts for:

- 63.4% of annual domestic arrivals
- 84.5% of annual domestic overnight stays

Thus, nearly two-thirds of domestic visitors and more than four-fifths of total domestic overnight activity in Ohrid are concentrated within a three-month period, indicating extreme seasonal compression.

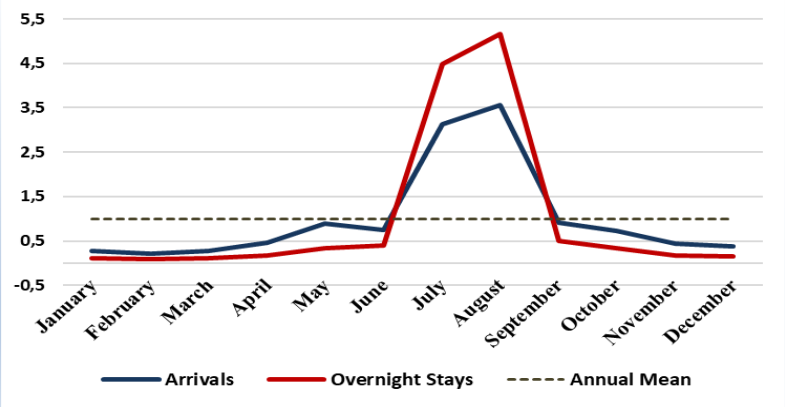


Figure 1. Seasonal Indices for Domestic Tourism in Ohrid (Arrivals and Overnight Stays)
Source: Author's calculations based on State Statistical Office data

4.*2 Seasonal Structure at the National Level*

At the national level, domestic tourism also exhibits pronounced summer dominance, though at lower intensity compared to Ohrid.

Table 2. Monthly Seasonal Indices for Domestic Tourism in North Macedonia (Arrivals and Overnight Stays)

Month	Raw Seasonal Index		Normalized Seasonal Index		Final Seasonal Index (%)	
	Arrivals	Nights	Arrivals	Nights	Arrivals	Nights
January	0.560	0.312	0.556	0.311	55.6	31.1
February	0.425	0.222	0.422	0.221	42.2	22.1
March	0.436	0.225	0.433	0.224	43.3	22.4
April	0.515	0.286	0.512	0.285	51.2	28.5
May	0.789	0.446	0.783	0.444	78.3	44.4
June	0.716	0.469	0.711	0.467	71.1	46.7
July	2.463	3.627	2.445	3.613	244.5	361.3
August	3.464	4.834	3.439	4.816	343.9	481.6
September	0.843	0.553	0.837	0.550	83.7	55.0
October	0.750	0.463	0.744	0.461	74.4	46.1
November	0.555	0.335	0.551	0.333	55.1	33.3
December	0.572	0.277	0.568	0.275	56.8	27.5
Sum	**12.089**	**12.047**	**12.000**	**12.000**		
Mean	**1.007**	**1.004**	**1.000**	**1.000**		
Maximum (Normalized)			**3.439**	**4.816**		
Minimum (Normalized)			**0.422**	**0.221**		
Peak-to-Trough Ratio (PTR)			**8.142**	**21.809**		

Summer Share (July–September)	**6.721**	**8.979**
Summer Share (%)	**56.0%**	**74.8%**

Source: Author's calculations based on State Statistical Office of the Republic of North Macedonia data (2011–2025), Domestic tourism only

Methodological note: Normalized seasonal indices are adjusted so that their annual mean equals 1.000 and their sum equals 12. Final Seasonal Index (%) expresses normalized indices in percentage form (annual monthly average = 100). Peak-to-Trough Ratio (PTR) is calculated as the ratio between maximum and minimum normalized seasonal index.

Maximum normalized indices (August) reach 3.44 for arrivals and 4.82 for overnight stays, while minimum values (February) amount to 0.42 and 0.22, respectively.

Peak-to-Trough Ratios equal:

- PTR (arrivals): 8.14
- PTR (overnight stays): 21.81

Although national seasonality remains substantial, its amplitude is markedly lower than that observed in Ohrid. This suggests that spatial aggregation partially smooths extreme local seasonal concentration. **The magnitude of the differential between local and national PTR values provides empirical evidence of scale amplification.**

The July–September share amounts to:

- 56.0% of annual arrivals
- 74.8% of annual overnight stays

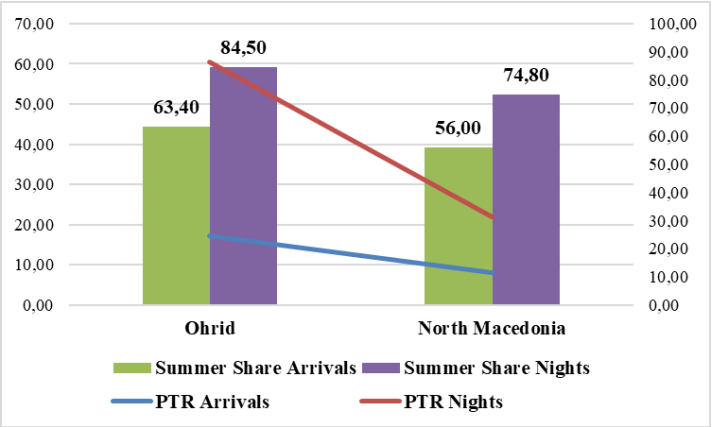


Figure 2. Comparative PTR and Summer Share – Ohrid vs. North Macedonia
Source: Author's calculations based on State Statistical Office data

The comparison confirms that seasonal intensity increases significantly at the local level, supporting the scale-dependent nature of domestic tourism seasonality.

4.3 Structural Weight of Ohrid in National Domestic Tourism

Annual calculations indicate that Ohrid constitutes a structurally dominant component of national domestic tourism.

Table 3. Share of Ohrid in National Domestic Tourism (2011–2025)

Year	Arrivals		Share (%) Arrivals	Overnight stays		Share (%) Overnight stays
	Ohrid	National		Ohrid	National	
2011	102,730	300,923	34.14	592,886	1,325,413	44.73
2012	99,850	294,943	33.85	575,308	1,252,247	45.94
2013	92,637	284,819	32.52	522,718	1,181,446	44.24
2014	88,118	290,379	30.35	468,268	1,174,655	39.86
2015	94,476	311,984	30.28	498,517	1,269,716	39.26
2016	107,351	324,376	33.09	533,165	1,302,197	40.94
2017	115,025	348,519	33.00	557,569	1,382,582	40.33
2018	117,734	404,042	29.14	585,051	1,625,992	35.98
2019	130,643	413,080	31.63	621,390	1,658,522	37.47
2020	129,054	335,178	38.50	652,644	1,413,110	46.18
2021	142,110	396,578	35.83	677,718	1,609,930	42.10
2022	149,125	417,615	35.71	690,384	1,648,828	41.87
2023	145,416	420,808	34.56	712,917	1,684,290	42.33
2024	147,478	414,054	35.62	752,455	1,704,599	44.14
2025	154,372	385,338	40.06	738,354	1,582,910	46.65

Source: Author's calculations based on State Statistical Office data

Between 2011 and 2025, Ohrid's share in national domestic arrivals fluctuates between 29% and 40%, reaching 40.06% in 2025. The share in domestic overnight stays is consistently higher, ranging from 36% to nearly 47%, peaking at 46.65% in 2025.

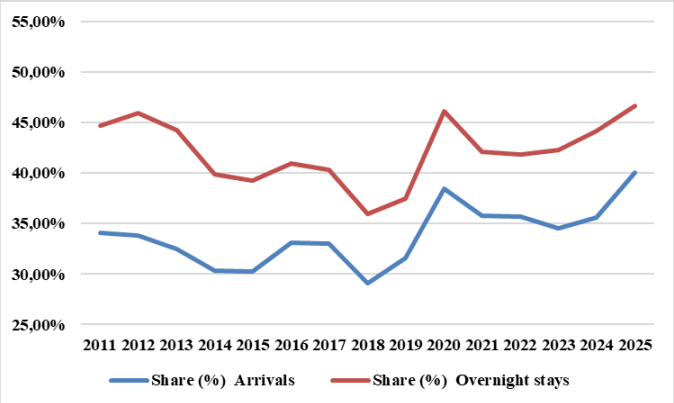


Figure 3. Share of Ohrid in National Domestic Tourism (Arrivals and Overnight Stays), 2011–2025

Source: Author's calculations based on State Statistical Office data

The consistently higher share in overnight stays relative to arrivals indicates that Ohrid exhibits a longer average domestic length of stay compared to the national average.

The increase in Ohrid's share during 2020 and 2025 suggests periods in which domestic demand became more spatially concentrated, reinforcing the systemic importance of Ohrid within the national tourism architecture.

5. Discussion: Scale Effects, Spatial Differentiation and the Stabilization Hypothesis

The empirical results provide strong evidence that domestic tourism seasonality in North Macedonia is fundamentally scale-dependent. While aggregate national indicators suggest pronounced but moderate summer concentration, the destination-level analysis for Ohrid reveals extreme seasonal compression. This confirms that spatial aggregation partially smooths temporal volatility, whereas geographically concentrated destinations experience amplified seasonal asymmetry.

These findings align with the spatial concentration arguments advanced by Baum and Hagen (Baum & Hagen, 1999) and extend the scale-sensitive perspective discussed by Jang (Jang, 2004). The results demonstrate that seasonality cannot be treated as a uniform national characteristic; rather, it emerges as a spatially differentiated structural property of tourism systems.

Importantly, the study challenges the stabilization hypothesis frequently associated with domestic tourism. At the macro level, domestic demand appears to contribute to partial smoothing due to geographic dispersion across multiple destinations. However, at the local level, particularly in highly concentrated destinations such as Ohrid, domestic tourism operates as a structural amplifier of seasonality. The synchronization of domestic travel behavior with climatic and institutional summer patterns reinforces peak accumulation instead of mitigating it.

The amplification mechanism is further intensified through length-of-stay dynamics. Seasonal asymmetry is consistently stronger for overnight stays than for arrivals, indicating that domestic tourists not only concentrate temporally but also extend their duration during peak months. This generates additional pressure on accommodation capacity, infrastructure utilization, and local labor markets.

The structural weight of Ohrid within national domestic tourism magnifies these effects. With roughly one-third to two-fifths of domestic arrivals and nearly half of domestic overnight stays concentrated in a single destination, local seasonal volatility acquires macroeconomic relevance. Fluctuations in Ohrid therefore influence national tourism stability, fiscal performance, and regional income distribution.

From a policy perspective, these findings suggest that strategies based solely on aggregate indicators may underestimate localized vulnerability. Tourism policy in small economies should incorporate spatial differentiation and destination-level seasonality metrics when designing diversification, infrastructure planning, and demand-management strategies.

Finally, several limitations should be acknowledged. The analysis is descriptive-structural and does not model causal determinants of seasonality. Additionally, the focus on one dominant destination limits generalization to other localities. Future research may integrate econometric modeling and comparative multi-destination analysis to further refine the scale-dependent framework.

6. Conclusion

This study examined the seasonal architecture of domestic tourism in North Macedonia over the period 2011–2025, comparing national dynamics with those of the Municipality of Ohrid. By applying multiplicative time-series decomposition and normalized seasonal indices, the analysis demonstrates that domestic tourism seasonality is not a uniform national phenomenon but a scale-dependent structural property of the tourism system.

The findings reveal a clear spatial asymmetry. While domestic tourism at the national level exhibits pronounced summer concentration, aggregation partially moderates extreme volatility. In contrast, the destination-level system of Ohrid displays severe seasonal compression, characterized by exceptionally high Peak-to-Trough Ratios and extreme concentration of overnight stays in the summer quarter. This confirms that spatial concentration amplifies temporal asymmetry.

The study contributes to the literature by empirically challenging the stabilization hypothesis often attributed to domestic tourism. Domestic demand does not automatically function as a counter-cyclical or smoothing mechanism. Its stabilizing capacity depends on spatial dispersion. In geographically concentrated destinations, domestic tourism may reinforce seasonal peaks rather than mitigate them, thereby intensifying capacity pressures and labor-market instability.

The distinction between arrivals and overnight stays further reveals a length-of-stay amplification effect. Seasonal asymmetry is systematically stronger for overnight stays, indicating that temporal concentration operates not only through visitor numbers but also through extended duration during peak months.

Given Ohrid's substantial structural weight within national domestic tourism flows, local seasonal volatility acquires macroeconomic relevance. In small economies with geographically concentrated tourism systems, destination-level seasonality may significantly shape national tourism performance and regional income distribution.

From a policy standpoint, these findings underscore the importance of incorporating spatial differentiation into tourism planning. Aggregate indicators may conceal localized vulnerabilities and lead to underestimation of infrastructure strain, labor instability, and regional inequality. Sustainable tourism strategies in small economies should therefore combine national diversification policies with destination-specific seasonality management.

Future research could extend this framework through econometric modeling of causal determinants, cross-destination comparisons, and integration of international tourism flows to further evaluate interaction effects between domestic and foreign demand.

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COMMUNICATION AS A SOCIAL CONSTRUCT: DEVELOPING THE COMMUNICATION MATRIX

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Abstract

The purpose of this paper is to offer an in-depth explanation of communication as the foundation for interaction between two or more subjective beings. According to the ontological approach, reality does not exist independently of language and communication. Therefore, this paper demonstrates that communication constructs reality. An overview will be provided of the semantics and basic functions of communication. The paper also explains the digitisation of communication and how it has changed the way humans perceive themselves in space and time, as well as how identity is constructed in virtual reality. Additionally, the authors will develop a communication matrix used in business to demonstrate the importance of high-level communication in improving the efficiency of a company or institution. The matrix will be created to visualise and explain the main steps for its applicability and use as a communication channel. Given the subject and objectives of the research, it became necessary to use specific methods appropriate to this issue. Namely, through observation of contemporary conditions in information and communication technology, i.e., the established information society and its role in communication, the inductive-deductive method will be used first. This will help to analyse the chronological development of communication and its characteristics as a surreal integration environment in which the digital economy functions globally. The analytical method is used throughout the research because the formulations of the conclusions arise from the analysis of the problem—communication as a social constructor. The research emphasises the importance of communication not only as a means of transmitting information, but also as a key mechanism for

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constructing social reality, shaping digital identity, and improving organisational efficiency in the modern information society.

Keywords: Communication, Communication Matrix in business, Virtual reality.

1. Introduction

Communication is a vital part of human life. It is a complex and intricate process, making any attempt to explain it fully impossible. The complexity of communication, involving numerous entities, presents a compelling challenge for us as authors. The need for communication is central to human life. In its simplest form, communication is easy to explain. However, communication is not simply an exchange of information, but a complex cognitive process. According to Radu & Bogdan (2023), people have communicated since the beginning of time in different ways. Communication and understanding have taken many and varied forms over time, but what has been achieved in recent decades has far surpassed thousands of years of human communication and connection. According to Gurning & Damanik (2025), language comprehension is fundamentally tied to the same cognitive systems we use to navigate the physical world. As a result, meaning is not merely a product of linguistic structures or syntactic rules but arises from embodied conceptualisation shaped by lived experience, cultural norms, and context.

The literature offers numerous definitions of the communication process. In this paper, we will mention only a few of them:

Definitions of communication:

1) The Oxford English Dictionary defines communication as “the action of conveying or exchanging information and ideas.”

2) Peter Little defines communication as “the process by which information is transmitted between individuals and or organizations so that an understanding response results.”

3) Allen Lui (Louis) defines communication as “Communication is the sum of all the things one person does when he wants to create understanding in the mind of another. It is a bridge of meaning. It involves a systematic process of telling, listening, understanding and responding.”

Dialogue between two subjects may appear to be a simple process at first glance, as we treat it as something given *a priori*; however, communication between two subjects is a complex process composed of several segments.

The process of communication includes a sequence of stages:

1) An impression arises in the mind of the sender

2) The sender encrypts the idea in the form of a 'message'

3) The sender selects a network to put across the message.

4) The receiver receives the message.

