



INTERNATIONAL
SCIENTIFIC
CONFERENCE

ebm 2024

**CONTEMPORARY ISSUES IN
ECONOMICS, BUSINESS
AND MANAGEMENT**

Editors

Dejana Zlatanović

Aleksandra Stevanović



FACULTY OF ECONOMICS
UNIVERSITY OF KRAGUJEVAC

CONTEMPORARY ISSUES IN ECONOMICS, BUSINESS AND MANAGEMENT

E d i t o r s

Dejana Zlatanović

Aleksandra Stevanović

FACULTY OF ECONOMICS
UNIVERSITY OF KRAGUJEVAC
Kragujevac, 2025

Publisher

Faculty of Economics, University of Kragujevac

For the Publisher

Milena Jakšić, Dean

Editors

Dejana Zlatanović, Faculty of Economics, University of Kragujevac

Aleksandra Stevanović, Faculty of Economics, University of Kragujevac

Reviewers

Katarina Borisavljević, Faculty of Economics, University of Kragujevac	Veljko Marinković, Faculty of Economics, University of Kragujevac
Nikola Bošković, Faculty of Economics, University of Kragujevac	Vladimir Mičić, Faculty of Economics, University of Kragujevac
Marijana Bugarčić, Faculty of Economics, University of Kragujevac	Vladimir Mihajlović, Faculty of Economics, University of Kragujevac
Violeta Domanović, Faculty of Economics, University of Kragujevac	Zlatko Nedelko, Faculty of Economics and Business, University of Maribor
Mikica Drenovak, Faculty of Economics, University of Kragujevac	Jelena Nikolić, Faculty of Economics, University of Kragujevac
Jelena Erić Nielsen, Faculty of Economics, University of Kragujevac	Gordana Radosavljević, Faculty of Economics, University of Kragujevac
Jovana Filipović, Faculty of Economics, University of Kragujevac	Vladimir Ranković, Faculty of Economics, University of Kragujevac
Milka Grbić, Faculty of Economics, University of Kragujevac	Marko Savićević, Faculty of Economics, University of Kragujevac
Vladan Ivanović, Faculty of Economics, University of Kragujevac	Slađana Savović, Faculty of Economics, University of Kragujevac
Nenad Janković, Faculty of Economics, University of Kragujevac	Marko Slavković, Faculty of Economics, University of Kragujevac
Dejan Jovanović, Faculty of Economics, University of Kragujevac	Vladimir Stančić, Faculty of Economics, University of Kragujevac
Zoran Kalinić, Faculty of Economics, University of Kragujevac	Nenad Stanišić, Faculty of Economics, University of Kragujevac
Nemanja Karapavlović, Faculty of Economics, University of Kragujevac	Aleksandra Stevanović, Faculty of Economics, University of Kragujevac
Mirjana Knežević, Faculty of Economics, University of Kragujevac	Dragan Stojković, Faculty of Economics, University of Kragujevac
Milan Kostić, Faculty of Economics, University of Kragujevac	Violeta Todorović, Faculty of Economics, University of Kragujevac
Jovana Lazarević, Faculty of Economics, University of Kragujevac	Nenad Tomić, Faculty of Economics, University of Kragujevac
Bojan Leković, Faculty of Economics in Subotica, University of Novi Sad	Tijana Tubić Ćurčić, Faculty of Economics, University of Kragujevac
Nemanja Lojanica, Faculty of Economics, University of Kragujevac	Stefan Vržina, Faculty of Economics, University of Kragujevac
Stevan Luković, Faculty of Economics, University of Kragujevac	Dejana Zlatanović, Faculty of Economics, University of Kragujevac
Drazen Marić, Faculty of Economics in Subotica, University of Novi Sad	

Technical support

Biljana Petković

Printed by

InterPrint – Kragujevac

Circulation: 100

The Proceedings was co-financed by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia, Decision number: 451-03-886/2024-03 as of 8th July 2024.

ISBN-978-86-6091-165-2

Copyright © 2025

Faculty of Economics, University of Kragujevac, Kragujevac, Republic of Serbia

Program committee:

1. Dejana Zlatanović, Faculty of Economics, University of Kragujevac, President
2. Milena Jakšić, Faculty of Economics, University of Kragujevac
3. Gordana Radosavljević, Faculty of Economics, University of Kragujevac
4. Pawel Lula, Cracow University of Economics
5. Tomasz Rojek, Cracow University of Economics
6. Marek Dziura, Cracow University of Economics
7. Grigoris Zarotiadis, Faculty of Economics and Political Sciences, Aristotle University of Thessaloniki
8. Zlatko Nedelko, Faculty of Economics and Business, University of Maribor
9. Tjaša Štrukelj, Faculty of Economics and Business, University of Maribor
10. Ganna Duginets, Faculty of Economics, Management and Psychology, Kyiv National University of Trade and Economics
11. Maria Cristina Cinici, University of Messina
12. Darko Tipurić, Faculty of Economics, University of Zagreb
13. Milenko Krajišnik, Faculty of Economics, University of Banja Luka
14. Predrag Trpeski, Faculty of Economics, University of Skopje
15. Marko Đogo, Faculty of Economics, University of East Sarajevo
16. Žaklina Stojanović, Faculty of Economics, University of Belgrade
17. Tadija Đukić, Faculty of Economics, University of Niš
18. Nebojša Gvozdenović, Faculty of Economics Subotica, University of Novi Sad
19. Milan Martić, Faculty of Organizational Science, University of Belgrade
20. Mirjana Gligorijević, Faculty of Economics, University of Belgrade
21. Suzana Đukić, Faculty of Economics, University of Niš
22. Gordana Marjanović, Faculty of Economics, University of Kragujevac
23. Mikica Drenovak, Faculty of Economics, University of Kragujevac
24. Predrag Mimović, Faculty of Economics, University of Kragujevac
25. Violeta Todorović, Faculty of Economics, University of Kragujevac
26. Mirjana Todorović, Faculty of Economics, University of Kragujevac
27. Violeta Domanović, Faculty of Economics, University of Kragujevac
28. Vesna Stojanović-Aleksić, Faculty of Economics, University of Kragujevac
29. Nenad Stanišić, Faculty of Economics, University of Kragujevac
30. Milan Kostić, Faculty of Economics, University of Kragujevac
31. Vladimir Mihajlović, Faculty of Economics, University of Kragujevac
32. Nenad Tomić, Faculty of Economics, University of Kragujevac
33. Milan Čupić, Faculty of Economics, University of Kragujevac
34. Mirjana Knežević, Faculty of Economics, University of Kragujevac
35. Veljko Marinković, Faculty of Economics, University of Kragujevac
36. Srđan Šapić, Faculty of Economics, University of Kragujevac
37. Milan Kocić, Faculty of Economics, University of Kragujevac
38. Jelena Erić Nilsen, Faculty of Economics, University of Kragujevac
39. Jelena Nikolić, Faculty of Economics, University of Kragujevac
40. Slađana Savović, Faculty of Economics, University of Kragujevac
41. Marko Slavković, Faculty of Economics, University of Kragujevac
42. Vladimir Ranković, Faculty of Economics, University of Kragujevac
43. Zoran Kalinić, Faculty of Economics, University of Kragujevac
44. Jasmina Bogićević, Faculty of Economics, University of Kragujevac
45. Dragomir Dimitrijević, Faculty of Economics, University of Kragujevac