5) The receiver decodes – absorbs, understands, and interprets the message.

6) The receiver sends feedback or his response.

Following this process of information transmission, the function for which the information was sent comes next. There are several functions of communication, such as the informative, cognitive, emotional, motivational, and epistemological functions, among others. So, Kapur (2020) concludes that the functions of communication are important concepts that are vital to understand to carry out the processes of communication effectively. Communication has various objectives: informing, persuading, integrating, building relationships, helping make selections between alternatives, improving connections, reducing misunderstandings, solving problems, evaluating, and making decisions. Therefore, communication is a key element of business processes. Whether it involves routine interaction between employees, be it verbal or electronic, the effective transmission of information is crucial for good management. According to Boshkoska et. al, (2026), Communication styles are an important aspect of business interaction and are largely shaped by cultural environments. In international business, communication is generally categorized into two main styles: the indirect style, characteristic of countries such as Japan, China, and India, which relies on context and non-verbal cues, and the direct style, typical of the USA, Germany, and Great Britain, which is characterized by clear and explicit messages

2. Literature review

As previously mentioned, the complexity of communication presents a challenge for us as authors. However, in this paper, we will focus on only certain segments of the communication process. We will cover communication as a social construct, the semantic dimension of communication, and communication in the digital age. We will also provide an example of creating a communication matrix designed to ensure information reaches the right place at the right time.

Dialogue between two entities creates a social construct. This implies that the process operates on a philosophical and metaphysical level, rather than being merely an exchange of information. According to Burr & Dick (2017), the core tenet of the social constructionist approach is that how we understand and even perceive the world and the objects (including people) and events within it does not necessarily reflect the nature of that world, but rather is a product of how the

world is represented or produced through language. The social construct emerges through communication aimed at shaping reality, rather than through passive participation. Although words are immaterial in nature, they lend materiality to other objects. Hollander & Gordon (2023) explain that types of meaning are socially constructed in interaction, including identities, events, social problems, social structures, inequalities, and abstract concepts. Regardless of the specific focus, speakers employ similar tools to construct meaning. These tools are "generic," in the sense that they occur across a wide range of situations.

Table 1. Tools of Social Construction Used in Everyday Talk

Building Blocks	Linking Devices	Finishing Devices
Categorizing Symbolizing	Explaining Storytelling Forecasting	Framing Evaluating Emoting Rhetorical devices

Building blocks include the most basic processes of social construction: Categorising (sorting people, objects, and experiences into contrasting groups) and Symbolising (using a particular word, object, or image to summarise and evoke a larger meaning).

Linking devices in the social construction literature are: Explaining (explaining is central to social construction, as explanations suggest the causal linkages that undergird differing perspectives); Storytelling (storytelling relays to others a sequence of past events that occurred in a particular context); and Forecasting (whereas storytelling constructs versions of the past, forecasting constructs possible futures).

Finishing devices are tools speakers use to add shades of meaning to the frameworks they have built. These devices include Framing (the ability to enforce a particular frame successfully plays out not only in large social systems and institutions, but also within everyday conversation.), evaluating (evaluating may also be implicit or invisible because the rankings invoked are taken for granted.), and emoting (a distinctive finishing device is the use of emotion in conversation.), as well as other Rehetorical moves (variety of rhetorical devices can enhance the persuasive power of a proposed social construction).

This table provides a comprehensive explanation of how reality is created through the tools mentioned within it. In other words, it illustrates the complex process by which a social construct is created through communication.

According to Burr & Dick (2017), social constructionism argues that the concepts and categories we use to think and communicate are socially constructed rather than 'natural' features of the world. These concepts and categories are historically and culturally specific, making our 'knowledge' of the world relative rather than absolute and rendering the idea of 'truth' uncertain. Researching deeper into the explanation of these socially constructed theoretical concepts leads us into an entirely new concept: do we create things through our communication - that is, do

things exist in their own right, or do they exist only when we name them? This is a philosophical issue that we will not examine here.
As Kretchmar (2019) specifies, social constructionists argue that knowledge is not static but evolves over time and across cultures, reflecting a variety of perspectives rather than a singular truth. The theory also highlights the processes through which knowledge becomes ingrained in society, such as externalisation, habituation, and internalisation.
According to the ontological approach, reality does not exist independently of language and communication, and it is shaped by how reality is created and understood.

(Henderson, 2004, pp. 469–476) Defining competent communication behaviours has been an active area of research and application in the field of communication for over 30 years. Researchers have broadly defined communication competence from a variety of perspectives, including goals, change, and skills.

According to Kapur (2020), communicating with other individuals is an integral part of individuals' lives. Throughout one's life, communication is regarded as a fundamental aspect that facilitates the implementation of various tasks and activities, the achievement of personal and professional goals, and the enrichment of individuals' overall quality of life.
Through communication and the exchange of information, people acquire new skills, knowledge, cognitive abilities, attitudes, and so forth. Communication can be divided in two ways: formal communication and informal communication, depending on what we want to exchange.
According to Drag et al. (2025), formal communication usually includes the exchange of information on strategic goals, plans, agreements, safety guidelines, and an organisation's policies and procedures. Informal communication channels are also used to deliver official messages in a more relaxed way, such as during lunchtime conversations and chats during ongoing collaboration among team members.

In a conventional communication structure, the source is transformed into bit sequences for processing. At the receiver, the bit sequence representing the source is recovered accurately.

As Adetunji et al. (2009) state, communication, which can be a one-way or two-way process, can be classified as verbal communication in the form of oral, intrapersonal, interpersonal, written, and non-verbal communication. The communication process has traditionally been identified with a stimulus or motivation, and it involves the sender of the message, the message, the medium, the channel, the receiver, and the feedback expected at the end of the process.

Thus, communication functions as a cooperative task between the transmitter and the receiver. The mission is to achieve the ultimate goal of communication. Meaning - the transmitter can generate different meanings to convey to the

receiver to achieve the ultimate goal. Message - messages are the carriers of meaning and are constructed following an agreed-upon language between the transmitter and the receiver. Symbol - symbols refer to the coded channel symbols to be transmitted to the receiver via the physical channel.

According to Zhang et al. (2023), compared with conventional communication systems, a semantic communication system conveys basic, necessary semantic information and recovers it through a shared knowledge base.

What is semantic communication? Shao et al. (2022) explain how Weaver, in his mathematical theory, classified the broad communication problem into three levels:

Level A (The technical problem): How accurately can the symbols of communication be transmitted?

Level B (The semantic problem): How precisely do the transmitted symbols convey the desired meaning?

Level C (The effectiveness problem): How effectively does the received meaning affect conduct in the desired way?

This paper focuses on Level B- the semantic problem of how precisely the transmitted symbols convey the desired meaning.

As Wei (2023) states, semantic communication is a communication method based on semantic information transmission, aiming to achieve more intelligent, efficient, and reliable data transmission. In the current era of information explosion, traditional communication methods are often limited to simple data transmission and cannot accurately capture and convey the semantic meaning in the data. By applying semantic analysis and understanding techniques to communication systems, semantic communication makes data transmission more intelligent and human-friendly.

Image 1

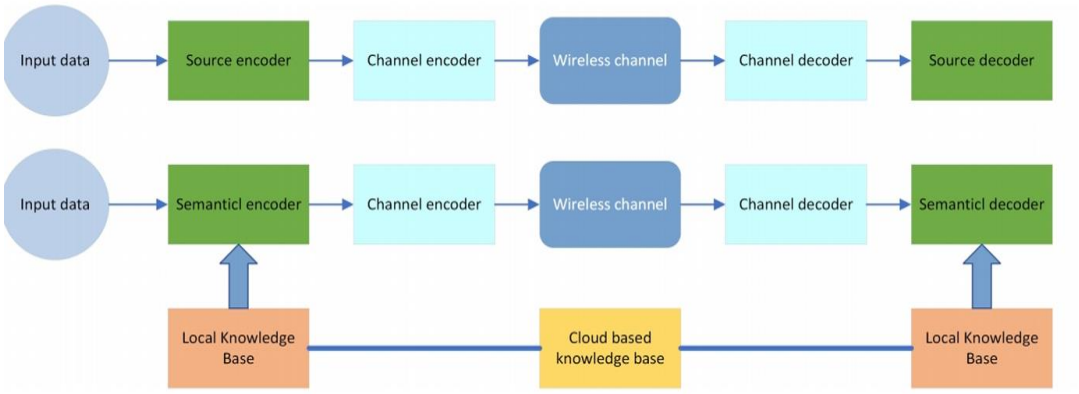


Fig. 1. Comparison between Semantic Communication and Traditional Communication Methods.

According to Evgenidis et al. (2023), semantic communications are a promising beyond-Shannon paradigm for reducing network traffic and increasing reliability, making wireless networks more energy efficient, robust, and sustainable. However, performance is limited by the efficiency of the semantic transceivers, i.e., the achievable "similarity" between the transmitted and received signals.

Human communication is becoming increasingly complex due to the vast amount of information being transmitted but also due to the rapid development of digital communication channels.
As Qin et al. (2022) conclude, semantic communications transmit the source's semantic meaning. One critical difference is the introduction of semantic coding, which captures semantic features based on the tasks or actions to be executed at the receiver. Only those semantic features are transmitted, which significantly reduces the required communication resources. Tasks at the receiver could be data reconstruction or more intelligent tasks, such as image classification and language translation.

Systems are becoming increasingly complex and are engaged in a race against time - something that is, in itself, elusive. Tasks are becoming ever more difficult, and transmitting information from source to recipient as an active subject is becoming increasingly arduous and, ultimately, impossible.
The traditional definition of digital communication refers to the exchange of information and knowledge through any medium encoded in a format readable by an electronic device. However, this concept has evolved over time, driven by technological developments and the spread of the Internet.

As Palevska et al. (2022) state, Modification in the application of digital communication tools is a corporate imperative for competitiveness and sustainable development. Globalisation has become an invasive challenge in creating digital business architecture, in which the strategy of knowledge-based societies continuously generates and distributes information to improve corporate competitiveness. Effective management of the digitization of communications depends on the application of adapted digital tools.

Today, digital communication takes place in more complex environments, as users can interact through different channels in real time and virtually at the same time. Consequently, today's digital communication is not linear, but multi-level and multi-channel. Social media is probably the best-known example of digital communication, but corporate blogs and videos are also digital means of communication.

According to Radu & Bogdan (2023), like most things nowadays, communication is directly connected to new technology. That is why this new type of communication can be regarded as digitally mediated communication. In practice, any form of communication conducted through new communication technology can be described as part of digitally mediated communication. When using e-mail, Twitter, Snapchat, Facebook, or an online discussion board, users use digital media resources to communicate. Brockhaus et al. (2022) explain that new digital technologies are both a trigger and the backbone for a rapid transformation of communication departments and agencies. The latter are under significant pressure to adapt to a changing digital environment with a 24/7 information flow. They also need to implement ever-new technologies to support basic organisational functions, as well as the management and tactical execution of communication activities. According to Zhang et al. (2023), with the rapid development of communication technology and the advent of the connected intelligent era, data communication and wireless network power consumption are growing exponentially, and existing communication technologies struggle to meet these needs.

3. Communication matrix

Effective communication is essential in everyday life. Many people deal with mixed messages, misalignment, and unnecessary slowdowns because communication is not crystal clear. According to McRoy & Hirst (1995), speech act misunderstandings occur when two participants differ in their understanding of the discourse role of an utterance. For example, one speaker might take an utterance as an assertion, while another understands it as a request. That is where a communication matrix comes in. It helps cut through the chaos, making sure the right people get the right information at the right time. Think of it as a

communication roadmap. It defines who needs to know what, when they need to know it, and how the information should be delivered. A well-structured matrix brings clarity, accountability, and efficiency to every conversation. Whether it is keeping projects on track, aligning leadership, or making presentations hit harder, a solid communication structure changes the game.

Here are some steps on how to create a Stakeholder Communication Matrix:

1. Determine the Purpose of the Communication Matrix

Clarify what you want this matrix to accomplish. Consider how it aligns with your project's main goals. Do you want to keep stakeholders informed, seek their input, or actively involve them in decision-making?

2. Identify Stakeholders and Their Roles

This process involves identifying key players, understanding their influence, and learning what matters to them. List both internal stakeholders (e.g., investors, company leadership, employees) and external stakeholders (e.g., customers, community members, regulators).

3. Define Communication Requirements and Content

Each stakeholder group has unique needs, so you must tailor your communication. What information is relevant to each group, and what tone and level of detail will they appreciate? Assess each stakeholder's needs to keep communication focused, avoid overload, and ensure everyone is well informed.

4. Select Appropriate Communication Channels

Some stakeholders prefer detailed reports, while others appreciate quick, digestible updates. Tools like stakeholder mapping can help you match the right channels to the right people.

5. Define Communication Frequency and Timing

Establish a cadence for communicating with each stakeholder group. When you get the timing right, stakeholders know when to expect updates, which helps prevent any confusion or unmet expectations.

6. Develop and Populate the Matrix

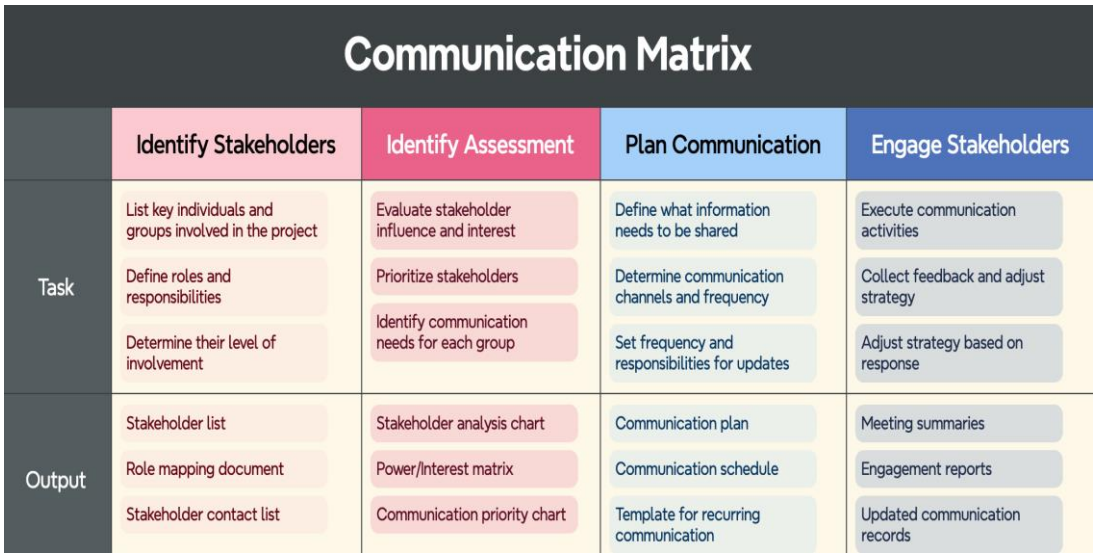
Structure your matrix by listing stakeholders in rows and using columns for factors such as purpose, frequency, and channels. This setup helps you organise each detail clearly.

7. Review and Refine the Matrix Regularly

Projects and stakeholder needs change over time, so review and adjust the matrix regularly to stay responsive and keep your communication plan relevant.

8. Utilise Tools and Templates

Leveraging digital tools makes creating and updating your matrix easier. Platforms like a stakeholder management system offer features such as stakeholder mapping, automatic tagging, and sentiment analysis to simplify the communication process and help you stay organised.



Communication Matrix				
	Identify Stakeholders	Identify Assessment	Plan Communication	Engage Stakeholders
Task	List key individuals and groups involved in the project Define roles and responsibilities Determine their level of involvement	Evaluate stakeholder influence and interest Prioritize stakeholders Identify communication needs for each group	Define what information needs to be shared Determine communication channels and frequency Set frequency and responsibilities for updates	Execute communication activities Collect feedback and adjust strategy Adjust strategy based on response
Output	Stakeholder list Role mapping document Stakeholder contact list	Stakeholder analysis chart Power/Interest matrix Communication priority chart	Communication plan Communication schedule Template for recurring communication	Meeting summaries Engagement reports Updated communication records

Source: https://xmind.com/blog/communication-matrix

There are many ways to communicate with staff. One approach, or set of approaches, will be more suitable in some workgroups or some situations than others.