46. Nenad Janković, Faculty of Economics, University of Kragujevac
47. Vladan Ivanović, Faculty of Economics, University of Kragujevac
48. Nikola Bošković, Faculty of Economics, University of Kragujevac
49. Marina Milanović, Faculty of Economics, University of Kragujevac
50. Zlata Đurić, Faculty of Economics, University of Kragujevac
51. Katarina Borisavljević, Faculty of Economics, University of Kragujevac

Organizing committee:

1. Aleksandra Stevanović, Faculty of Economics, University of Kragujevac, President
2. Jovana Lazarević, Faculty of Economics, University of Kragujevac, Secretary
3. Jovana Filipović, Faculty of Economics, University of Kragujevac
4. Katarina Sofronijević, Faculty of Economics, University of Kragujevac
5. Nemanja Karapavlović, Faculty of Economics, University of Kragujevac
6. Milka Grbić, Faculty of Economics, University of Kragujevac
7. Nemanja Lojanica, Faculty of Economics, University of Kragujevac
8. Maja Luković, Faculty of Economics, University of Kragujevac
9. Dejan Jovanović, Faculty of Economics, University of Kragujevac
10. Olivera Stančić, Faculty of Economics, University of Kragujevac
11. Tijana Tubić Ćurčić, Faculty of Economics, University of Kragujevac
12. Milena Kranjec, Faculty of Economics, University of Kragujevac
13. Dragan Stojković, Faculty of Economics, University of Kragujevac
14. Ana Krstić, Faculty of Economics, University of Kragujevac
15. Milan Stamenković, Faculty of Economics, University of Kragujevac
16. Ivana Nedeljković, Faculty of Economics, University of Kragujevac
17. Marijana Bugarčić, Faculty of Economics, University of Kragujevac
18. Aleksandra Vasić, Faculty of Economics, University of Kragujevac
19. Andrija Đonić, Faculty of Economics, University of Kragujevac
20. Stefan Vržina, Faculty of Economics, University of Kragujevac

FOREWORD

The Faculty of Economics, University of Kragujevac organized the Eighth Biennial International Scientific Conference on Contemporary Issues in Economics, Business, and Management (EBM 2024), scheduled for December 16th-17th, 2024. This conference continued to serve as an important platform for exchanging knowledge, providing a space for scholars, practitioners, and experts to present and discuss diverse theoretical and empirical perspectives. As in previous years, this event offered an opportunity to deepen and expand knowledge on key aspects of economics, business, marketing, and management.

This year, the conference brought together 91 authors from higher education institutions in Serbia and 36 authors from abroad. In addition to researchers from the Faculty of Economics in Kragujevac, the conference featured contributions from scholars at the universities in Krakow (Poland), Kyiv (Ukraine), Messina (Italy), Huelva (Spain), Grenoble (France), Dubai (UAE), Kuwait, St Petersburg (Russia), Minsk (Belarus), Maribor (Slovenia), Zagreb (Croatia), Osijek (Croatia), Brčko (BiH), Banja Luka (BiH), Travnik (BiH), Štip (North Macedonia), Sofia (Bulgaria), Bucharest (Romania), Zenica (BiH), as well as several faculties across Serbia, including Belgrade, Niš, Subotica, Čačak, Vrnjačka Banja, Leskovac, Valjevo and Novi Pazar. These diverse participants presented their research, further enriching the discussions on contemporary economic, business, and management issues.

Forty papers were reviewed, of which thirty-nine were positively reviewed and published in the proceedings. It is important to emphasize that several papers were selected for publishing in the journals which supported the Conference: *Economic Horizons* and *Our Economy/Naše gospodarstvo*. The authors of two papers will submit their papers to the journal *Our Economy*, and the authors of six papers decided to submit the paper to the journal *Economic Horizons*. Therefore, the above-mentioned papers are not included in the Proceedings.

The first section, *Key Issues in Management and Marketing*, covers a wide range of topics, including regional differences in assessing key corporate entrepreneurship factors, the effects of global accreditation on institutional performance, the influence of digitalization on ESG performance, the adoption of hybrid work models in the Serbian IT industry, employees' perceptions of agile ways of working, studies on the application of neuroscience in HR management, artificial intelligence in public administration decision-making, as well as the role of social capital in sustainable management. The section also addresses the impact of social media consumer engagement on green product purchasing behavior, the perception of business events among different age groups, mobile technology adoption in Serbia, and post-COVID-19 consumer behavior trends, along with the implementation of CSR in SMEs in Serbia.

The section *Globalization and Regionalization* explored international trade issues, the implications of digital transformation on regional interconnectedness, defense technology transfer, various aspects of innovations – innovations and entrepreneurship, innovations in defense industry, innovations and export performance, consumer protection laws, the brain drain implications for economic growth, the flexicurity concept in the post-pandemic labor markets, the impact of Covid-19 on the banking market, labor market dynamics, the implications of transportation infrastructure on local economy, different aspects of sustainable tourism, sustainable finance and environmental issues, including renewable energy transitions.

The *Accounting and Business Finance* section covered a range of topics related to the use of advanced techniques in financial analysis and business optimization. These included studies on the diffusion of Activity-Based Costing (ABC) as a strategic management tool in higher education institutions, and the legal and financial implications of tax, civil law, and accounting qualifications. The section also addressed the performance analysis and auditing of banks' financial statements in Serbia.

Additionally, the impact of export on the profitability of IT companies was explored, along with the use of event study analysis to determine the influence of significant political events on the financial sector. Finally, the role of quality management standards on improving financial performance was also discussed.

The *Applied Informatics and Quantitative Methods in Economics and Management* section explored various applications of advanced data analysis techniques and their integration into business and healthcare sectors. Topics included the use of BERTopic models in analyzing Serbian research publications in economics and management, and the application of business intelligence tools in the Microsoft Fabric environment. The section also focused on housing price prediction through machine learning methods like XGBoost and Random Forest. Additionally, it examined the role of artificial intelligence and cybersecurity in the banking sector. Lastly, the application of business intelligence methods in analyzing the treatment of diabetes patients highlighted the intersection of data analysis with healthcare management.

The Conference Program included a plenary session and eight parallel sessions. Thirty-nine reviewers participated in reviewing the papers presented at the conference. As distinguished researchers in the specified fields of business management, the keynote speakers at the Conference were as follows: Professor Alfonso Vargas Sánchez (Spain), Professor Maria Cristina Cinici (Italy), and Professor Vladimir Dženopoljac (United Arab Emirates). A high number of participants is a strong indicator of the success of the EBM 2024 conference, demonstrating its effectiveness in fostering scholarly exchange and networking. We would like to thank all authors who submitted their work, contributing to our shared response to contemporary challenges in economics, business, and management.