Communication may be: face-to-face, voice communication, communication via paper or electronic communication.

Why is a communication matrix so important?

- To help employees understand their department's goals and how their work fits into the big picture.
- For regular and routine communications, it may be necessary to convey an unexpected but important message that has a broad impact.
- For information sharing, updating, and assigning tasks.
- Half- or full-day gathering of managers in the department or agency to discuss management issues. It provides an opportunity for management to refocus on departmental goals and strategies.
- For information sharing and decision-making.

Creating a communication matrix is a vital process applicable to any field. Communication is crucial, whether within companies, institutions, or projects, or

in interactions involving individuals with special needs. Information transparency, as well as accurate transmission to the intended recipient, helps prevent misunderstandings and delays in communication.

4. Conclusion

Based on the analyses presented in this paper, several important conclusions can be drawn:

- Communication is a vital part of human life. It is a complex and intricate process, making any attempt to explain it fully impossible.
- Communication has several functions, including informative, cognitive, emotional, motivational, and epistemological functions, among others.
- The social construct emerges through communication aimed at shaping reality, rather than through passive participation. Although words are immaterial in nature, they lend materiality to other objects.
- Delving deeper into these socially constructed theoretical concepts leads us to an entirely new question: do we create things through our communication; that is, do things exist in their own right, or only when we name them?
- By applying semantic analysis and understanding techniques to communication systems, semantic communication makes data transmission more intelligent and human-friendly.
- Human communication is becoming increasingly complex due to the vast amount of information being transmitted. As we delve deeper into the digital age, communication systems and frameworks are becoming increasingly complex.
- Creating the Communication matrix is important because it helps employees understand their department's goals and how their work fits into the big picture; it supports information sharing, updates, and task assignment; and it allows management to refocus on departmental goals, strategies, and decision-making.

Limitations: This research also synthesises various aspects of communication. As authors, we could not comprehensively cover all these perspectives within the scope of this study. Social construction, semantic meaning, and digital communication will serve as challenges for future, more detailed research, allowing us to delve deeper into this subject matter.

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PRODUCTIVITY GAINS AND HERD DECLINE IN MACEDONIA'S DAIRY SECTOR: A NATIONAL AND REGIONAL DECOMPOSITION

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Abstract

This study examines whether productivity gains offset the decline in the number of dairy cows in Macedonia from 2016 to 2025 and how the adjustment varied across the eight planning regions. Official State Statistical Office data are analysed using symmetric endpoint and annual dynamic decompositions, regional concentration and dispersion indicators, and robustness checks. The number of dairy cows fell by 39.1%, while milk yield per cow increased by 18.1%; total cow milk production nevertheless declined by 28.1%. The endpoint decomposition attributes a negative effect of 171.8 million litres to herd contraction and a positive effect of 58.6 million litres to productivity. Productivity therefore compensated only 34.1% of the negative herd effect; annual decomposition and alternative-period checks confirm that herd contraction remained dominant. Regional patterns differed markedly: Polog achieved near-complete productivity compensation, whereas the Southeast expanded its herd but experienced a sharp productivity decline. Concentration and productivity dispersion were higher in 2025 than in 2016, but fluctuated during the period. The findings show that productivity improvements can mitigate, but cannot indefinitely replace, a shrinking production base. Stabilising milk supply therefore requires coordinated measures for herd retention, replacement, and region-specific productivity improvement.

Keywords: agricultural productivity; dairy sector; structural change; decomposition; regional concentration

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1. Introduction

From a production-economics perspective, cow milk output is jointly determined by the number of dairy cows and the average output obtained per animal. This relationship shows that a sector can improve productivity while total output declines if the number of cows falls faster. Equally, an expanding herd may produce only limited growth when milk yield per cow deteriorates. Separating the two effects shows whether production changed mainly because of herd size, milk yield, or both..

The dairy sector in Macedonia has long been characterised by small production units, relatively low average yields, fragmented supply channels, and recurrent pressure on farm viability (Sekovska et al., 2015; Sulejmani & Iseni, 2023). These constraints matter beyond the farm level because a sustained decline in the dairy-cow population may reduce domestic raw-milk supply, weaken processing capacity utilisation, place farm incomes and rural employment under pressure, and reduce the resilience of the food system. Improvements in genetics, nutrition, animal health, housing, and management can raise output per cow, but the central empirical question is whether those gains have been large enough to counterbalance the decline in animal numbers.

International evidence shows that dairy restructuring commonly combines fewer farms or animals with larger herds, higher yields, and a geographical redistribution of production. Shift-share and related decomposition methods have been used to distinguish herd and productivity effects and to identify regions in which intensification offsets structural contraction (Bender Filho et al., 2023; de Oliveira et al., 2024). Evidence from Chile also shows that national averages can hide important regional differences in farm structure and resource use. (Toro-Mujica & Vera-Infanzón, 2024).

This paper contributes to applied agricultural and regional economics by applying a transparent national and regional decomposition to official annual data for 2016-2025. It combines endpoint and annual dynamic decompositions with a compensation rate, regional contribution measures, concentration indicators, productivity dispersion, and a proxy for herd-renewal potential. Three questions guide the analysis: (1) which factor dominated the change in national production; (2) how strongly did regional patterns differ; and (3) did the main conclusion remain stable under alternative periods and levels of aggregation?

2. Data and methodology

2.1 Data and variables

The analysis uses annual aggregate data from the State Statistical Office MAKSTAT database for Macedonia and its eight planning regions. Table ES380M16 provides the number of dairy cows, published milk yield per cow, and

cow milk production. Table ES366M16 provides cattle categories used to construct the herd-renewal proxy. The balanced period covers 2016-2025. All production data are secondary aggregates and contain no farm- or animal-level observations.

Table 1. Variables and analytical role

Variable / symbol	Unit	Analytical role
Cow milk production (P)	'000 L	Outcome and accounting identity
Dairy cows (N)	head	Production-base effect
Derived milk yield (Y*)	L/cow	Productivity effect without rounding residual
Regional production share (s_i)	share	HHI and CR3 concentration
In-calf heifers per 100 dairy cows (R)	no.	Approximate renewal potential

Source: State Statistical Office MAKSTAT; authors' definitions and calculations.

The officially published yield is rounded to whole litres. Direct multiplication of that series by the number of cows can therefore produce a small residual relative to reported total production. To ensure an exact accounting identity, the decomposition uses derived yield Y*, calculated directly from P and N; the published yield remains the descriptive indicator.

$$P_t = N_t \times Y*_t / 1{,}000 \quad (1)$$

$$Y*_t = P_t \times 1{,}000 / N_t \quad (2)$$

2.2 Symmetric and dynamic decomposition

The change between the initial and final years is decomposed symmetrically. This allocates the interaction term equally between the herd-size and productivity components and is invariant to the order in which factors are changed.

$$E^N = (N_1 - N_0) \times (Y*_1 + Y*_0) / 2{,}000 \quad (3)$$

$$E^y = (Y*_1 - Y*_0) \times (N_1 + N_0) / 2{,}000 \quad (4)$$

$$\Delta P = E^N + E^y \quad (5)$$

The same equations are applied to every pair of consecutive years and the annual effects are summed. Endpoint decomposition captures the net difference between 2016 and 2025, whereas dynamic decomposition reflects the full annual path. When the herd effect is negative and the productivity effect positive, compensation is CR = E^y / |E^N| x 100. A value below 100% indicates partial compensation. Regional contribution is measured as each region's production change divided by the national production change.

2.3 Concentration, dispersion, renewal, and robustness

Regional concentration is measured by HHI = Σs_i^2 and CR3, the combined production share of the three largest regions. Productivity dispersion is measured by the coefficient of variation across regional milk yields. The number of in-calf heifers per 100 dairy cows over two years is used only as an approximate indicator of immediate replacement potential; it is not a forecast of future herd

size. Robustness is assessed with alternative start and end years, three-year averages, and a comparison of national decomposition with the sum of regional decompositions. Because the analysis is an exact arithmetic decomposition, The results are interpreted by their size and direction rather than statistical significance.

3. Results

3.1 National trends and decomposition

Between 2016 and 2025, the number of dairy cows declined from 132,332 to 80,605, a fall of 51,727 head or 39.1%. Published milk yield increased from 3,046 to 3,596 litres per cow, or 18.1%. Total cow milk production nevertheless fell from 403.0 to 289.9 million litres, a decline of 113.2 million litres or 28.1%. Figure 1 shows that milk yield varied over time, but its increase was not enough to prevent total production from declining as the herd shrank..

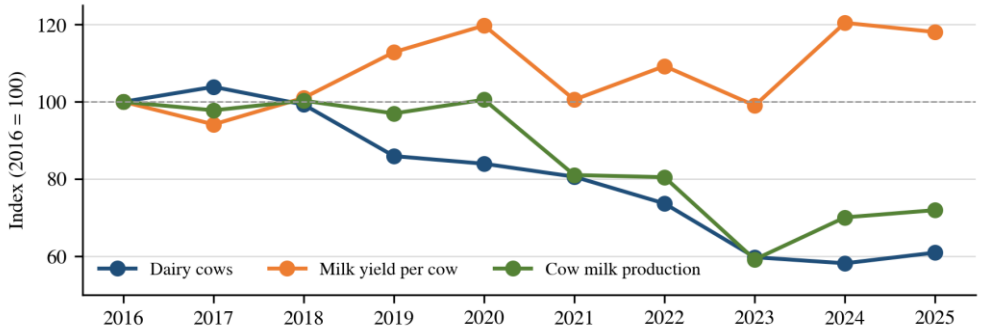


Figure 1. National cow milk indicators, 2016-2025
Source: Authors' calculations based on State Statistical Office MAKSTAT data.

Table 2. National change and decomposition, 2016-2025

Indicator / approach	Change, 2016-2025	Herd effect	Yield effect
Dairy cows	-51,727 (-39.1%)	-	-
Milk yield	+550 L/cow (+18.1%)	-	-
Cow milk production	-113.2 million L (-28.1%)	-	-
Endpoint decomposition	-113.2 million L	-171.8	+58.6
Dynamic decomposition	-113.2 million L	-166.1	+53.0

Source: Authors' calculations based on State Statistical Office MAKSTAT data.

The endpoint decomposition assigns a negative effect of 171.8 million litres to the reduction in dairy-cow numbers and a positive productivity effect of 58.6 million litres. Productivity therefore compensated 34.1% of the herd effect. The annual dynamic approach produces a comparable result: a herd effect of -166.1 million litres, a productivity effect of 53.0 million litres, and compensation of 31.9%. Both methods lead to the same conclusion, showing that the result does not depend only on the comparison between 2016 and 2025..

3.2 Regional heterogeneity

Seven regions recorded fewer dairy cows in 2025 than in 2016, while milk yield increased in seven. The Southeast followed the opposite path: dairy-cow numbers rose by 91.0%, but yield fell by 44.4%, limiting production growth to 6.2%. Polog represents the strongest productivity-compensation case. Its cow population fell by 27.4%, but a 33.8% yield gain offset 91.1% of the negative herd effect, leaving production only 2.9% lower. By contrast, the Southwest experienced a 71.3% production decline because a very large herd contraction was accompanied by almost no endpoint productivity gain.

Table 3. Regional change and symmetric decomposition, 2016-2025

Region	ΔN	ΔY*	ΔP	Compensation
Vardar	(38.5)	+26.5	(22.2)	49.1
East	(44.2)	+23.1	(31.3)	36.5
Southwest	(71.5)	+0.8	(71.3)	0.7
Southeast	+91.0	(44.4)	+6.2	n.a.
Pelagonia	(50.3)	+22.9	(38.9)	30.6
Polog	(27.4)	+33.8	(2.9)	91.1
Northeast	(52.5)	+36.2	(35.2)	43.1
Skopje	(39.7)	+32.5	(20.1)	56.4

Note: All change and compensation values are percentages. Parentheses indicate declines; n.a. means the compensation condition is not met. Detailed effects are shown in Fig. 2.

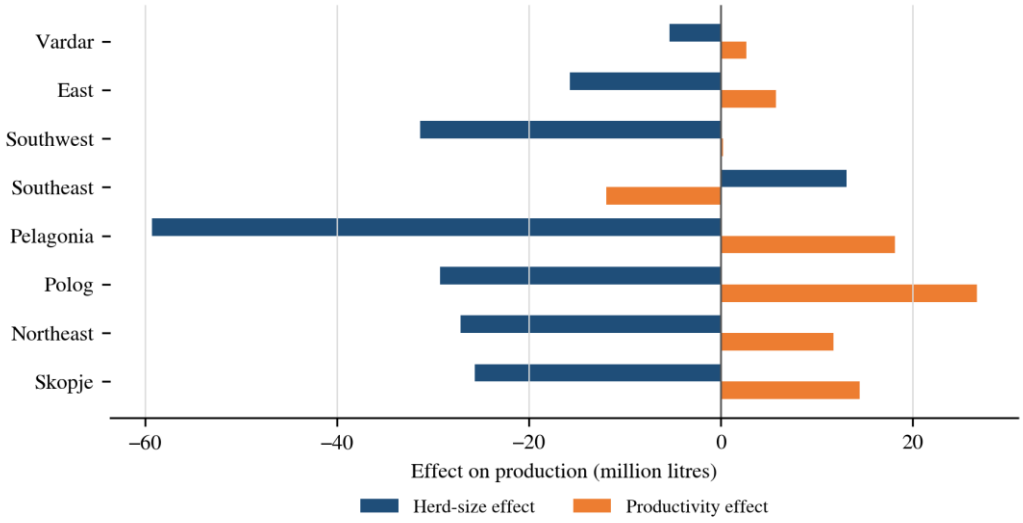


Figure 2. Regional herd-size and productivity effects
Source: Authors' calculations based on State Statistical Office MAKSTAT data.

Pelagonia accounted for 36.4% of the national decline, followed by the Southwest (27.5%), Northeast (13.7%), Skopje (9.9%), and East (8.8%). The Southeast had a contribution of -1.0% because its production increase partly moderated the national fall. The regional results show why policy cannot focus on

animal numbers alone: in the Southeast, herd expansion without productivity maintenance generated little output growth, while in Polog productivity almost neutralised contraction.

3.3 Concentration, dispersion, renewal, and robustness

HHI increased from 0.172 in 2016 to 0.190 in 2025, and CR3 from 62.7% to 68.2%. These endpoint comparisons indicate greater concentration, but the annual path was not monotonic: HHI peaked at 0.218 in 2020 and CR3 at 73.0% in 2022. Regional productivity dispersion was also higher at the end of the period. The coefficient of variation rose from 14.1% to 27.6%, but reached its maximum of 34.4% in 2023. Concentration and productivity differences were higher in 2025 than in 2016, but varied from year to year.

The national renewal proxy declined from 11.1 to 7.1 in-calf heifers per 100 dairy cows over two years, a fall of 36.5%. This reinforces the evidence of a weakening production base, although the indicator does not cover all reproductive, culling, and management flows.

Table 4. Robustness and structural checks

Check	Result	Interpretation
Alternative endpoint: 2016-2024	35.1% compensation	Herd effect remains dominant
Alternative start: 2017-2025	43.3% compensation	Largest offset, still incomplete
Alternative start: 2018-2025	32.5% compensation	Consistent with baseline
Three-year averages	26.0% compensation	Most stable additional check
National vs regional endpoints	34.1% vs 37.4%	Different allocation, same net change
National vs regional dynamic	31.9% vs 31.5%	Very close cumulative result

Source: Authors' robustness calculations. Net changes reconcile within 1-2 thousand litres due to official rounding.