Editors

KEY NOTE SPEECHES

Alfonso Vargas Sánchez, University of Huelva

The Challenge of Interconnected Transformations

Maria Cristina Cinici, University of Messina

From Brain to Business: The Neuroscientific Foundations of Management

Vladimir Dženopoljac, Zayed University

Active Learning and Generative AI in Higher Education: Balancing Innovation with Responsibility

CONTENTS

KEY ISSUES IN MANAGEMENT AND MARKETING

REGIONAL DIFFERENCES IN ASSESSING THE KEY CORPORATE ENTREPRENEURSHIP FACTORS: STUDY FROM SERBIA, CROATIA AND B&H Ljiljana Kontić, Nebojša Janićijević, Mirta Benšić	3
GLOBAL ACCREDITATION, LOCAL IMPACT: EVALUATING THE INFLUENCE OF INTERNATIONAL BUSINESS SCHOOL ACCREDITATION ON INSTITUTIONAL PERFORMANCE Vladimir Dženopoljac, Aleksandra Dženopoljac, Oualid Abidi	13
THE EFFECTS OF DIGITALISATION ON ESG PERFORMANCE: THE CASE STUDY OF NIS A.D. NOVI SAD Violeta Domanović, Slađana Savović.....	27
JOB DESIGN AND HYBRID WORK MODELS DURING COVID-19: A STUDY OF THE SERBIAN IT INDUSTRY Aleksandra Stevanović, Vesna Stojanović-Aleksić, Jelena Erić Nielsen.....	43
CAN NEUROSCIENCE BE APPLIED IN HUMAN RESOURCE MANAGEMENT? EXPLORING THE ATTITUDES OF HR PROFESSIONALS IN SERBIA Nastasija Vučković, Tatjana Ivanović.....	51
EMPLOYEES' PERSPECTIVES ON DIMENSIONS OF AGILE WAY OF WORKING: EMPIRICAL EVIDENCE FROM THE ICT SECTOR Milica Dukanac, Dejana Zlatanović, Tjaša Štrukelj.....	59
SOCIAL CAPITAL IN THE CONCEPT OF SUSTAINABLE MANAGEMENT Tomasz Kusio.....	71
ARTIFICIAL INTELLIGENCE FOR IMPROVING DECISION-MAKING PROCESSES IN PUBLIC ADMINISTRATION Antonino Interdonato	85
BUSINESS EVENT EVENTQUAL PERCEPTION AMONG DIFFERENT AGE GROUPS: GENERATION Z PERSPECTIVE Marijana Đurađević, Darko Dimitrovski, Vladimir Senić	95
CURRENT TRENDS IN THE POST-COVID-19 CONSUMER BEHAVIOR Veljko Marinković, Biljana Chroneos Krasavac, Jovana Lazarević	109
IMPLEMENTATION OF CSR IN SMES – EVIDENCE FROM SERBIA Milena Damnjanović.....	119
THE IMPACT OF SOCIAL MEDIA CONSUMER ENGAGEMENT AND GREENWASHING ON GREEN PRODUCT PURCHASE BEHAVIOR Jovana Filipović	131
EXPLORING MOBILE TECHNOLOGY ADOPTION IN THE REPUBLIC OF SERBIA: IDENTIFYING CONSUMER SEGMENTS Julija Vidosavljević	143

GLOBALIZATION AND REGIONALIZATION

INTERNATIONAL TRANSFER OF DEFENSE TECHNOLOGIES

Ganna Duginets, Kostyantyn Nizheiko 155

ALIGNMENT OF THE LEGAL FRAMEWORK FOR CONSUMER PROTECTION IN BIH WITH EU LAW

Alaudin Brkić, Amina Hasanović, Alisa Imamović 167

THE MOTORWAYS AVAILABILITY IMPLICATIONS FOR EMPLOYMENT AND EARNINGS AT MUNICIPAL LEVEL IN SERBIA

Marko Miljković, Jelica Petrović-Vujačić..... 177

NAVIGATING ENTREPRENEURSHIP AND INNOVATION: THE IMPORTANCE OF INSTITUTIONAL QUALITY IN CEE

Ljubivoje Radonjić, Damjan Jolović, Nevena Veselinović 187

LOST BRILLIANCE: THE IMPACT OF BRAIN DRAIN ON ECONOMIC GROWTH

Marija Radulović..... 197

RETHINKING THE FLEXICURITY CONCEPT IN THE POST-PANDEMIC LABOR MARKETS

Vladimir Mihajlović, Gordana Marjanović 209

THE ROLE OF ECONOMIC POLICY IN THE DEVELOPMENT OF SUSTAINABLE TOURISM IN SERBIA

Aleksandra Ranković, Nikola Bošković, Srđan Furtula, Miloš Dimitrijević 219

EVALUATING SUSTAINABLE PRACTICES IN RURAL TOURIST HOUSEHOLDS: A STUDY FROM THE REPUBLIC OF SERBIA

Jovana Davidović, Danijela Pantović, Tijana Babović 231

SERBIA`S TRADE DEFICIT: MADE IN CHINA?

Božidar Čakajac, Nenad Janković 239

THE IMPACT OF THE COVID-19 CRISIS ON BANKING MARKET CONCENTRATION AND COMPETITION IN THE WESTERN BALKANS

Nađa Đurić, Andrijana Đurđević, Zlata Đurić 255

THE DYNAMICS OF DIGITAL TRANSFORMATION: REGIONAL TRENDS AND THEIR INTERCONNECTIONS

Cetulean Maxim 267

SOCIO-ECONOMIC AND CULTURAL INFLUENCES ON THE HOUSEHOLD TRANSITION TO RENEWABLE ENERGY SOURCES: A RESEARCH DESIGN

Dušan Mojić..... 279

IS THERE AN ENVIRONMENTAL KUZNETS CURVE IN WESTERN BALKANS: EXAMINING EDUCATION-TECHNOLOGICAL INNOVATION-CO₂ EMISSION

Marija Petrović-Ranđelović, Snežana Radukić, Žarko Popović..... 289

CHALLENGES OF INDUSTRY 4.0: INNOVATIONS AS KEY DRIVERS OF PROGRESS IN DEFENSE INDUSTRY

Goran Mladenovic..... 305

ANALYSIS OF THE IMPACT OF INNOVATION ON EXPORT PERFORMANCE: THE CASE OF WESTERN BALKAN COUNTRIES	
Marija Stojmenović.....	319

SUSTAINABLE FINANCE IN THE BOND MARKET: THE CASE OF GREEN BONDS	
Milica Pavlović.....	329

ACCOUNTING AND BUSINESS FINANCE

COMPARISON OF THE DIFFUSION OF ACTIVITY BASED COSTING AS A STRATEGIC MANAGEMENT TOOL IN HIGHER EDUCATION INSTITUTIONS	
Ljilja Antić, Bojana Novičević Čečević, Kristina Spasić.....	343

COMPARATIVE LEGAL ANALYSIS OF THE CONSISTENCY BETWEEN CIVIL LAW, TAX, AND ACCOUNTING QUALIFICATIONS OF FINANCIAL LEASING	
Smajo Šabić, Alaudin Brkić, Amna Gagula	357

PERFORMANCE ANALYSIS AND AUDIT OF BANKS' FINANCIAL STATEMENTS IN THE REPUBLIC OF SERBIA	
Biljana Jovković, Aleksandra Radojević.....	367

PROFITABILITY OF SERBIAN INFORMATION TECHNOLOGY COMPANIES: THE IMPACT OF EXPORT	
Nemanja Karapavlović, Vladimir Obradović	375

USING EVENT STUDY ANALYSIS TO DETERMINE THE INFLUENCE OF DONALD TRUMP'S ELECTION RESULTS ON FINANCIAL SECTOR	
Nenad Tomić, Aleksandra Vasić, Violeta Todorović	385

THE IMPACT OF ISO 9001 STANDARD ON FINANCIAL PERFORMANCE	
Ivana Vuković	395

APPLIED INFORMATICS AND QUANTITATIVE METHODS IN ECONOMICS AND MANAGEMENT

UNIFIED BUSINESS INTELLIGENCE IN THE MICROSOFT FABRIC ENVIRONMENT	
Jelena Plašić, Andrijana Gaborović, Nenad Stefanović	407

HOUSING PRICE PREDICTION USING XGBOOST AND RANDOM FOREST METHODS	
Ljiljana Matić, Zoran Kalinić	417

ARTIFICIAL INTELLIGENCE AND CYBERSECURITY IN BANKING SECTOR: OPPORTUNITIES AND RISKS	
Ana Kovačević, Sonja D. Radenković, Dragana Nikolić.....	425

APPLICATION OF BUSINESS INTELLIGENCE METHODS AND TECHNIQUES IN THE ANALYSIS OF TREATMENT OF PATIENTS WITH DIABETES	
Vukašin Vasiljević, Nenad Stefanović	435

KEY ISSUES IN MANAGEMENT AND MARKETING

REGIONAL DIFFERENCES IN ASSESSING THE KEY CORPORATE ENTREPRENEURSHIP FACTORS: STUDY FROM SERBIA, CROATIA AND B&H

Ljiljana Kantić*

University MB, Faculty of Business and Law, Belgrade, Serbia, ljiljana.kontic@yahoo.com,
ORCID number 0000-0002-5117-0419

Nebojsa Janićijević

University of Belgrade, Faculty of Economics and Business, Belgrade, Serbia, jnebojsa@eunet.rs,
ORCID number 0000-0003-3919-0086

Mirta Benšić

University of Osijek, School of Applied Mathematics and Informatics, Osijek, Croatia,
mirta@mathos.hr, ORCID number 0000-0001-9063-0310

Abstract: *The main aim of this study was to investigate similarities and differences in the key corporate entrepreneurship factors in selected regions from Serbia, Croatia and Bosnia and Herzegovina. The key corporate entrepreneurship factors were Management Support, Work discretion, Rewards, Time availability, and Organizational Boundaries. Methodological tool has been Corporate Entrepreneurship Assessment Instrument (CEAI). The written permission to use the CEAI questionnaire was provided by the authors. Mainly, CEAI model has been used in developed economies i.e. United States of America and Canada. This was the first used of CEAI in the regional context in emerging economies. Previous researches has been conducted in Serbia. This study filled the gap between developed and emerging economies in the context of the corporate entrepreneurship. The respondents were 240 managers from the region. In the selection process of companies main criteria have been economic and financial standing, and regional importance. The correspondent analysis has been used. The findings revealed similar assessment of Management support and Work discretion by managers in Croatia and Bosnia and Herzegovina. The Time availability factor has been different assessed by managers from region. Managers from Bosnia and Herzegovina were differed from the rest of the region in assessment Organizational Boundaries. The higher rating of Organizational boundaries had observed managers from Croatia.*

Keywords: *Corporate entrepreneurship, Management, CEAI model, Organizational culture, Correspondence analysis*

JEL Classification: *M 14, M 21, L 26*

* Corresponding author

1. INTRODUCTION

Regions are recognized as important engines of economic development (Hollanders & Es-Sadki, 2023). Economic growth grounds on the capacity of regional economies to change and innovate. Regions and cities have become the primary spatial units where knowledge is transferred, innovation systems are built and competition to attract investments and talents takes place. The regions stimulate the innovation because innovation tends to be spatially concentrated over time. The corporate entrepreneurship implies two essential components: innovations and changes at the level of the entire organization (Janicijevic & Kontic, 2023). Therefore, investigating the key factors of corporate entrepreneurship may stimulate innovation at regional level.

The main aim of this paper is to identify similarities in assessment the key corporate entrepreneurship factors in the selected regions from Serbia, Croatia, and Bosnia and Hercegovina. According to Regional Innovation Scoreboard (Hollanders & Es-Sadki, 2023), in Serbia the most innovative regions are Belgrade and Vojvodina; in Croatia Zagreb city; in Bosnia and Hercegovina there is not reliable data. Therefore, we selected a company from Belgrade, and one from Vojvodina, one from Zagreb city, and one from Banja Luka. Along with data from Regional Innovation Scoreboard (Hollanders & Es-Sadki, 2023), statistical data have been revealed the companies with the best financial status.

Previous studies revealed reliability of using Corporate Entrepreneurship Assessment Instrument (CEAI) in emerging economies (Kontic *et al.*, 2016; Janicijevic & Kontic, 2023). This methodological tool has been first used in Bosnia and Hercegovina in our study.

All three countries was former Yugoslav republics, have similar social-economic conditions, and similar cultural heritage. It could be supposed that senior management similarly assess management support, rewards, time availability, work discretion, and organizational boundaries. This paper will contribute to better understanding of the corporate entrepreneurship in emerging economies.

The paper is structured in three main parts. The introduction is followed by a review of literature and then a description of the research methodology. After that, the research results will be presented and discussed. At the end, the conclusion and recommendations are given.

2. LITERATURE REVIEW

The concept of the corporate entrepreneurship is a somewhat problematic but therefore also a challenging topic. The problem lies in the lack of consensus among authors on what constitutes it and how to measure it. Four types of corporate entrepreneurship have been identified: sustainable regeneration, organizational rejuvenation, strategic recovery and strategic turnaround, and the authors believe that these four forms include most of the ways in which corporate entrepreneurship appears in organizations (Dess *et al.*, 2003). Which elements are the most important in this construct? Some authors emphasize innovation, investment and strategy renewal (Zahra, 1993) while others emphasize proactivity, innovation and willingness to take risks (Miller, 2011; Morris & Paul, 1987; Covin & Slevin, 1990; Dean *et al.*, 1993). The second view finds support and foundation in empirical studies (Covin & Slevin, 1989; Zahra *et al.*, 1999).

Corporate entrepreneurship includes activities that contain novelty, new resources, consumers, markets or a new combination of resources, consumers and markets (Ireland *et al.*, 2009) and also includes efforts aimed at innovation, recovery and investments of the organization (Zahra, 1995; Hisrich, 2006; Sharma & Chrisman, 1999). Corporate entrepreneurship has many advantages and it leads to gaining and maintaining competitive advantages regardless of the industry and size of the organization (Covin & Miles, 1999; Bhardwaj *et al.*, 2011). It also ensures increased profitability, long-term survival, growth and financial stability (Hitt *et al.*, 2001).