All alternative periods lead to the same conclusion: the decline in the number of dairy cows is the dominant negative factor. The magnitude and, for the 2016-2023 endpoint, even the direction of the productivity effect depend on the selected final year; three-year averages therefore provide a more stable sensitivity check. National and regionally summed decompositions allocate the two effects differently because aggregate yield also reflects changes in regional production weights. This is an aggregation effect, not a computational error, since the net production change is preserved.

4. Discussion and economic policy implications

The results show that the dairy sector is producing more milk per cow but losing cows faster than productivity can offset. This is structurally different from simultaneous decline in herd size and yield: technical improvement is present, yet it is not sufficient to stabilise aggregate production. From an economic

perspective, the result points to a weakening domestic supply base, with potential consequences for farm viability and processing capacity utilisation. The result is consistent with international studies in which productivity gains coexist with declining animal numbers and with a redistribution of production toward a smaller number of locations (Bender Filho et al., 2023; de Oliveira et al., 2024).

Regional heterogeneity is the most policy-relevant result. Polog demonstrates that strong productivity growth can substantially reduce the output consequences of herd contraction. The Southeast demonstrates the reverse: increasing the number of cows has limited value when output per animal deteriorates sharply. Support measures should therefore be differentiated and economically targeted. Regions dominated by herd loss require retention, replacement, and entry incentives, together with access to investment finance, while regions with expanding herds but weak yield require productivity-enhancing investments in nutrition, health, genetics, housing, and day-to-day management.

Greater regional concentration can bring both benefits and risks. Spatial specialisation may support processing linkages, specialised services, and economies of scale. At the same time, greater dependence on a limited number of regions can increase exposure to local climatic, animal-health, feed-price, or market shocks. The higher coefficient of variation further indicates that national average productivity gains have not produced regional convergence. A national programme based on uniform productivity targets would therefore overlook very different starting positions and constraints.

The analysis also highlights data priorities. Better information is needed on farm numbers and size classes, breeds, lactation structure, culling, reproduction, feeding systems, milk quality, purchase prices, subsidies, and production costs. Linking such information to farm-level technology adoption would allow future studies to move from accounting decomposition toward causal analysis. With the current aggregate data, the analysis shows how much of the change is linked to herd size and milk yield, but it cannot explain how farms respond to prices, subsidies, or other incentives.

5. Conclusion

From 2016 to 2025, Macedonia lost 39.1% of its dairy cows, while milk yield per cow increased by 18.1%. Total cow milk production consequently declined by 28.1%. The symmetric decomposition shows that the negative herd-size effect reached 171.8 million litres and was offset by a positive productivity effect of 58.6 million litres. Compensation of 34.1%, confirmed by the dynamic and robustness results, was economically important but insufficient.

The regions showed different patterns of change in herd size and productivity. Polog achieved near-complete productivity compensation, while the Southeast expanded its herd but experienced a severe fall in yield. Pelagonia and the Southwest contributed most to the national decline. Concentration and

regional productivity differences were higher in 2025 than in 2016, although both indicators fluctuated substantially during the period. The economic implication is clear: productivity improvements can partly offset the production losses caused by herd decline, but they cannot indefinitely replace a shrinking and weakly renewed production base. Sustainable recovery requires coordinated incentives for herd retention and replacement, productivity-enhancing investment, and region-specific measures that reflect different structural constraints.

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FROM DIGITAL DIVIDE TO SMART INTEGRATION: RECONFIGURING TOURISM–AGRICULTURE VALUE CHAINS IN RURAL DESTINATIONS OF NORTH ALBANIA

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Abstract

Digital asymmetries between tourism enterprises and agricultural producers may constrain the development of integrated agri-tourism value chains in rural destinations. The study examines how digital adoption is associated with tourism–agriculture integration in Northern Albania, using mixed-methods evidence from 59 enterprises. Exploratory factor analysis identifies three dimensions of digital capability, namely Operational Capability, Market Connectivity, and Administrative Capacity, while correlation and regression analyses assess their relationships with value-chain integration. The findings reveal a pronounced sectoral divide, with 72.73% of agricultural producers reporting no digital technology adoption. Digital adoption is positively associated with local product integration ($r = 0.672$, $p < 0.01$), and Operational Capability and Market Connectivity emerge as significant predictors of integration. Enterprises with above-median digital adoption report 28.9% higher local product integration, 33.3% greater inventory turnover, and 21.9% lower supply-chain costs than low-adoption enterprises. Building on these findings, the study conceptualizes smart value-chain integration as a multi-layered process that connects digital capabilities, business processes, intersectoral coordination, and ecosystem governance. The results suggest that rural digitalization generates value not merely through technology adoption, but through its capacity to strengthen coordination between otherwise fragmented tourism and agricultural actors.

Keywords: Digital Capabilities; Smart Value Chains; Tourism–Agriculture Integration; Agri-Tourism; Rural Digitalization; Northern Albania.

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1. Introduction

Digitalization and sustainable development are increasingly reshaping traditional sectors such as tourism and agriculture. In rural regions endowed with natural and cultural capital, integrating these sectors through agri-tourism can strengthen rural resilience, local sourcing, and inclusive economic development (Scheyvens, 2007; Torres & Momsen, 2011). Yet these potential synergies often remain constrained by fragmented value chains, information asymmetries, and distribution inefficiencies. Digital transformation offers mechanisms to address these constraints by improving coordination, transparency, efficiency, and market connectivity across sectoral boundaries (Ndou et al., 2023).

The study shows how digital innovation supports smart value-chain integration between tourism and agriculture in Northern Albania. Rather than treating digitalization as technology adoption alone, it examines adoption patterns, underlying digital capabilities, and their relationship to intersectoral integration. Conceptually, the study draws on smart destination and territorial innovation perspectives, which emphasize digital connectivity, knowledge flows, and collaborative governance as components of regional transformation (Ndou et al., 2023). Northern Albania offers a relevant setting for examining these dynamics because tourism development increasingly intersects with locally embedded agricultural production, while substantial differences in digital adoption persist across the two sectors.

Drawing on insights from tourism–agriculture linkages in contexts such as Oaxaca, Mexico, the study examines whether digital capabilities can help bridge these sectoral asymmetries and strengthen locally embedded value chains. It thereby provides empirical evidence on the role of digitalization in connecting fragmented rural economic activities and informing more integrated approaches to sustainable rural development.

2. Literature Review

The tourism–agriculture nexus has traditionally been understood through sectoral linkages and local economic development, with tourism demand creating opportunities for locally embedded agricultural production and exchange (Torres, 2003). More recent perspectives extend this relationship to co-creative, increasingly interconnected value chains, in which agricultural resources, local food systems, and tourism activities jointly contribute to the formation and valorization of territorial capital (Cei et al., 2018; Giovannetti et al., 2021). Within this evolving perspective, digitalization is an additional dimension of intersectoral coordination rather than an end in itself.

Smart specialization and smart destination approaches emphasize the capacity of territories to combine distinctive local assets with digital connectivity, knowledge exchange, and institutional coordination to support competitiveness and resilience (Ndou et al., 2023).

Evidence from cooperation within the Adriatic–Ionian macro-region similarly highlights digital platforms and knowledge-sharing networks as mechanisms for connecting fragmented actors across territorial and sectoral boundaries (Ndou et al., 2023), consistent with the National Innovation Systems perspective, which conceptualizes innovation as an interactive process involving firms, knowledge institutions, and public actors rather than as an isolated firm-level phenomenon (Edler, 2016). Within agri-tourism value chains, these digital capabilities operate at several interconnected levels: precision agriculture, IoT-based monitoring, and farm-management systems support information-intensive agricultural operations (Verdouw et al., 2021); traceability technologies and digital platforms strengthen information exchange and direct connections between agricultural producers and tourism businesses (Li & Wang, 2023; Kamble et al., 2020); and social media and digital storytelling extend the visibility and market positioning of local products and place-based experiences (Kumar et al., 2021). However, access to and use of these capabilities remain uneven, particularly in rural contexts, where financial constraints, limited digital skills, inadequate connectivity, and institutional weaknesses shape firms' capacity to participate in digitalized value chains (Wyche & Steinfield, 2020; Misra & Singh, 2022).

This digital divide is particularly relevant for small agricultural producers because unequal technological capabilities may reproduce rather than overcome existing asymmetries among actors in the same territorial value chain, reinforcing the importance of inclusive, capacity-oriented approaches to rural digital transformation (Lioutas & Charatsari, 2021). Accordingly, the key analytical question is not merely whether rural enterprises adopt digital technologies, but whether different forms of digital capability are associated with stronger coordination between tourism and agriculture. Although previous research offers substantial insight into tourism–agriculture linkages and the use of individual digital technologies, comparatively little empirical evidence examines these two dimensions together by assessing how differentiated digital capabilities relate to tourism–agriculture integration in developing European rural contexts.

Addressing this gap, the present study conceptualizes smart value-chain integration through three observable dimensions, namely local product sourcing, digital transactions between sectors, and product traceability, and examines digital adoption as a multidimensional construct spanning operational capability, market connectivity, and administrative capacity.

This perspective shifts attention from technology adoption per se to the configuration of digital capabilities within territorially embedded tourism–agriculture value chains, providing a conceptual basis for examining smart integration in Northern Albania.

3. Methodology

3.1. Research Design, Sample, and Data Collection

This study used a pragmatic, cross-sectional, mixed-methods design that combined quantitative enterprise-level data with qualitative contextual evidence.

The empirical analysis focused on active tourism and agricultural enterprises in rural areas of Northern Albania with agri-tourism potential, specifically Theth, Razma, Boga, Tamara, Lepushë, and Vermosh. The final sample comprised 59 enterprises: 26 tourism businesses, including hotels, guesthouses, restaurants, and camping establishments, and 33 agricultural producers. The tourism subsample included all identifiable tourism businesses operating in the selected study areas at the time of data collection, while the agricultural subsample represented more than 80% of registered farms and consisted predominantly of family farms (78.79%), alongside small commercial agricultural enterprises (21.21%). A purposive sampling strategy was used to ensure representation of both sectors across the study territory.

Primary data were collected using two pretested, sector-specific structured questionnaires administered via face-to-face interviews from June to August 2023. The instruments captured enterprise characteristics, the type and intensity of technology adoption, supply-chain relationships and sourcing practices, sales channels, selected performance indicators, and perceived barriers and development needs. Open-ended responses and interview notes complemented the structured data by providing contextual information on adoption constraints and perceived opportunities. Secondary policy documents, regional development strategies, and the macro-regional cooperation framework discussed by Ndou et al. (2023) were also used to contextualize the empirical evidence. Given the purposive and geographically bounded sampling design, the analysis is intended to characterize relationships and sectoral patterns within the study context rather than provide population-wide causal estimates.

3.2. Analytical Strategy

The quantitative analysis was conducted in SPSS v.26 using a sequential analytical procedure that combined descriptive, dimensionality-reduction, reliability, association, group-comparison, and multivariate techniques. First, frequencies, percentages, means, and standard deviations were used to characterize enterprise profiles and sectoral patterns of technology adoption. Second, Exploratory Factor Analysis using Principal Component Analysis (PCA) with Varimax rotation was applied to 15 technology-related variables to identify the underlying dimensions of digital adoption. Sampling adequacy and factorability were assessed using the Kaiser–Meyer–Olkin (KMO) measure and Bartlett's test of sphericity, and Cronbach's alpha was used to evaluate the internal consistency of the resulting dimensions.

A Pearson correlation analysis was subsequently used to examine associations among technology-adoption measures, factor scores, and selected value-chain outcomes, including local product integration and inventory turnover. To provide an additional descriptive comparison of performance patterns across levels of digitalization, enterprises were classified as higher adopters when their technology-use score exceeded the sample median and as low/non-adopters when it was equal to or below the median. Relative differences between the two groups were expressed as:

$$RD(\%) = \frac{\bar{Y}_{Higher\ Adopters} - \bar{Y}_{Low/Non-Adopters}}{\bar{Y}_{Low/Non-Adopters}} \times 100 \quad (1)$$

where $\bar{Y}$ represents the mean of the respective outcome indicator. These percentage differences are interpreted as descriptive between-group differentials rather than causal treatment effects.

Finally, multiple linear regression was used to examine the multivariate association between the three extracted digital-capability dimensions Operational Capability, Market Connectivity, and Administrative Capacity and Local Product Integration, while controlling for enterprise size. The empirical specification was:

$$LPI_i = \beta_0 + \beta_1 OC_i + \beta_2 MC_i + \beta_3 AC_i + \beta_4 Size_i + \varepsilon_i \quad (2)$$

where LPI_i denotes Local Product Integration, OC_i Operational Capability, MC_iMarket Connectivity, AC_i Administrative Capacity, $Size_i$enterprise size, and $\varepsilon_i$the error term. Given the cross-sectional observational design, coefficients are interpreted as conditional associations and not as estimates of causal effects.

4. Results

4.1. Descriptive Profile and the Digital Divide

The descriptive evidence reveals a pronounced asymmetry in digital adoption between tourism and agricultural enterprises. Tourism businesses reported some degree of digital technology use, with adoption concentrated primarily in supply coordination (32.00%) and inventory control (30.67%), followed by data management (13.16%) and e-government applications (13.16%). Nevertheless, digital adoption coexists with largely informal procurement structures: 72% of tourism enterprises reported relying on informal procurement arrangements, while 35.62% maintained direct sourcing relationships with farmers. This combination suggests that digitalization within tourism enterprises remains more developed at the operational level than at the level of formalized intersectoral coordination.

Agricultural enterprises display a substantially different digital profile. Overall, 72.73% reported no use of digital technologies, while adoption among the remaining enterprises was limited and concentrated in specific functions, particularly forecasting (16.67%) and e-government services (12.50%). Agricultural marketing also remained predominantly embedded in conventional channels, with direct sales accounting for 47.37% and personal networks continuing to play an important role. As shown in Table 1, the largest sectoral disparities occur in inventory control and supply coordination, whereas differences are considerably smaller for e-government, forecasting, and marketing applications. The pattern therefore indicates not simply a difference in the overall level of digitalization, but an uneven distribution of digital capabilities across functions that are particularly relevant to tourism–agriculture value-chain coordination.

Table 1: Technology Application Patterns by Sector (%)

Application Area	Tourism	Agriculture
Data Management	13.16	5.26
Inventory Control	30.67	2.63
Supply Coordination	32.00	3.95
E-Government	13.16	12.50
Forecasting	9.21	16.67
Marketing	8.42	8.77

Source: Author's calculation

4.2. Factor Analysis: The Latent Structure of Technology Adoption

Principal Component Analysis identified three factors with eigenvalues greater than 1, jointly explaining 68.34% of the total variance. Sampling adequacy was satisfactory (KMO = 0.723), while Bartlett's test of sphericity was statistically significant ($\chi^2 = 328.45$, $p < 0.001$), supporting the factorability of the data.

The first factor, Operational Capability, explained 32.17% of the variance and was primarily represented by inventory control (0.842), supply coordination (0.816), and production planning (0.791), with strong internal consistency (Cronbach's $\alpha = 0.842$).

The second factor, Market Connectivity, accounted for 21.45% of the variance and was characterized by e-marketing (0.845), customer relations (0.812), and market information access (0.783), with Cronbach's $\alpha = 0.791$. The third factor, Administrative Capacity, explained a further 14.72% of the variance and comprised e-government (0.835), record keeping (0.806), and financial management (0.792), with Cronbach's $\alpha = 0.734$.

The resulting three-factor structure indicates that digital adoption within the sampled enterprises is multidimensional rather than uniform, distinguishing capabilities related to internal operations, external market connectivity, and administrative functions. Operational Capability captures the digitalization of core production and coordination processes; Market Connectivity reflects digitally enabled interaction with markets and customers; and Administrative Capacity represents the integration of digital tools into regulatory, financial, and record-management activities. This differentiation provides an empirical basis for examining digitalization beyond aggregate adoption rates and for assessing how distinct digital capabilities relate to tourism–agriculture value-chain integration.