Corporate entrepreneurship can have multiple positive impacts on a company. Within the organization, this type of entrepreneurship leads to increased productivity and greater employee satisfaction. When managers promote workers, empower them and give them greater creative freedom, they work harder and their work fulfills them more (Yukl, 2008).

Corporate entrepreneurship can also act outside the organization, that is, influence how others perceive it. A company that has a reputation as a place where employees have management support, creative freedom and an innovative spirit will have a good reputation and will have more prestige in the eyes of others. Furthermore, it affects the recruitment of future personnel, where there will be a greater chance of attracting good experts and motivated workers.

To achieve results better than the competition and progress in to its branch of business, it is necessary that, as an integral part of corporate entrepreneurship, in addition to innovations in business and products, be ready for changes, but also to accept the potential risks.

Five factors that indicate the existence of corporate entrepreneurship in the organization are (Kuratko *et al.*, 2014):

- *Management Support* representing the highest level of readiness of managers to facilitate and promote entrepreneurial behaviour and includes encouraging ideas and providing resources for entrepreneurial activities. An organization's ability to increase entrepreneurial efforts is conditional on compatibility of managerial experience and their entrepreneurial initiatives.
- *Work Discretion/autonomy*, which includes tolerance of failure, delegation of authority and responsibility to managers of medium level. It is important that employees are creative in the execution of their tasks. Participation in decisions that affect the business is perceived as challenging and significant.
- *Rewards/empowerment*, which is the development and use of the reward system based on performance and highlighting significant achievements and praise. Reward systems are the main source of individual motivation.
- *Time availability* is a time for the initiation of innovation by individuals and groups, as well as the structuring their affairs so as to implement short and long term goals of the organization. To encourage innovation, it is important to provide employees the time to devote to solving long-term problems.
- *Organizational boundaries* specify the expected results and developing mechanisms for evaluation, selection and implementation of innovations. Corporate entrepreneurship encourage vertical and lateral communication, multidisciplinary work teams, empowerment of supervisors and the creation of small organizational units.

Majority of study have been conducted in developed economies i.e. USA and Canada (Hornsby *et al.*, 1999; Hornsby *et al.*, 2002; Rutherford & Holt, 2007; Holt *et al.*, 2007;

Hornsby *et al.*, 2009; Goodale *et al.*, 2011). Few studies have been conducted in emerging economies (De Araújo Castro *et al.*, 2020; Vela *et al.*, 2023; Agapie *et al.*, 2018). Regarding our focus region, Serbia has been well investigated (Kontic, 2012; Kontic & Vidicki, 2016; Kontic *et al.*, 2017; Janicijevic & Kontic, 2023). There is a little evidence about corporate entrepreneurship in Croatia (Kolakovic *et al.*, 2008; Sucic Funko, 2023; Singer *et al.*, 2009). The same situation is in Bosnia and Herzegovina (Smajlovic *et al.*, 2024; Macura & Tanjga, 2013; Umihanic & Delic, 2013).

The main research question is: Do managers in Serbia, Croatia, Bosnia and Hercegovina similarly assess key factors of the corporate entrepreneurship?

3. METHODOLOGY

In order to test our research question, we used a sample of 240 managers from Serbian regions, Croatia, and Bosnia and Herzegovina (B&H).

The sample consists of managers of the most successful companies in the field of oil production and refining from aforementioned countries (120 from Serbia, 60 from Croatia, and 60 from B&H).

In 2022, oil industry in Serbia achieved high business results. The oil companies' revenue in 2022 raised by 74 percent, primarily due to a rise in the average price of Brent crude oil in that period by 43 percent. The key indicator of profitability, EBITDA, increased 1.6 times, to 136.2 billion dinars (Statistical Office of the Republic of Serbia, 2023).

The same situation was in Croatia as well as Bosnia and Hercegovina (Croatian Bureau of Statistics, 2023; Agency for statistics of Bosnia and Hercegovina, 2023).

Data was collected by a CEAI questionnaire containing 48-item Likert scale questions. The Corporate Entrepreneurship Assessment Instrument (CEAI) measures key internal organizational factors that influence a firm's entrepreneurial activities and outcomes, such as top management support, work discretion, rewards/reinforcement, time availability and organizational boundaries.

Correspondence analysis is a statistical method that is particularly helpful in analysing crosstabular data in the form of numerical frequencies, and results in an elegant but simple graphical display which permits more rapid interpretation and understanding of the data (Greenacre, 2017). Correspondence analysis is a generalization of a simple graphical concept with which we are all familiar, namely the scatterplot.

4. RESULTS AND DISCUSSION

The results of the correspondence analysis will be presented by the key corporate entrepreneurship factors i.e. Management support, Work discretion, Rewards, Time availability and Organizational boundaries.

First, the average score for the Management support has been calculated across all questions for each region separately. The share of individual grades in a given region, total for all questions that appear in Management support.

Table 1 contains those average profiles for the Management support factor by region, expressed as a percentage.

Table 1. *The average profiles for the Management support factor by region*

Region	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5
B&H	1.58%	6.68%	30.76%	48.51%	12.48%
Croatia	4.23%	16.9%	33.1%	37.32%	8.45%
Belgrade	26.99%	21.84%	26.87%	21.23%	3.07%
Vojvodina	20.93%	27.06%	32.77%	15.43%	3.81%

Source: Authors' calculation

The Chi-square test confirmed the heterogeneity of the factor by regions (p value is of the order of magnitude 10^{-16}). The appearance of a large share of grade 4 in B&H and Croatia, in contrast to Belgrade and Vojvodina, is quite clearly expressed. The question is to what extent are these profiles different from each other? The Chi/square distance between the profiles showed the large distances between B&H and Belgrade as well as B&H and Vojvodina, also between Croatia and the same two regions, while the distance between B&H and Croatia, as well as between Vojvodina and Belgrade, is significantly smaller.

In order to get a better insight, the correspondence analysis has been used. In this procedure, the total inertia (which is the overall measure of dispersion among the profiles) is broken down in a way that enables the recognition of the main components (principal components) composed of these profiles and the calculation of the share of variability described by each component. Principal component coefficients can be used to see similarities and differences between profiles. Therefore, the first main component accounts for 93.15% of the total inertia, i.e. it accounts for most of the dispersion among these profiles.

The similarity of the profiles of Croatia and B&H was clearly recognized, with the dominant representation of higher ratings in those profiles. Unlike them, the Belgrade and Vojvodina grade profiles were also similar and were dominated by the presence of smaller grades.

Second, the average score for the Work discretion has been calculated across all questions for each region separately. The share of individual grades in a given region, total for all questions that appear in Work discretion.

The Chi-square test confirmed the heterogeneity of the profile by region (p value is of the order of magnitude 10^{-12}). However, the largest share of grade 4 was noticeable in all regions, followed by grade 3. The third position, in terms of share has been occupied by grades 2 or 5, depending on the region, and this is probably where the difference in profiles is recognized. To what extent were these profiles different from each other? The significantly smaller distance between the profiles than with the Management support factor has been observed.