4.3. Digital Capabilities and Value-Chain Integration

Correlation analysis revealed a strong positive association between the composite technology adoption score and Local Product Integration ($r = 0.672$, $p < 0.01$). Operational Capability was also positively associated with supply-chain reliability ($r = 0.534$, $p < 0.05$). These relationships indicate that higher levels of digital adoption, particularly in operational functions, are systematically linked to stronger indicators of tourism–agriculture value-chain coordination.

Group comparisons further revealed substantial performance differentials between enterprises with above-median technology adoption and those with low or no adoption.

Higher-adoption enterprises reported an average Local Product Integration rate of 58%, compared with 45% among low/non-adopters, corresponding to a relative difference of **28.9%**. Similar patterns were observed for inventory turnover, supply-chain costs, and perceived product quality (Table 2).

Table 2: Performance Differentials between Higher- and Low/Non-Digital Adopters

Performance Metric	Higher Adopters	Low/Non-Adopters	Relative Difference
Local Product Integration (%)	58%	45%	+28.9%
Inventory Turnover (annual rate)	5.2	3.9	+33.3%
Supply Chain Cost (% of revenue)	18.5%	23.7%	-21.9%
Perceived Product Quality (1-5 scale)	4.1	3.7	+10.8%

Source: Author's calculation

The comparison shows that higher-adoption enterprises had 28.9% greater local product integration, 33.3% higher inventory turnover, and 21.9% lower supply-chain costs, along with a 10.8% higher perceived product-quality score. These differences are consistent with the proposition that stronger digital capabilities coexist with more integrated and operationally coordinated value-chain configurations. Given the observational and cross-sectional design, however, these differentials should be interpreted as descriptive associations rather than causal effects of technology adoption.

The multivariate analysis reinforces this pattern. When Local Product Integration is the dependent variable, Operational Capability is the strongest positive predictor ($\beta = 0.482$, $p < 0.01$), followed by Market Connectivity ($\beta = 0.315$, $p < 0.05$).

Administrative Capacity is not statistically significant. The results therefore distinguish among forms of digital capability: operational and market-oriented capabilities are more strongly associated with tourism–agriculture integration, whereas administrative digitalization alone shows no significant relationship with integration. Taken together, the correlation, group-comparison, and regression evidence suggests that the relevance of digitalization lies not simply in whether technology is adopted, but in which digital capabilities are developed and how closely they relate to intersectoral coordination.

4.4. The Digital Divide as a Structural Constraint on Value-Chain Integration

The finding that 72.73% of agricultural enterprises reported no adoption of digital technology indicates a structural asymmetry within the tourism–agriculture value chain rather than a simple difference in technology use.

While tourism enterprises have adopted digital tools primarily for operational coordination and inventory management, agricultural producers remain largely confined to limited administrative and forecasting applications, creating uneven digital capabilities across interconnected sectors.

This asymmetry has direct implications for intersectoral coordination. Tourism enterprises seeking to increase local sourcing operate within a value chain in which many agricultural suppliers still rely on analog production, communication, and transaction processes. Consequently, digital coordination mechanisms for inventory synchronization, supply planning, and information exchange remain unevenly distributed among actors in the same rural value chain.

The factor structure offers additional insight into this imbalance. Administrative Capacity appears to reflect the diffusion of compliance-oriented digital functions, whereas Operational Capability and Market Connectivity capture digital capabilities related to production coordination, supplier interaction, and market integration. Both descriptive and regression results consistently indicate that these capabilities are more strongly associated with Local Product Integration than administrative digitalization alone.

Taken together, the evidence suggests that the principal challenge for smart agri-tourism value chains is not only expanding digital adoption but also reducing functional asymmetries in digital capabilities between tourism enterprises and agricultural producers. Strengthening operational and market-oriented digital capabilities across both sectors is therefore a prerequisite for more coordinated, traceable, and locally integrated rural value chains.

4.5. From Smart Destinations to Smart Value Chains

The findings extend the logic of smart destinations to the concept of smart value chains, emphasizing that destination-level digitalization depends not only on the technological capabilities of individual firms but also on the degree of digital alignment among interconnected economic actors. In agri-tourism, a value chain cannot be considered fully "smart" if tourism enterprises develop operational and market-oriented digital capabilities while agricultural suppliers remain largely disconnected from comparable digital infrastructures.

Smart integration therefore implies a shift from firm-level adoption to intersectoral digital coordination, enabling information, transactions, sourcing decisions, and product traceability to circulate more effectively across tourism and agricultural actors.

The empirical patterns observed in Northern Albania reinforce this distinction. Higher-adoption enterprises exhibit greater local product integration and inventory turnover and lower supply-chain costs than low/non-adopters. Operational Capability and Market Connectivity show the strongest associations with Local Product Integration.

These findings suggest that the relevance of digitalization for agri-tourism lies less in the presence of individual technologies than in their capacity to support complementary functions across the value chain.

Smart value-chain integration can therefore be conceptualized as the alignment of digital capabilities across operational, market, and interorganizational interfaces, enabling agricultural production and tourism demand to be more closely coordinated.

From this perspective, digital tools such as shared supply information, digitally supported procurement, product traceability, and integrated payment mechanisms represent potential interfaces through which otherwise fragmented actors may connect within a common information environment. Rather than isolated technological upgrades, these mechanisms demonstrate how digital capabilities can support a transition from fragmented sectoral digitalization toward a more coordinated rural ecosystem. Accordingly, the study positions smart value-chain integration as an intersectoral capability, extending the smart-destination perspective beyond the digitalization of tourism enterprises to the digital connectivity of the wider territorial production system.

4.6. From Digital Barriers to Enabling Conditions

The observed digital asymmetry suggests that strengthening tourism–agriculture integration requires attention to the conditions under which digital capabilities can develop across both sectors. Financial constraints may be addressed through targeted support mechanisms that reduce the upfront costs of technology adoption, while improvements in rural broadband and mobile connectivity are an important infrastructure condition for digitally coordinated value chains.

Equally important is developing human capital by integrating digital competencies into agricultural extension services and tourism-oriented vocational training. At the institutional level, collaborative mechanisms such as innovation hubs, living labs, cooperatives, and business associations may provide spaces for knowledge exchange, technology demonstration, and coordination between agricultural producers and tourism enterprises. Rather than treating these interventions independently, the findings point toward an integrated policy approach in which infrastructure, capabilities, finance, and institutional coordination operate as complementary enabling conditions for smart value-chain integration.

4.7. A Multi-Layer Framework for Smart Agri-Tourism Integration

Building on the empirical findings and the macro-regional perspective presented by Ndou et al. (2023), this study proposes a Multi-Layer Smart Agri-Tourism Integration Framework that conceptualizes digital transformation as an interconnected process operating across four levels. The Data and Technology Layer comprises the digital infrastructure through which information is generated, transmitted, and managed, including mobile applications, cloud-based systems, IoT-enabled technologies, and traceability solutions. Its effectiveness depends on adequate connectivity and accessibility, linking technological adoption directly to the infrastructural conditions of rural territories.

The Business Process Layer captures the application of these capabilities to operational activities, including production planning, digital procurement, inventory management, market communication, and digitally supported tourism services.

The Value-Chain Integration Layer represents the interorganizational dimension that connects digital information and processes among agricultural producers, intermediaries, and tourism enterprises, supporting sourcing coordination, information exchange, traceability, and collaborative planning. Finally, the Ecosystem and Governance Layer encompasses the institutional conditions surrounding these interactions, including public policy, cooperatives, business associations, skills-development initiatives, financial support mechanisms, and macro-regional cooperation networks.

The framework therefore conceptualizes smart integration not as the accumulation of individual technologies, but as the progressive alignment of technological infrastructure, enterprise capabilities, interorganizational coordination, and territorial governance.

This interpretation aligns with the study's empirical distinction among Operational Capability, Market Connectivity, and Administrative Capacity, and extends these firm-level dimensions to the broader value chain and ecosystem levels. In this sense, digitally enabled agri-tourism marks a transition from isolated technology adoption to a territorially embedded system in which digital capabilities enable stronger coordination between tourism demand and local agricultural supply.

5. Conclusion

This study provides empirical evidence that digitalization within rural tourism–agriculture systems is characterized not only by differences in technology adoption but also by structural asymmetries in the distribution of digital capabilities across interconnected sectors. Evidence from Northern Albania shows that tourism enterprises exhibit substantially greater engagement with digital technologies, whereas 72.73% of agricultural producers report no digital adoption, creating an uneven technological environment within the same territorial value chain.

The identification of Operational Capability, Market Connectivity, and Administrative Capacity further demonstrates that digitalization is multidimensional, while correlation, group-comparison, and regression results consistently associate stronger operational and market-oriented capabilities with higher levels of local product integration and more favorable operational characteristics. These findings reinforce the argument that the strategic relevance of digitalization lies less in technology adoption per se than in the alignment of complementary digital capabilities across tourism and agriculture, supporting the conceptualization of smart value-chain integration as an intersectoral capability embedded within the wider rural ecosystem.

From a policy perspective, this interpretation shifts attention from isolated technology subsidies toward an integrated enabling environment combining rural connectivity, digital skills, accessible financing, institutional coordination, and digitally supported producer–tourism networks; for development agencies and business organizations, it similarly emphasizes collaborative mechanisms capable of connecting small agricultural producers with more digitally advanced tourism

enterprises rather than treating sectoral digitalization independently. The findings should nevertheless be interpreted within the boundaries of the research design: the cross-sectional and geographically concentrated sample limits causal inference and broader generalization, while self-reported measures may introduce reporting and measurement biases. Future research should therefore examine these relationships longitudinally, evaluate specific digital interventions through appropriate experimental or quasi-experimental designs, and test the proposed smart value-chain framework across other Balkan and Mediterranean rural destinations. Further attention to the socio-cultural dimensions of technology adoption and to emerging applications of advanced analytics and artificial intelligence may additionally clarify how different technological trajectories shape intersectoral coordination. Overall, the study advances the discussion from digital adoption toward digital alignment, suggesting that the development of smart agri-tourism systems depends on the capacity of territorially connected actors to build compatible operational, market, and institutional capabilities rather than on the technological advancement of individual enterprises alone.

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BUDGET CONSTRAINT IMPACT ON FOOD PREFERENCES IN ECONOMIC UNCERTAINTY

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Abstract

Bulgaria's transition to the Eurozone at the beginning of 2026 was marked by economic uncertainty. Pricing was marked in both the local currency - Bulgarian LEV, and the common European one – EURO for the latter half of 2025. This specific effort by the local government has had limited success regarding consumer confidence and economic stability. Most consumers were wary of market inflation and were concerned about having to restrain their food budgets. This study was conducted during the first half of February 2026 to evaluate the impact of these constraining actions on the food preferences of consumers.
Consumer reaction to economic uncertainty, especially concerning food consumption pattens holds a significant importance for the development of a country. The budgetary constraints in these conditions are not limited to just food, but also impact all other consumer goods, as the population shifts a larger portion of its income towards covering its food security. The impact on these models for adaptation to economic uncertainty of local consumers is reveled through their preferences shifts, and is the main topic of this study.

Keywords: Inflation, Consumer behavior, Food security, Currency transition.

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1. Introduction

The adoption of the common European currency – the Euro in Bulgaria on 1 January 2026 led to a period of significant economic uncertainty among the population. In the second half of 2025, the country introduced a requirement for dual price indication (in the local currency "Lev" and Euros) to prepare consumers (European Commission, 2026). Despite these measures, the transition was accompanied by growing concerns about inflation and price speculation. Official data indicate meaningful inflationary dynamics. At the end of 2025 (December), annual inflation, measured by the Consumer Price Index (CPI), was 5.0% (National Statistical Institute [NSI], 2026). However, the trend accelerated dramatically in the first half of 2026. In April 2026, Bulgaria reported the highest annual inflation among the euro area countries – 6.8% in terms of the national CPI and 6.0% in terms of the Harmonized Index of Consumer Prices (HICP) (NSI, 2026, April). This peak continued in May 2026, when annual inflation reached 6.9% (CPI), while the average for the European Union and the euro area was significantly lower – 3.3% and 3.2%, respectively. Only in June 2026 was there a slight calming down to 5.4% (Eurostat, 2026).

In conditions of economic instability, budget constraints cease to be an isolated financial problem and become a leading factor determining the pattern of behavior. When households are forced to allocate an increasing percentage of their income to ensure their food security, this directly reflects on the consumption structure of all other groups of goods and services. This analysis examines how these budget constraints change the food preferences of Bulgarian consumers in the first half of 2026.

2. Theoretical Background

Consumer behavior under inflation is primarily explained through changes in purchasing power, household budget constraints and the reallocation of expenditures. As food prices increase, households adjust their consumption patterns by reducing discretionary expenditures, substituting expensive products with cheaper alternatives or purchasing smaller quantities. The extent of these adjustments depends on income, consumer preferences and the availability of substitute goods. Economic theory therefore predicts that persistent food inflation alters both the quantity and composition of household food consumption (Timmer, 1997).

A fundamental concept explaining household food expenditure is Engel's law, which states that although absolute food expenditure increases with income, the proportion of household income allocated to food declines as income rises. Consequently, lower-income households are considerably more vulnerable to increases in food prices because food accounts for a larger share of their total expenditure. During periods of inflation, these households experience a stronger reduction in real purchasing power and are therefore more likely to modify their consumption behavior. Modern empirical research further demonstrates that income growth is associated not only with lower food expenditure shares but also

with greater dietary diversity and higher-quality food consumption (Chai & Moneta, 2010; Cirera & Masset, 2010).

The response of consumers to changes in food prices is commonly analyzed through the concept of price elasticity of demand. Price elasticity measures the responsiveness of the quantity demanded to changes in price. Food products generally exhibit relatively inelastic demand because they represent essential goods; however, elasticity differs considerably across food categories. Staple foods such as bread and cereals usually display lower price elasticity than higher-value products such as fish or premium meat products. Price increases also generate a substitution effect, whereby consumers replace relatively expensive products with cheaper alternatives while attempting to maintain overall food consumption. Simultaneously, an income effect reduces households' real purchasing power, limiting their ability to purchase the same quantities as before. The interaction of these two effects explains why inflation often changes the structure of food consumption even when total food expenditure remains relatively stable (Timmer, 1997; OECD, 2013).

These theoretical relationships are closely connected with the concept of food security, which extends beyond the physical availability of food to include economic access to sufficient, safe and nutritious food. According to the Food and Agriculture Organization (FAO), rising food prices disproportionately affect vulnerable households because they spend a larger share of their income on food. Consequently, inflation may reduce dietary quality even when food remains physically available on the market. The relationship between food prices, purchasing power and food security has therefore become an important area of research, particularly during periods of macroeconomic uncertainty and structural economic change such as currency integration (Timmer, 1997; OECD, 2013).

The present study builds on these theoretical foundations by examining whether the food price developments observed during Bulgaria's transition to the euro are associated with changes in consumer perceptions and household purchasing behavior. By combining official HICP statistics, household consumption data and survey evidence, the study evaluates whether the observed behavioral responses are consistent with established theories of consumer demand, price elasticity and food security.

3. Materials and Methods

This study applies a mixed-methods research design to examine how budget constraints associated with the introduction of the euro influenced food preferences among Bulgarian consumers during the first months of 2026. The methodological framework integrates primary survey data with official macroeconomic statistics in order to compare subjective consumer perceptions with objective indicators of food price developments.

Primary data were collected through a structured online questionnaire administered between 26 January and 8 February 2026, immediately after Bulgaria's adoption of the euro. Restricting the survey to this relatively short period allowed the study to capture consumer reactions during the initial phase of

the currency transition, before subsequent market adjustments could substantially influence purchasing behaviour. The questionnaire was distributed mainly among households in the Southeastern region of Bulgaria, yielding 156 valid responses representing different age groups, household compositions, income levels and food expenditure patterns.

The empirical analysis combines survey findings with official statistical information obtained from Eurostat and the National Statistical Institute (NSI). Harmonised Index of Consumer Prices (HICP) data for selected food categories were used to measure objective price developments during the period from September 2025 to June 2026. To facilitate comparison with the survey results, relative changes in food price indices were calculated using September 2025 as the reference period.