The closeness of Croatia and B&H grades, on one side, and Belgrade and Vojvodina grades, on another side has been evidenced again. At the same time, a very small share of the grade 1 has been recognized, especially in the Croatia and B&H profiles, while it can be said that the Belgrade and Vojvodina profiles were more prone to extreme evaluations than managers from B&H and Croatia.

The results of the factor Rewards has been very similar as Management support. The similarity assessment by managers from Croatia and B&H was clearly recognized, with the dominant representation of higher ratings in those regions. Unlike them, managers from Belgrade and Vojvodina have given smaller grades to the factor Rewards.

The results of the correspondence analysis for Time availability factor is presented in Figure 1.

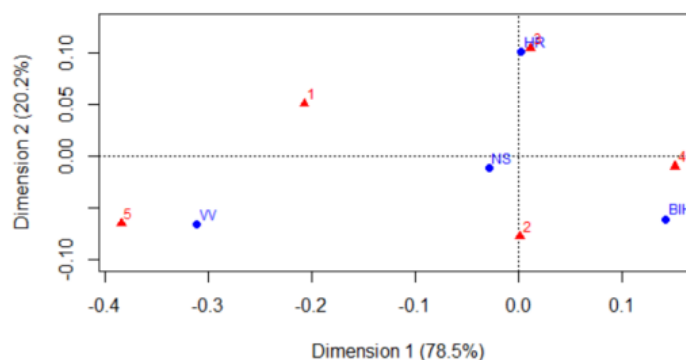


Figure 1. *Different assessment of Time availability by managers in the regions*
Source: Authors' calculation

Factor Time availability got the lowest grades from all managers with significant differences between regions (See Figure 1). The Chi-square test confirmed the heterogeneity of the profile by region (p value was 0.004782). Total inertia was 0.02491788 that has been considered as quite small. This goes in line with other studies (Janicijevic and Kontic, 2023).

Regarding the Organizational boundaries factor, the results showed that assessment of managers from Bosnia and Herzegovina has been differed from the others by this factor, which is the furthest from the extreme ratings. In general, the grade one is very poorly represented in all regions. Grade 5 has been frequently used by Croatian managers than in other regions.

5. CONCLUSIONS AND RECOMMENDATIONS

Investigating the key factors of corporate entrepreneurship may stimulate innovation at regional level. The main aim of this paper is to identify similarities in assessment the key corporate entrepreneurship factors in the selected regions from Serbia, Croatia, and Bosnia and Hercegovina.

Five factors that indicate the existence of corporate entrepreneurship in the organization are: management support, work discretion, rewards, time availability, and organizational boundaries.

The main research question was: Do managers in Serbia, Croatia, Bosnia and Hercegovina similarly assess key factors of the corporate entrepreneurship?

The sample consists of 240 managers of the most successful companies in the field of oil production and refining from Serbian regions, Croatia, and Bosnia and Herzegovina (B&H). The research instrument was CEAI. Data have been processed by correspondence analysis.

The findings showed that in terms of the Management support and Work discretion rating, two groups of managers stand out. On the one hand, managers from Croatia and B&H gave similar and higher ratings to these factors than managers from Belgrade and Vojvodina, who gave these factors similar but lower ratings. The Time availability factor has been differently assessed by managers from region. Managers from Bosnia and Herzegovina were different from the rest of the region in assessment Organizational Boundaries. The higher rating of the Organizational boundaries had observed managers from Croatia.

REFERENCES

- Agapie, A., Paiusan, R., Vizitiu, C., Nastase, M., & Hadad, S. (2018). Adapting a corporate entrepreneurship assessment instrument for Romania. *South African Journal of Business Management*, 49(1), 1-7.
- Bhardwaj, B. R., Sushil, & Momaya, K. (2011). Drivers and enablers of corporate entrepreneurship: Case of a software giant from India. *Journal of Management Development*, 30(2), 187-205.
- Covin, J. G., & Slevin, D. P. (1989). Strategic management of small firms in hostile and benign environments. *Strategic management journal*, 10(1), 75-87.
- Covin, J. G., & Slevin, D. P. (1990). New venture strategic posture, structure, and performance: An industry life cycle analysis. *Journal of business venturing*, 5(2), 123-135.
- Covin, J. G., & Miles, M. P. (1999). Entrepreneurship and the Pursuit of Competitive Advantage. *Entrepreneurship Theory and Practice*, 23(3), 47-63.
- Croatian Bureau of Statistics (2023). *Annual financial report for 2022*. Zagreb: Croatian Bureau of Statistics.
- De Araújo Castro, A., de Oliveira Guimarães, L., & Siffert, P. V. (2020). Designing and testing an assessment model of the antecedents of corporate entrepreneurship in public and private companies. *Revista de Empreendedorismo e Inovação Sustentáveis*, 5(3), 3-20.
- Dean, C. C. (1993). *Corporate entrepreneurship: Strategic and structural correlates and impact on the global presence of United States firms*. University of North Texas.
- Dess, G. G., Ireland, R. D., Zahra, S. A., Floyd, S. W., Janney, J. J., & Lane, P. J. (2003). Emerging issues in corporate entrepreneurship. *Journal of management*, 29(3), 351-378.
- Goodale, J. C., Kuratko, D. F., Hornsby, J. S., & Covin, J. G. (2011). Operations management and corporate entrepreneurship: The moderating effect of operations control on the antecedents of corporate entrepreneurial activity in relation to innovation performance. *Journal of operations management*, 29(1-2), 116-127.
- Greenacre, M. (2017). *Correspondence analysis in practice*. Third edition. New York: Chapman and Hall/CRC.
- Hisrich, R. D. (2006). *Entrepreneurship research and education in the world: Past, present and future*. Jahrbuch Entrepreneurship 2005/06: Gründungsforschung und Gründungsmanagement, 3-14.