By integrating survey evidence with official HICP statistics and household consumption data, the study applies a triangulation approach that enhances the robustness and credibility of the empirical findings.

To examine the relationship between perceived price increases and intended changes in food consumption, Pearson's correlation coefficient was applied. The correlation analysis evaluates the strength and direction of the association between respondents' perceptions of food price inflation and their declared intentions to reduce or substitute specific food products.

The combination of official inflation indicators and household survey data provides a comprehensive assessment of consumer adaptation strategies during a period of economic uncertainty, allowing both the objective dynamics of food prices and the behavioural responses of households to be analysed within a unified methodological framework.

4. Research and Discusion

To understand the objective reasons behind consumer pessimism, it is necessary to follow the official statistics on the Harmonized Index of Consumer Prices (HICP), provided by Eurostat and the National Statistical Institute (NSI).

Eurostat data clearly show that inflationary pressure in the group of food and non-alcoholic beverages is outpacing the growth rate of the average wage for the same period.

Table 1. Changes in food price indices during the euro adoption period (2025 = 100)

Food category	Sept. 2025	June 2026	Change (%)	Expected consumer response
Food	100.43	102.30	+1.86	Higher concern about food expenditure
Meat and meat products	101.06	101.13	+0.07	Reduced meat purchases
Fish and other seafood	101.73	106.42	+4.61	Strong reduction in purchases
Milk, other dairy products and eggs	100.57	100.95	+0.38	Brand substitution
Cereals and cereals	100.75	101.83	+1.07	Consumption largely maintained

products				
Fruit and nuts	106.36	108.96	+2.44	Lower quantities purchased
Vegetables	94.60	105.42	+11.44	Seasonal purchasing and reduced consumption

Source: Eurostat (HICP, 2026).

According to official Eurostat data as of January/February 2026, a clear monthly and annual change in the price levels of the main food categories in Bulgaria was observed. Table 1 demonstrates a clear relationship between official food price inflation and the behavioural responses observed in the survey. Food categories with the highest HICP values, particularly meat, dairy products, and fruit and vegetables, correspond to the products respondents most frequently intend to reduce or substitute. Conversely, bread and cereals exhibit relatively stable demand despite continued price increases, confirming their role as essential goods with low price elasticity. These findings suggest that budget constraints lead households to replace high-value protein foods with lower-cost carbohydrate-based alternatives, indicating a deterioration in dietary quality under conditions of economic uncertainty.

Vegetables exhibit the highest relative increase (+11.44%), while cereals show only modest growth (+1.07%). This indicates that inflation affected food categories unevenly, forcing households to prioritise staple foods while reducing purchases of more expensive or nutritionally valuable products. These price increases for fruits and vegetables during the winter/spring period are common for Bulgarian food markets, as currently most of these products are imported. Large food retailers have a significant impact on the prices of these products. During periods of economic uncertainty these retailers can increase prices for local consumers as an adaptation strategy to mitigate market risk.

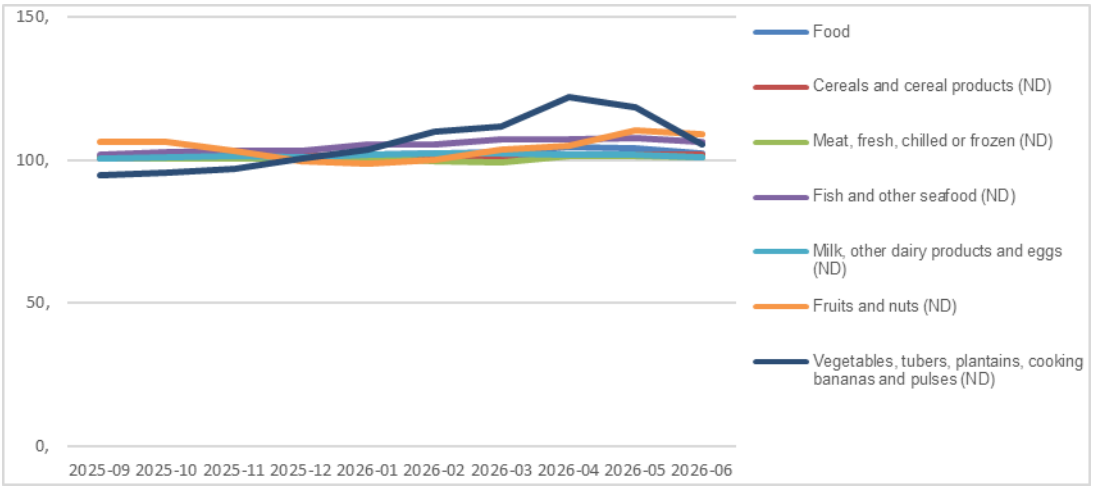


Figure 1. HICP trends for selected food categories in Bulgaria, September 2025 – June 2026 (2025 = 100)

Source: Author's own research

Figure 1 illustrates the monthly evolution of HICP values for the selected food categories between September 2025 and June 2026. While cereals and dairy

products remained relatively stable throughout the observed period, vegetables and fish displayed considerably stronger upward dynamics, particularly during the spring months of 2026. The graphical trends support the evidence presented in Table 1 and reinforce the conclusion that price increases differed substantially across food categories.

The official HICP statistics provide an objective data on food consumption and create a base for comparison with the data observed in the survey. The following section investigates whether these price developments are statistically associated with consumers' purchasing decisions.

The official household consumption statistics for selected food groups based on the National Statistical Institute's Household Budget Survey is presented in Table 2. Unlike the HICP, which measures price developments, this data reflects actual quantities of food consumed by households and therefore provide an objective measure of behavioural adaptation to changing economic conditions.

Table 2. Quarterly household consumption of selected food products in Bulgaria

Food group	Q1 2024	Q4 2024	Q1 2025	Q4 2025	Change Q1 2024 - Q1 2025 (%)	Change Q4 2024 - Q4 2025 (%)
Bread and paste products (kg)	18.0	16.9	16.9	16.8	-6.1	-0.6
Meat (kg)	10.0	10.2	10.2	10.4	+2.0	+2.0
White cheese (kg)	2.8	2.7	2.7	2.7	-3.6	0.0
Fresh milk (l)	4.9	5.0	5.0	4.8	+2.0	-4.0
Fruit (kg)	12.4	13.7	12.9	13.7	+4.0	0.0
Vegetables (kg)	14.3	17.3	14.5	17.3	+1.4	0.0

Source: NSI, 2026

The data reveal relatively modest changes in food consumption despite the observed increase in food prices. Consumption of bread and paste products declined by approximately 6.1% between the first quarter of 2024 and the first quarter of 2025, whereas meat consumption increased slightly (+2.0%). Fruit and vegetable consumption remained broadly stable, suggesting that households attempted to preserve the intake of nutritionally important products despite increasing food prices.

These findings create a base for comparison with the survey results in an important way. While the two studied periods are different due to data availability, the dynamics of food consumption for the previous period (through 2025) formulates the background for consumer perception.

Taken together, the HICP statistics, household consumption data and survey responses provide a comprehensive picture of consumer adaptation during the initial phase of Bulgaria's euro adoption. Price increases can created significant financial pressure on households; however, the adjustment process can also involve gradual modifications in purchasing strategies rather than abrupt reductions in overall food consumption.

The triangulation of survey evidence, official price indices and household consumption statistics strengthens the validity of the findings by demonstrating

that consumer perceptions can be interpreted alongside objective economic indicators rather than in isolation.

In order to access consumer's perception of food price changes after the full adaptation of the common currency of the EU in Bulgaria, as a period of uncertainty, we have conducted a survey with 156 participants. The questionnaire was divided in to three key parts – household information including size, income, food expenditure, etc., consumer perception of price changes for the main food groups (grouping was based on the models used in national statistics and the local food traditions) and consumers planned changes in food consumption based on their perception of price changes. The survey was conducted during the last week of January 2026 and the first week of February 2026, as the beginning of the period of full adaptation of the Euro, as well as during the period of uncertainty, that have already begun with both prices (in local currency – "Lev" and Euro) being shown for all products since July 2025.

The results from the survey have shown that consumers largely perceive food prices as increasing, with some of them selecting the option of "by more than 30%". At the same time this information was no supported by statistical data, that have shown an increase of 3% for all food products (Based on data from Eurostat database – HICP for the period from September 2025 to February 2026). That skewed personal perception of food price hikes was evident among all age groups and household sizes. The main reason for that phenomenon was the media's focus (traditional and contemporary) on every case of price increase or difference between other countries in the EU that have adopted the Euro already. These key results from the survey data has let us to conclude that consumers perceive this period as one of economic uncertainty and thus may employ different strategies to adapt to it.

In order to analyze how consumers, adopt to that perceived uncertainty we used Pearson's correlation to find a connection between the reported food price increase and changes in food purchasing patterns of consumers. The correlation information is displayed in Table 3.

Table 3. Pearson's correlation between price change perception among consumers and the planned reduction of consumption of key food groups

Planned reduction in the consumption of:	Cereals and bread	Meat	Fish	Milk and dairy products	Oils and fats	Fruits	Vegetables
Consumer perception of price increase in the price of cereals and bread	**0.1504**	0.1554	0.0977	0.0720	0.1504	0.1213	0.2355
Consumer perception of price increase in the price of meat	0.1500	**0.1969**	0.1526	0.1980	0.1500	0.1527	0.2605
Consumer perception of price increase in the price of fish	0.2098	0.2098	**0.1576**	0.1950	0.2098	0.0687	0.1351
Consumer perception of price increase in the price of	0.1974	0.0659	0.0683	**0.3395**	0.1974	0.0759	0.0089

milk and dairy products							
Consumer perception of price increase in the price of oils and fats	0.1568	0.2077	0.1353	0.2212	**0.1568**	0.0622	0.0635
Consumer perception of price increase in the price of fruits	0.1306	0.1193	0.1270	0.1746	0.1306	**0.1496**	0.2005
Consumer perception of price increase in the price of vegetables	0.0719	0.0898	0.1691	0.0554	0.0719	0.0742	**0.1403**

Source: Calculated based on own survey conducted in February 2026

As evident by the correlation data there is a complete lack of strong or even moderate correlation between consumer's perception of price increase for food groups and the following planned reduction of consumption for the same food group. We also analyzed the crossed correlation in case of food groups substitution – the price increase of one food group leading to the increased consumption of another (which would appear as a negative correlation in the table). This substitution effect is entirely missing in reported results.

The only case with weak correlation is reported for dairy products, where the coefficient of 0.3395 shows that some consumers may lower the intake of these products due to their price increase. Other notable correlation is the reported willingness to reduce consumption of fresh vegetables due to the price increase of three food groups – bread and cereals, meat and meat products and fruits. Although being weak that correlation shows consumer willingness to change their purchasing patterns and exclude food groups that they perceive as more expensive per calorie.

The other two food groups that might see a decrease in consumption are animal products, mainly meat and dairy products. Overall the correlation data proves that consumers perceive food prices as increasing but they are yet to feel impacted by economic uncertainty and thus are not planning to change anything in their purchasing patterns for food, as 65% of all surveyed consumers have declared.

In order to further analyze the real changes in food purchase during the same period – from August 2025 to May 2026 we have used statistical data from Eurostat Database, concerning the retail trade of all consumer goods (excluding motor vehicles), food and beverages, as well as non-food products and fuel based on sales volumes and net turnover. These two key indicators will allow us to access any significant price changes in these four groups. The selected data is shown in Figure 2.

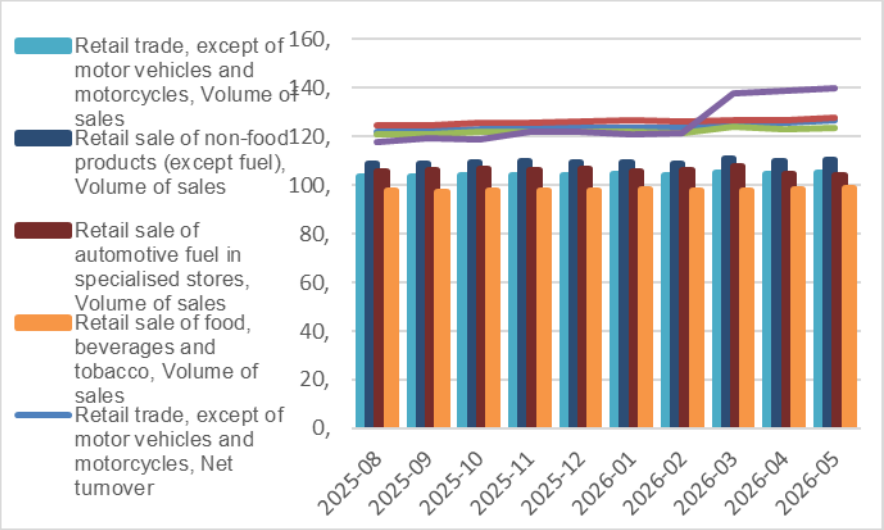


Figure 2. Net turnover and volume of sales in wholesale and retail trade – monthly data in Bulgaria, August 2025 – May 2026 (2021 = 100) (Seasonally and calendar adjusted data), Source: EUROSTAT database

During the studied period the harmonized data adjusted for seasonality of trade proves no significant change in the volume of sales of any of the four groups. Specifically, food products have actually increased their sale volume throughout the period and by the end have reached the levels achieved in 2021 (the year used as base). The same pattern is displayed for all consumer goods (except motor vehicles) with the values not fluctuation in any significant way, as the volumes increase from 103.7% to 105% overall. These patterns prove that consumers do not yet feel budgetary constraints during the studied period and although they perceive it as economically uncertain, that perception is not significantly enough founded in reality and thus consumers are unwilling to change anything about their purchases.

At the same time another significant process is displayed in the presented data. The net turnover of retail trade is increasing slowly for most groups, but rapidly for fuels. The net turnover for food products is increasing from 124.9% to 127.8%, and considering the lack of increase in sale volumes supports the reported 3% price increase of food products in the country during this period. The same pace of price increase is evident for non-food products as well (excluding fuels) – exactly 3% during the studied period.

The pattern is very different for the retail market for fuels. The available data for fuel volume sales and net turnover displays a rapid price increase, as the volume of sales decreases from 105.9% to 104.1%, as net turnover increases from 118% to 139.8%. The data clearly shows an increase of the price of fuels of over 20% for the period. Such rapid rise of prices of the main energy source for the local transport industry will undoubtedly lead to further price ingresses for all consumer products and food in the future. A further analysis for future period is necessary to access the impact of that process on all consumer product groups. During the studied period the price increase of fuels have not led to any significant increase in the prices of food products, as the period from February to

May 2026 has recorded an increase over 18% net turnover for fuels and 1% for food products.

Through the conducted study of consumers, we aimed to access their strategies for adaptation to economic uncertainty in order to not compromise their household's food security. To achieve this goal, we gathered data as previously shown on their planned reduction of consumption of different key food groups. The survey data shows that only 35% of all consumers are willing to change anything about their purchasing patterns. The detailed data for that section of the survey is displayed in Figure 3.

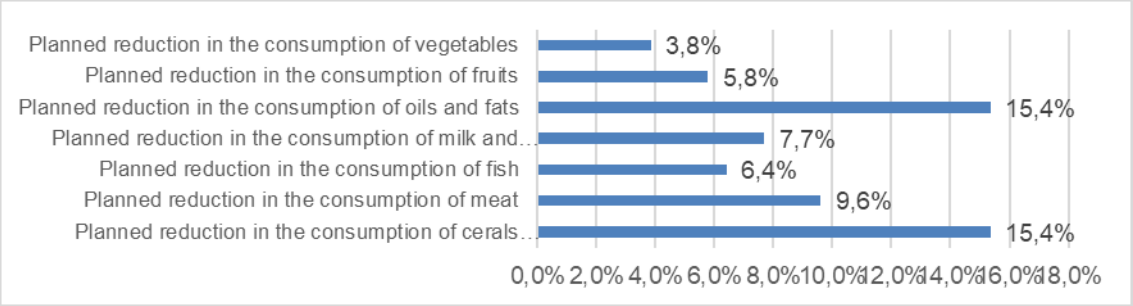


Figure 3. Planned reduction of the consumption of key food groups as a strategy for inflation adaptation of consumers,
Source: Calculated based on own survey conducted in February 2026

Consumers have stated that they are most willing to reduce their consumption of bread and cereals, as well as oils and fats - 15.4% of surveyed for both groups. These two food groups are key part of Bulgaria's culinary tradition and are consumed by local households daily. Their common characteristic is that they are also a cheap source of calories as they are both high in calories per gram. They are also commonly considered by local consumers as "unhealthy". Surveyed consumers have stated that they plan to reduce the consumption of these products in order to "live a healthier lifestyle" (one of the options in the survey for a reason of increasing/decreasing the consumption of a food group). The same opinion was shared by some of the consumers planning to lower their intake of meat and meat products. The analysis of the survey data on planned reduction of key food groups consumption again displays that consumers are not feeling budgetary constraints due to economic uncertainty at the time of survey and thus are not planning to employ any adaptation strategies. This process may evolve and change in the future, especially considering the stated significant price increase of energy sources. The significance of the process merits further study upon the availability of data for the summer months of 2026.

6. Conclusion

This study's findings demonstrate that food inflation following Bulgaria's adoption of the euro affected food categories unevenly, resulting in different consumer responses across product groups. Official HICP statistics show that vegetables recorded the largest increase during the analysed period (+11.44%),

followed by fish (+4.61%), whereas cereals and cereal products experienced only a modest increase (+1.07%). These price fluctuations have a seasonal characteristics and connected to logistical availability of imported products. These differences indicate that households were exposed to unequal price pressures depending on the type of food purchased.

The survey results are consistent with the official statistics as there was no strong or even moderate correlation between the perception of food prices increasing and planned changes in purchasing patterns. The only weak correlations were displayed for dairy products, as some consumers were willing to decrease their consumption due to perception of higher prices. Overall there was no clear pattern of adaptation to higher prices for food and surveyed consumers are only willing to change their food consumption based on their personal pursuit of a healthier diet.

Overall, the study confirms that budget constraints during the initial stage of euro adoption does not influenced the quantity of food purchased or the composition of household food consumption. Consumers are yet to employ any of the expected adaptation strategies, primarily through substitution towards lower-cost staple products. The concerning increase in price of energy sources may lead to persistent food price inflation and in turn may have important implications for dietary quality and long-term food security. Future research should investigate whether there are evident behavioural changes over time and whether a verity of adaptation patterns emerge across different regions of Bulgaria.

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DRAWDOWNS AND RECOVERY PERIODS: AN ALTERNATIVE METHODOLOGICAL PERSPECTIVE ON INVESTMENT RISK

Alexander Ganchev[1]

Abstract

The study presents an alternative approach to measuring and assessing investment risk using metrics that are primarily used in the sector of highly leveraged investment funds. These quantitative measures are based on the concept of drawdown and its duration. The aim of the paper is to outline their specific features and fundamental characteristics regarding the magnitude of losses, their duration, and the time required for recovery. The discussion systematically presents the metrics such as average drawdown, drawdown deviation, maximum drawdown, largest individual drawdown, recovery period, and drawdown duration. Their primary advantages are related to their simplicity, intuitive nature, and ease of application. Conversely, their drawbacks arise from their sensitivity to losses caused by irregular or extreme events. Therefore, the drawdown-based metrics cannot fully replace traditional risk measures but rather serve to complement the information derived from them. At the same time, drawdown-based risk metrics can be viewed as tools for assessing the quality of investment management, particularly in terms of actual performance.

Keywords: Investment Risk, Drawdowns, Drawdown Duration, Recovery Period.

1. Introduction

Traditional financial theory employs various tools to measure and assess investment risk. Many of the most widely used tools to this day are based on measuring the volatility of returns across different assets or investment instruments. Others calculate the magnitude of expected losses and the probability of their occurrence. These traditional methods have clear mathematical definitions, and their application rests on rigorous scientific foundations. Despite their methodological soundness, however, they fail to capture key aspects of risk from an investor's perspective – specifically, how declines in asset value unfold, their magnitude, duration, and the time required to recover the losses. Risk metrics based on the drawdown concept and drawdown duration are grounded in this alternative understanding of how investment risk manifests. In the financial

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sector, these metrics are particularly popular in the hedge fund industry. This is because the performance of highly leveraged investment funds is aimed primarily at achieving positive absolute returns (Ganchev, 2022). Consequently, the magnitude and nature of deviations from this objective hold significant informational value regarding the risk profiles of these funds.

Traditionally, a drawdown is defined as the percentage decline in asset value from the last known peak to the current minimum (Appel, 2009, p. 79). For illustrative purposes, this theoretical definition can be visualized in Fig. 1, which depicts the fluctuations in the net asset value per share of a hypothetical hedge fund over a specific period. Against this background, the aim of the study is to present the specific features and fundamental characteristics of non-traditional investment risk measures based on the drawdown concept, specifically regarding the magnitude and duration of losses and the time required for their recovery.

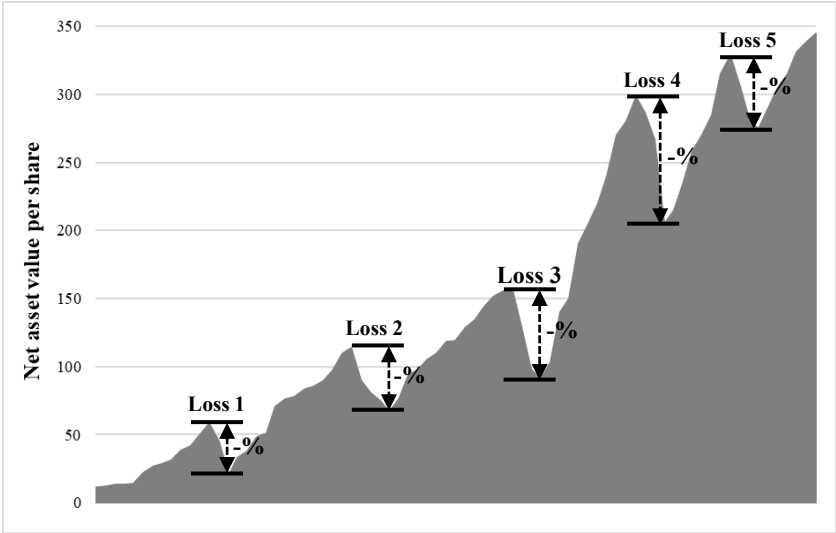


Figure 1. Graphical representation of the drawdown concept

2. Methodological framework of drawdowns and recovery periods

Generally, drawdown risk measures are quite simple and yield results that are relatively easy to interpret from an investment point of view. They do not require complex computations or assumptions about the nature of the risk, the probability distributions and confidence intervals. In other words, drawdown risk measures are not strongly related to the concepts of modern portfolio theory and are therefore not perceived as part of it. However, they are important for assessing the risk of hedge funds because the main goal of these funds is to achieve high positive returns. Since any deviation from this goal in terms of different losses should to the greatest extent reflect the understanding of risk according to the philosophy of hedge funds. Thus, the estimation of the relative losses using drawdown measures determines a hedge fund's risk characteristics that other measures objectively cannot do. What is more, or as Anson points out, the presence of losses, their absolute and relative size as well as the time to recoup

them are important indicators of the qualities and skills of hedge fund managers (Anson, 2006, p. 116).

The first measure that uses the relative losses in the net asset value to measure risk is the average drawdown. Calculated using Eq. (1), it is the average relative loss over a given period:

$$ADD = \left| \frac{\sum_{i=1}^{i=d} D_i}{d} \right| \quad (1)$$

where: ADD is the average drawdown; Di is the value of the i-th drawdown in the net asset value per share; d is the total number of the analysed drawdowns (for more details, see Stavetski, 2009, p. 52).

The arithmetic averaging in Eq. (1) inevitably means that the relative loss should be estimated using the continuously compounded returns. A very similar to the average drawdown is the drawdown deviation (DDD) presented in Eq. (2) (Bacon, 2008, p. 88). Theoretically, it is the root mean square relative loss, which means that this measure will have a greater value than the average drawdown:

$$DDD = \sqrt{\frac{\sum_{i=1}^{i=d} D_i^2}{d}} \quad (2)$$

where DDD is the drawdown deviation.

The maximum drawdown (for details see Nekritin & Peters, 2012, p. 215) that is also known as peak-to-valley drawdown in Eq. (3) is the maximum percentage loss measured between the highest and lowest net asset value per share over a specific time period or over the entire history of a hedge fund. What is special about the measure is that it is calculated before a new maximum of the net asset value is attained for a specific period, i.e. without taking into account any increase in it that is lower than the maximum value. Therefore, the maximum drawdown is the loss that could be incurred if an investor enters the hedge fund when its net asset value per share is maximal and exits the fund when it is at its lowest level:

$$MDD = \frac{NAVS_{MIN}}{NAVS_{MAX}} - 1 \quad (3)$$

where: MDD is the maximum drawdown; $NAVS_{MIN}$ is the minimal net asset value per share; $NAVS_{MAX}$ is the maximal net asset value per share.

Unlike maximum drawdown, the measure in Eq. (4) shows the largest individual loss incurred within two consecutive points in time (see Bacon, 2021, p. 108), between which there is no growth in the net asset value. Thus, it is a negative return relative to the previous observation. That is why the measure is also known as largest individual drawdown or uninterrupted drawdown. Note that

in certain cases the largest individual drawdown can be equal to the maximum drawdown. Due to the characteristics of the processes in modern financial markets, this is a theoretical rather than a real possibility:

$$LDD = \frac{NAVS_{MIN,t}}{NAVS_{MAX,t-1}} - 1 \quad (4)$$

where: LDD is the largest individual drawdown; $NAVS_{MIN,t}$ is the minimal net asset value per share at moment t; $NAVS_{MAX,t-1}$ is the maximal net asset value per share at moment t-1.

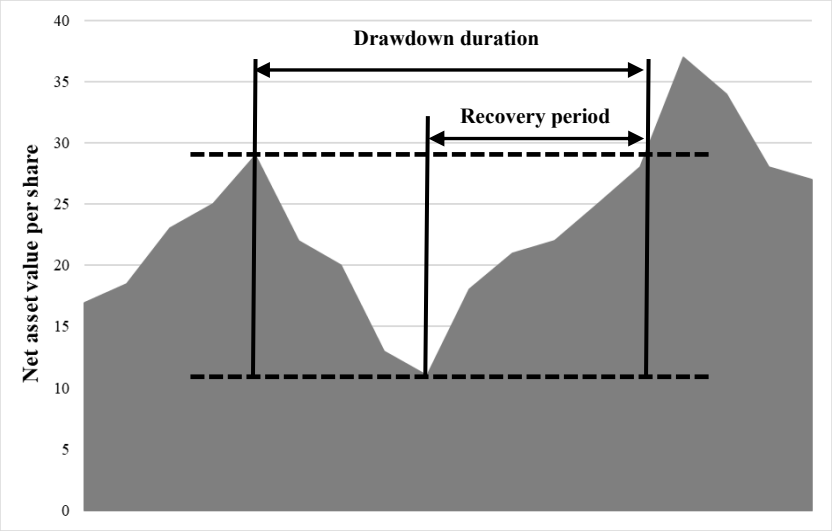


Figure 2. Recovery period and drawdown duration

Another concept related to maximum drawdown is the recovery period. This is the time (days, months, years) during which the growth in net asset value fully covers an incurred individual loss. On the other hand, the time interval combining the duration of the incurred individual loss and the recovery period is usually referred to as drawdown duration.

A common disadvantage of all drawdown measures is their sensitivity to losses caused by irregular or extreme events. Such events can greatly compromise their reliability, and this is especially true for the maximum drawdown and the largest individual drawdown. Therefore, their application should take into account the duration, frequency and characteristics of the database used in the calculations. Another solution to this problem is to use the average drawdown and drawdown deviation measures, which due to their methodology minimize the commented shortcomings.

3. Conclusion

The study has presented unconventional methods for measuring and assessing investment risk, the philosophy of which differs from the models, tools,

and methods traditionally used and widely accepted in investment theory. To a large extent, the measures explored can be classified as highly simplified, intuitive, and easy to apply. Consequently, they are used in investment practice to assess risk characteristics that volatility- or probability-based tools cannot objectively capture – such as the magnitude of the loss, its duration, or the time required for recovery. In other words, these are tools for assessing the quality of investment management. However, despite their advantages, drawdown measures also have significant drawbacks related to their sensitivity to extreme events. Thus, they cannot depict the full picture of investment risk but rather complement it with important elements that would otherwise be missing. Therefore, empirically testing them – either in conjunction with or in comparison to traditional risk assessment approaches – represents a possible direction for further research on the topic of the study.

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THE EVOLUTION OF ECONOMIC PLANNING FROM STATIC TO DYNAMIC MODELS IN THE CONTEXT OF DIGITAL TRANSFORMATION

Nadezhda Veselinova[1]

Abstract

This study examines the conceptual evolution of economic planning under the influence of digital transformation, focusing on the transition from static to dynamic models. The relevance of the problem is justified, arising from the increasing nonlinearity of economic processes and information overload, which question the effectiveness of traditional planning approaches. The formulated goal is to trace and analyze the conceptual evolution of economic planning, and the main thesis is that digital transformation is a catalyst for conceptual change, not just a technological superstructure. The essence of economic planning is also defined and the main approaches such as directive and indicative planning are considered. Classical static models are analyzed, including balance models and linear forecast models, outlining their characteristics and significant limitations. A historical review of the origin of dynamic models, associated with the works of Ragnar Frisch and Jan Tinbergen, and their subsequent development to modern dynamic stochastic models of general equilibrium, is made. Digital transformation is also considered as a factor for conceptual change. Its main dimensions according to the OECD framework are presented. The impact of digitalization on economic planning is analyzed through three key mechanisms: real-time data and analytics, artificial intelligence and machine learning, as well as simulation environments and digital twins. Challenges to planning in a digital environment are outlined as technological, institutional, human capital-related, process and measurement. The main conclusion is that dynamic models, with their adaptability and scenario flexibility, are not just a technological choice, but a strategic necessity for modern economic management in an increasingly unpredictable world.

Keywords: economic planning, digital transformation, adaptive planning, dynamic systems, conceptual evolution

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1. Introduction

The modern economic environment is characterized by increasing turbulence, non-linearity, and information overload, which challenge the effectiveness of traditional economic planning approaches (Abramov, 2026). Digital transformation is emerging as a comprehensive process of integrating modern technologies into economic and societal systems wherein static planning models-based on linear forecasts and the extrapolation of past trends-increasingly prove inadequate. This necessitates a rethinking of the conceptual foundations of planning and the pursuit of dynamic approaches capable of processing large datasets in real time and adapting to rapidly changing conditions (Seleznova & Khvostikov, 2025).

The relevance of this topic stems from the need to overcome the fragmented nature of digitalization and to construct a holistic theoretical framework for the evolution of planning (Rezazadeh et al., 2026). Most publications focus on the microeconomic level, whereas the conceptual evolution of planning as a scientific discipline-and the transition from static to dynamic models at the macro and meso levels-remains under-researched. There is a lack of systematic theoretical analysis that traces this shift not merely as a series of technological improvements, but as a change in scientific paradigm (Rezazadeh et al., 2026). This report aims to fill precisely this gap. The aim of the study is to trace and analyze the conceptual evolution of economic planning under the influence of digital transformation, focusing on the shift from static to dynamic models. The objectives include: defining the nature of static and dynamic models; identifying key aspects of digital transformation as drivers of change; conducting a comparative analysis of the two model types; outlining practical implications and challenges; and formulating directions for future research.