- Hitt, M. A., Ireland, R. D., Camp, S. M., & Sexton, D. L. (2001). Strategic entrepreneurship: Entrepreneurial strategies for wealth creation. *Strategic management journal*, 22(6-7), 479-491.
- Hollanders, H. & Es-Sadki, N. (2023). Regional Innovation Scoreboard 2023. 11th edition.
- Holt, D. T., Rutherford, M. W., & Clohessy, G. R. (2007). Corporate entrepreneurship: An empirical look at individual characteristics, context, and process. *Journal of Leadership & Organizational Studies*, 13(4), 40-54.
- Hornsby, J. S., Kuratko, D. F., & Montagno, R. V. (1999). Perception of internal factors for corporate entrepreneurship: A comparison of Canadian and US managers. *Entrepreneurship Theory and Practice*, 24(2), 9-24.
- Hornsby, J. S., Kuratko, D. F., & Zahra, S. A. (2002). Middle managers' perception of the internal environment for corporate entrepreneurship: assessing a measurement scale. *Journal of business Venturing*, 17(3), 253-273.
- Hornsby, J. S., Kuratko, D. F., Shepherd, D. A., & Bott, J. P. (2009). Managers' corporate entrepreneurial actions: Examining perception and position. *Journal of business venturing*, 24(3), 236-247.
- Ireland, R. D., Covin, J. G., & Kuratko, D. F. (2009). Conceptualizing corporate entrepreneurship strategy. *Entrepreneurship theory and practice*, 33(1), 19-46.
- Janićijević, N., & Kontić, L. (2023). Corporate entrepreneurship in a collectivist culture: the role of time availability. *International Journal of Emerging Markets*, ahead-of-print. <https://doi.org/10.1108/IJOEM-08-2022-1304>
- Kolakovic, M., Sisek, B., & Milovanovic, B. M. (2008). Influence of corporate entrepreneurship on the performance of Croatian large companies. *Global Business & Economics Anthology, Selected papers of 2008 Business & Economics Society International Conference*.
- Kontić, Lj. (2012). Investigating corporate entrepreneurship in serbian context. *CONTEMPORARY ISSUES IN ECONOMICS, BUSINESS AND MANAGEMENT-EBM 2012*, 121.
- Kontic, Lj., & Vidicki, D. (2016). Corporate entrepreneurship in Serbian public sector. *Entrepreneurship: Types, current trends and future perspectives*, 14.
- Kontić, Lj., Vidicki, D., & Domanović, V. (2017, October). Testing corporate entrepreneurship assessment instrument in transition environment. In DIEM: Dubrovnik International Economic Meeting (Vol. 3, No. 1, pp. 67-78). Sveučilište u Dubrovniku.
- Kuratko, D. F., Hornsby, J. S., & Covin, J. G. (2014). Diagnosing a firm's internal environment for corporate entrepreneurship. *Business Horizons*, 57(1), 37-47.
- Macura, R. & Tanjga, R. (2013). Characteristics of the entrepreneurial environment of the Banja luka region. *Anali poslovne ekonomije*, 5(2), 15-32.
- Miller, D. (2011). Miller (1983) revisited: A reflection on EO research and some suggestions for the future. *Entrepreneurship theory and practice*, 35(5), 873-894.
- Morris, M. H., & Paul, G. W. (1987). The relationship between entrepreneurship and marketing in established firms. *Journal of business venturing*, 2(3), 247-259.
- Rutherford, M. W., & Holt, D. T. (2007). Corporate entrepreneurship: An empirical look at the innovativeness dimension and its antecedents. *Journal of organizational change Management*, 20(3), 429-446.
- Sharma, P., & Chrisman, J. J. (1999). Toward a reconciliation of the definitional issues in the field of corporate entrepreneurship. *Entrepreneurship theory and practice*, 23(3), 11-28.

- Singer, S., Alpeza, M., & Oberman Peterka, S. (2009). Corporate Entrepreneurship—a Way How Big Companies Can Deal with Challenges of Global Economic Crisis. Challenges of Europe—Financial Crisis and Climate Change, Split—Bol, May, 21-23.
- Smajlović, S., Muratović, A., & Umihanić, B. (2024). Influence of corporate entrepreneurship on business model innovation of companies in Bosnia and Herzegovina after the COVID-19 pandemic. *Management: Journal of Contemporary Management Issues*, 29(1), 31-45.
- Statistical Office of the Republic of Serbia (2023). *Annual financial report for 2022*. Belgrade: Statistical Office of the Republic of Serbia.
- Sučić Funko, I. (2023). Corporate entrepreneurship in state owned enterprises, private companies and companies in mixed ownership in the Republic of Croatia (Doctoral dissertation, University of Zagreb. Faculty of Economics and Business. Department of Organization and Management).
- Vela, E. G., Mercader, V., Qalati, S. A., & Ravina-Ripoll, R. (2023). How does the work climate influence intrapreneurship? Evidence from Mexico. *Middle East Journal of Management*, 10(3), 277-296.
- Umihanic, B., & Delic, A. (2013). Organizational assumptions for development of intrapreneurship in companies across Bosnia and Herzegovina. In *DIEM: Dubrovnik International Economic Meeting*, 1 (1), 0-0 . Sveučilište u Dubrovniku.
- Yukl, G. (2008). How leaders influence organizational effectiveness. *The leadership quarterly*, 19(6), 708-722.
- Zahra, S. A. (1993). Environment, corporate entrepreneurship, and financial performance: A taxonomic approach. *Journal of business venturing*, 8(4), 319-340.
- Zahra, S. A. (1995). Corporate entrepreneurship and financial performance: The case of management leveraged buyouts. *Journal of business venturing*, 10(3), 225-247.
- Zahra, S. A., Nielsen, A. P., & Bogner, W. C. (1999). Corporate entrepreneurship, knowledge, and competence development. *Entrepreneurship theory and practice*, 23(3), 169-189.

GLOBAL ACCREDITATION, LOCAL IMPACT: EVALUATING THE INFLUENCE OF INTERNATIONAL BUSINESS SCHOOL ACCREDITATION ON INSTITUTIONAL PERFORMANCE

Vladimir Dženopoljac*

College of Interdisciplinary Studies, Zayed University, Dubai, UAE, vladimir.dzenopoljac@zu.ac.ae,
ORCID number 0000-0003-2974-6466

Aleksandra Dženopoljac

S P Jain School of Global Management, Dubai, UAE, aleksandra.dzenopoljac@spjain.org,
ORCID number 0009-0006-7717-7535

Oualid Abidi

College of Business Administration, Australian University – Kuwait, o.abidi@au.edu.kw,
ORCID number 0000-0002-0099-889X

Abstract: *The impact of international accreditation on the performance of business schools in terms of schools' reputation, student enrollment, research output, and research quality. This paper discusses the impact of a prestigious international accreditation by the Association to Advance Collegiate Schools of Business (AACSB) on research output and international ranking. Using the case studies of the AACSB-accredited business schools in the Gulf region, besides the most current empirical findings in the literature, the paper underscores the role of accreditation in increasing the global competitiveness of the business schools that undertake and pass the accreditation process. It also examines challenges and opportunities for business schools to meet international standards. These findings and the literature reviewed may conclude that the AACSB accreditation creates a nurturing ambiance for an increase in research productivity and quality, improvement in teaching quality, and enhancement of the brand image of the accredited business schools. The two most essential measures applied in this study are the research output and position in international rankings. The international ranking is a composite measure, aggregating academic reputation, citations per faculty, employment outcomes, employer reputation, faculty-student ratio, international faculty ratio, international research network, international student ratio, and the aspect of sustainability. This discussion evidences the critical importance of accreditation in affecting not just educational quality but also strategic initiatives of growth and development within these institutions.*

Keywords: *Higher education, accreditation, institutional performance*

Jel Classification: *A22, A23, M16*

* Corresponding author

1 INTRODUCTION

The universities were mainly considered as the means of industrial competitiveness and regional economic growth during the 1980s. However, this role has shifted with the emergence of the knowledge economy, and universities are seen as hubs for attracting talent in order to serve their purposes adequately (Florida, 1999). Alongside this, the universities evolved from being solely conservers and reproducers of knowledge, which points to their primary activities of teaching and research (Lu & Etzkowitz, 2008), to taking a more proactive role in innovation processes by actively engaging in knowledge commercialization and new venture creation (Urbano & Guerrero, 2013). These trends affect universities' engagement with a broader range of stakeholders making them more comprehensive and more active when it comes to expanding the role of universities as a driver of regional innovation processes (Miller et al., 2014). In line with this, many contemporary universities are seen as entrepreneurial universities that embrace transformational entrepreneurship principles as the main guiding principles of functioning, which include the intersection between Schumpeterian entrepreneurship, driven by profit and efficiency (Schumpeter, 1934), high-growth entrepreneurship, characterized by relying on technological developments and significant growth potential (Azoulay et al., 2020), as well as social entrepreneurship that focuses more on the societal impact, rather than just the economic one (Abidi et al., 2021; Yahchouchy & Dzenopoljac, 2022).