The object of the study is economic planning as a managerial decision-making process, while the subject is its conceptual evolution driven by digital transformation (Seleznova & Khvostikov, 2025). The central thesis is that digital transformation is not merely a technological overlay but a catalyst for conceptual change, leading to the replacement of static models with dynamic, adaptive systems (Abramov, 2026); these systems do not aim to precisely forecast a single future state but rather focus on continuous adaptation, scenario modeling, and real-time decision-making (Seleznova & Khvostikov, 2025).

To achieve these objectives, the study employs system analysis, comparative analysis, logical generalization, and conceptual analysis (Rezazadeh et al., 2026; Abramov, 2026; Seleznova & Khvostikov, 2025). The study is primarily theoretical, lacking empirical measurements, and covers the macro and meso levels, while microeconomic, social, ethical, and regulatory aspects are addressed only peripherally (Seleznova & Khvostikov, 2025; Rezazadeh et al., 2026).

2. Nature and Evolution of Economic Planning

Static economic planning models are mathematical constructs that describe the economy at a specific point in time without accounting for the dynamics of change or time-based dependencies between variables. They are characterized by the lowest level of mathematical complexity among various types of economic models and rely on a fixed time horizon, linear relationships, the extrapolation of past trends, and an equilibrium-based approach. Their primary limitations stem from these very characteristics: they fail to account for the time factor, do not capture non-linearities, possess limited adaptability, and simplify reality-often overlooking the long-term consequences of decisions. Nevertheless, static linear forecasting models remain useful for outlining alternative medium-term programs, and their realism is enhanced through the integration of properly specified behavioral relationships (Myronchuk et al., 2025).

Two main classes of static models stand out, with their internal structures and limitations summarized in Fig. 1. Balance models are based on a system of equations that establish an equilibrium between output and the demand for it; a classic example is the inter-industry balance (the "input-output" model). This model enables the management of the national economy's structural proportions, the monitoring of key indicators, and the selection of an optimal course of action; extensions of this approach include optimal balance models that incorporate optimization mechanisms (Harvey & Proietti, 2005).

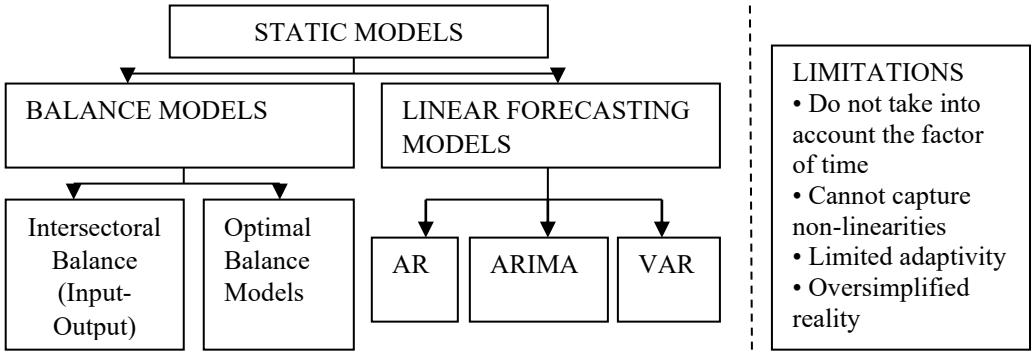


Figure 1. Classification of static models and their limitations

Note. AR and ARIMA are univariate models; VAR is a multivariate model.

Source: compiled by the author

Linear forecasting models, in turn, rely on the assumption of a linear relationship between variables and employ statistical forecasting methods. The most prevalent among these are autoregressive (AR) models, autoregressive integrated moving average (ARIMA) models, and unobserved component models, with univariate ARIMA and multivariate VAR models emerging as staples in economic practice. While widely used in macroeconomic forecasting due to their relative simplicity and computational efficiency, they reach their limits when dealing with data characterized by non-linearities and frequent structural changes;

this necessitates the introduction of hybrid methodologies that combine linear and non-linear approaches (Tresch, 2023).

Dynamic models emerged precisely in response to these limitations, placing the time factor at the heart of economic modeling. Early developments are associated with Ragnar Frisch (Carret, 2020; Gjorgjioska, 2016), who introduced the term "macrodynamic models" and formulated concepts regarding economic dynamics and stability, while Jan Tinbergen constructed and estimated the first macrodynamic model of the business cycle in 1936, utilizing discrete difference equations with exogenous variables (Morgan, 2009). Input-output models for economic planning from the 1950s to the 1970s were the precursors to modern computable general equilibrium (CGE) models, and in 1960, Johansen developed the first empirical multisectoral model. In the ensuing decades, macro-modeling evolved through several generations-Keynesian, classical, real business cycle (RBC), New Keynesian, and finally dynamic stochastic general equilibrium (DSGE) models-placing particular emphasis on dynamics and stochastic elements. Computerized time-stepping procedures "brought to life" the growing economy, illustrating its development trajectory with increasing detail, scope, and complexity, and laid the foundations for the modern approach in which dynamic models play a central role (Geremicca et al., 2026).

3. Nature and Evolution of Economic Planning

3.1 Main Dimensions of Digital Transformation

Digital transformation is a profound and comprehensive process of integrating digital technologies into all aspects of economic and social life, leading to fundamental changes in how organizations, industries, and entire societies function. It goes beyond the mere introduction of new technological solutions, representing instead a strategic rethinking of all economic and social policies.

According to the OECD Going Digital Integrated Policy Framework, digital transformation encompasses seven key policy dimensions that provide a holistic approach to balancing the opportunities and risks associated with digitalization (OECD, 2026):

- Access to communication infrastructures, services, and data - ensuring broadband access and digital connectivity is a fundamental prerequisite for any form of digital transformation.
- Effective use of digital technologies and data - the potential of technologies depends on the ability of individuals, businesses, and governments to use them effectively.
- Innovation driven by data and digital technologies - digital innovation expands the boundaries of what is possible, fostering job creation, productivity, and sustainable growth.
- Quality jobs for all-labor markets are evolving, and digital transformation should lead to more and better jobs.

- Social prosperity and inclusion - digital technologies affect society in complex and interconnected ways, requiring cooperation among all stakeholders.
- Trust in the digital age-trust in the digital environment is essential; without it, a vital source of economic and social progress remains untapped. Market openness in the digital business environment - digital technologies are transforming the way firms compete, trade, and invest.

These dimensions are interconnected, and only by considering them holistically can the full potential of digital transformation be realized.

Measuring digital transformation is a key component in the design and implementation of evidence-based policies (OECD, 2026). As the OECD notes, "measuring the digital components of the economy is complex, partly because digital technologies and data are ubiquitous to some extent, rendering the concept of a distinct 'digital economy' obsolete." National statistical systems must adapt and expand to adequately reflect the digitalization of economies and societies, emphasizing the need for new, complementary data infrastructures capable of monitoring digital activities and data flows in a timely manner.

3.2 Impact on Economic Planning

Digital transformation exerts a multidimensional impact on economic planning, altering not only the toolkit but also the very philosophy of planning. Systemic digitalization enhances management efficiency through process automation, real-time monitoring, integrated information systems, and analytical capabilities, thereby facilitating cross-sectoral coordination and responsiveness to economic fluctuations (Kanabekova et al., 2025). A study on Kazakhstan (Kanabekova et al., 2025) provides concrete empirical evidence of how systemic digitalization improves strategic planning: the country rose from 39th to 24th place in the UN's EGDI index, access to digital government services reached 92%, and the time required for policy development decreased by 47.9%. Research identifies challenges related to institutions, technology, and human capital, while simultaneously highlighting opportunities associated with productivity growth, transparency, fiscal efficiency, and competitiveness.

One of the most significant advantages is access to real-time data and the ability to process it in a timely manner (Gjorgjioska et al., 2024). While traditional static models rely on historical data and periodic reports-creating a lag between an event and the response-digital technologies enable continuous monitoring via sensors, the Internet of Things (IoT), transactional data, and satellite imagery. The OECD emphasizes the need for "new, complementary data infrastructures capable of monitoring digital activities and data flows on a timely basis, wherever they occur" (OECD, 2026). Big Data analytics reveals hidden dependencies and non-linear relationships between economic variables, enabling more precise forecasting and the early identification of risks. In the context of planning, this translates into adaptive management, integrated situational awareness, and evidence-based decision-making (Kanabekova et al., 2025).

Artificial Intelligence (AI) and Machine Learning (ML) are establishing themselves as the most significant technological drivers of change, radically transforming economic analysis and enhancing forecasting, policy simulations, and market research (Angalaeswari et al., 2025). Machine learning is employed for macroeconomic forecasting via hybrid econometric models and for inflation prediction (Jaworski, 2026), as well as for the analysis of unstructured data-where Large Language Models (LLMs) process news, central bank commentary, and corporate disclosures, converting them into interpretable economic indices (Qiu et al., 2026). AI-driven scenario planning integrates multiple modeling layers; unlike traditional approaches, it does not aim to be "correct" in a predictive sense but rather seeks to outline multiple probable trajectories and prepare decision-makers for various future states (Uddandarao, 2026). Forecasts indicate an additional $15 trillion in global GDP by 2030 (World Economic Forum, 2017). However, it is important to note that AI cannot replace free markets and the function of prices as a mechanism for coordination and resource allocation; its role is complementary.

Digital twins-virtual replicas of physical systems created using data from databases, CAD models, sensors, and IoT devices-offer fundamentally new possibilities for planning (Andrejevic et al., 2025). They invert the traditional hierarchy between managerial planning and the material world, enable a two-way flow of information between the virtual and physical systems, allow for offline simulation and scenario testing prior to real-world implementation and compress feedback loops (Andrejevic et al., 2025). The global digital twin market is valued at $10 billion and is projected to reach $74 billion by 2027 (Argolini et al., 2023), with an increasing number of countries viewing them as a key element of their national digital strategies.

3. Conclusion

This study examined the conceptual evolution of economic planning under the influence of digital transformation. The analysis revealed that static models are increasingly proving inadequate for accurately reflecting the contemporary economic reality, which is characterized by non-linearity, rapid change, and a high degree of uncertainty (Abramov, 2026). Digital transformation emerges not merely as a technological overlay but as a catalyst for conceptual change, driving the replacement of dominant static models with dynamic, adaptive systems. Unlike static models, dynamic models do not aim to precisely forecast a single future state; instead, they focus on building capabilities for continuous adaptation, scenario modeling, and real-time decision-making (Seleznova & Khvostikov, 2025; Kanabekova et al., 2025; Angalaeswari et al., 2025; Andrejevic et al., 2025).

The study contributes to clarifying the conceptual foundations of economic planning in the digital era by systematizing existing theoretical frameworks and linking them to the practical challenges facing planning authorities. Its limitations stem from its predominantly theoretical nature; it does not include empirical measurements of the models' effectiveness and focuses on the macro- and meso-

economic levels, while the social, ethical, and regulatory dimensions of digital transformation fall outside the scope of the analysis. Future research could focus on developing hybrid models that combine the advantages of static and dynamic approaches, conducting empirical comparative analyses of dynamic model effectiveness across countries with varying levels of digitalization, and examining the ethical, regulatory, and human aspects of implementing AI and digital twins in planning.

It is worth noting that economic planning is at a pivotal stage of its development. The transition from static to dynamic models is not merely a technological choice but a strategic necessity for enabling economic entities to manage their development amidst increasing complexity and uncertainty. The success of this transition depends not only on technological solutions but also on institutional readiness, investment in human capital, and the creation of an environment that fosters innovation without overlooking associated risks.

Acknowledgment

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COMMERCIAL ENTREPRENEURIAL NICHES FOR THE DEVELOPMENT OF RURAL TOURISM IN BULGARIA

Tsvetelina Kabakchieva[1]

Abstract

Rural tourism in Bulgaria represents an important instrument for the sustainable development of rural areas and economic diversification. It contributes to the creation of new entrepreneurial opportunities, increased employment, additional income for local communities, and the preservation and promotion of natural and cultural heritage. At the same time, the development of rural tourism is closely related to the effective utilization of local resources, the entrepreneurial potential of rural areas, and the capacity of local actors to develop innovative and competitive tourism products.

This paper analyzes the main entrepreneurial niches in rural tourism in Bulgaria, the key factors influencing its development, and the role of European policies and support mechanisms in creating favorable conditions for entrepreneurial activity in rural areas. Particular attention is paid to the potential for integrating tourism with agriculture, local food production, traditional crafts, cultural heritage, and other locally available resources. Such integration can contribute to the diversification of rural economies and the development of sustainable business models based on the specific characteristics and competitive advantages of individual territories.

The paper emphasizes the importance of an integrated approach that combines entrepreneurial initiative, local resources, tourism development, and European policy support. This approach can contribute to strengthening the economic potential of rural areas and creating new opportunities for sustainable local development in Bulgaria.

Keywords: rural tourism, agrotourism, entrepreneurship, sustainable development, regional policy, Bulgaria.

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1. Introduction

Rural tourism is becoming established as a strategic sector for the development of rural areas in Bulgaria. It serves as an instrument for reducing regional disparities and creating alternative employment opportunities. According to Grancharov and Dimitrov (2016), tourism in rural areas plays a key role in increasing incomes and stimulating the local economy. European policy promotes diversification by supporting small businesses and fostering integration among tourism, agriculture, and cultural heritage (European Commission, 2021).

2. Nature of Rural Tourism

Rural tourism is a form of alternative tourism that develops in rural areas and is associated with nature, traditions, and an agricultural way of life. According to Todorov (2015), it is characterized by authenticity, environmental sustainability, and an individualized approach to tourists.

Main characteristics:

- contact with nature and the rural environment
- participation in traditional activities
- use of local products
- cultural and historical heritage

3. Entrepreneurial Niches in Rural Tourism and Preconditions for Development in Bulgaria

Bulgaria has strong potential for the development of rural tourism due to its rich natural and cultural diversity. According to Kostov and Mihaylov (2018), the main challenges facing rural areas include demographic decline, low employment, and limited economic opportunities.

Main preconditions:

- a large share of rural territory
- natural resources and protected areas
- traditions and cultural heritage
- access to European funding

Rural tourism creates opportunities for diverse business models with varying levels of investment requirements.

Table 1. Main Entrepreneurial Niches in Rural Tourism

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Niche	Description	Investment	Profitability	Risk
Guest houses	Accommodation and tourism services	Medium	High	Medium
Agritourism farms	Participation in agricultural activities	Medium/High	High	Medium
Culinary tourism	Local cuisine and tastings	Low	Medium/High	Low
Ecotourism	Nature trails and activities	Low	Medium	Low
Folklore events	Festivals and celebrations	Low	Medium	Low
Craftsmanship	Handmade products and demonstrations	Low	Medium	Low

Source: Adapted from Ivanova (2017) and Kostov and Mihaylov (2018).

Guest houses and agritourism farms have the highest profitability, as they combine several sources of revenue. Low-investment niches, such as folklore events and craftsmanship, are suitable for start-up entrepreneurs and involve low risk, making them viable options for local development.

SWOT Analysis of Rural Tourism in Bulgaria

Table 2. SWOT Analysis

Strengths	**Weaknesses**
Rich natural and cultural heritage	Poor infrastructure
Low-cost labor	Aging population
European funding	Insufficient marketing
Traditions and authenticity	Seasonality of tourism
Opportunities	**Threats**
Growing interest in ecotourism	Migration to urban areas
EU funding programs	Economic instability
Development of small businesses	Climate change
Digital marketing	Foreign competition

Source: Adapted from Georgiev (2016) and Stoyanova (2019).

4. Economic Significance and European Support

Rural tourism contributes to employment creation and the development of the local economy. According to Stoyanova (2019), it is a key factor in retaining the population in rural areas.

Main effects:

- development of small businesses

- increased incomes
- stimulation of local production
- infrastructure development

European policy supports rural tourism through rural development programmes. Funding includes investments in tourism facilities, infrastructure, and services (European Commission, 2021).

3. Conclusion

Rural tourism in Bulgaria is a promising sector with significant potential for entrepreneurial development. It combines economic, social, and environmental benefits and contributes to the sustainable development of rural areas. With appropriate policies and investment, this sector can become a key driver of regional economic development.

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