The universities, in turn, provide their stakeholders with services that have been largely described as "experience goods" or goods whose quality remains undetected prior to the use or actual consumption of the goods (Jacqmin & Lefebvre, 2021). This dynamic has generated a unique environment where innovation and economic development thrive in these educational institutions, together with the breeding of socially responsive leaders ready to face complex challenges posed by today's world. That approach will yield academia-industry collaboration in the development of programs designed to address the dynamism of fast-changing, highly demanding problems in society while furnishing students with practical skills fundamental to future success. The remainder of the paper will address the following topics. The literature review will provide a general overview of the AACSB accreditation and research studies that tackled the issue of international accreditations and institutional performance. The methodology section will focus on elaborating on the major research approaches used in this study, namely bibliographic analysis and case studies. The results section will provide a brief overview of the results for these two analyses, while the conclusion will develop main inferences based on the conducted analyses and will emphasize the avenues for future research.

2 LITERATURE REVIEW

The interest in pursuing international accreditations among business schools and colleges has significantly grown in the past, mainly for the reasons of global recognition and the improvement and streamlining of these educational institutions. The main challenge nowadays is recognizing the impact of international accreditations on organizational effectiveness and overall performance (Lejeune & Vas, 2009). The issue of performance can be viewed from multiple perspectives when higher education institutions are in question. Performance improvement through international accreditations, as one of the initiatives towards quality enhancement, is often seen as improvements in operational results (Hendricks & Singhal, 1997), striving towards excellence (Cornuel, 2007), or simply improving the

institution's financial performance (Chow-Chua et al., 2003). The desired performance improvements represent the main drivers behind which accreditation body a business school chooses to pursue. Having the overall improvement of business education as a main prerogative, it is important to distinguish between different metrics of organizational performance in this context. In general, the result of accreditation is seen as the assurance of the quality of the school's operations (Urgel, 2007), the overall improvement of education quality (Chang et al., 2016), the institution's effectiveness (Lejeune & Vas, 2009), increased employee productivity (Hedrick et al., 2010), and improved research performance (Ke et al., 2016).

The major accreditation body for business schools worldwide is the Association to Advance Collegiate Schools of Business (AACSB), initially founded in 1916 in the USA. The accreditation criteria were extremely simple and mainly mechanistic in the early stages of AACSB development (Lock, 1999). Initially, the AACSB was formed on the initiative made by the deans of three business schools from: Harvard University, the University of Chicago, and Northwestern University. Later on, additional universities joined the initiative, namely, the University of California, The Ohio State University, Columbia University, the University of Pennsylvania, Dartmouth University, the University of Pittsburgh, the University of Texas, the University of Nebraska, Tulane University, New York University, and the University of Wisconsin (AACSB, 2021). Over the years, AACSB has evolved significantly, adapting its standards and processes to meet the changing needs of business education and ensuring that member institutions maintain high-quality educational practices. This evolution has included a focus on innovation, diversity, and global engagement, reflecting the dynamic landscape of business education in an increasingly interconnected world. As a result, AACSB-accredited institutions are now better equipped to prepare students for the complexities of the modern business environment, fostering skills that are essential for success in a global marketplace. Today, the AACSB accreditation has more than 1,900 member organizations and more than 1,000 accredited business schools. Additionally, there are more than 100 countries represented within its member organizations and accredited schools (AACSB, 2024). Among the three accreditation organizations, it appears that AACSB International is also one of the most successful in terms of market positioning and attracting new business schools (Miles et al., 2016).

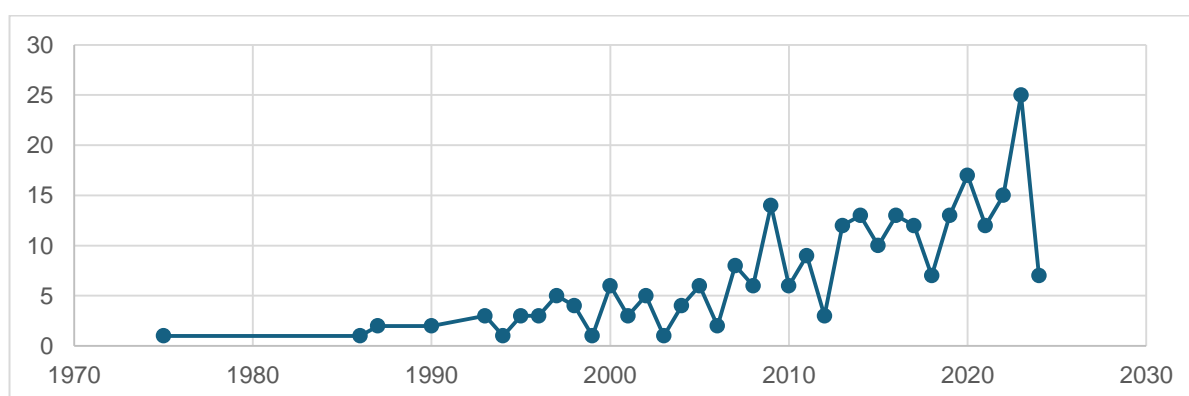


Figure 1. Number of AACSB-related publications

Although business accreditation emerged at the beginning of the 20th century, the research into its effects and impact started being thoroughly studied approximately seven decades later. According to the research statistics obtained from the Scopus database, the studies looking

into the impact of business accreditation on institutional performance commenced in 1986 (Figure 1). Figure 1 depicts a growing trend in this field of research. The business schools are seen to have undergone important transformations while pursuing legitimacy confirmations. The mentioned transformations and corresponding challenges arose within three distinct periods: scientification, politicization, and corporatization of business schools. The growing trend in research regarding the various accreditation standards and their importance coincides with the emergence of the so-called *corporatization* period of business schools, which started when societies started to reflect on universities as expensive investments that need to be managed more efficiently. This view triggered the transformation of universities from “cathedrals of learning” to cathedrals of earning” (Alajoutsijärvi et al., 2015). One of the consequences of such changes is business schools’ efforts to differentiate themselves from the competition, which has become more intensive, especially with the emergence of contemporary technologies and remote learning opportunities. The two main ways for business schools’ differentiation are achieving international recognition through accreditation and higher positioning on international university rankings.

3 METHODOLOGY

The current manuscript will utilize a qualitative research design, mainly bibliographic analysis, with elements of case study analysis and ethnographic research design. The bibliographic analysis refers to a research method that aims at discovering certain characteristics and patterns from a body of literature. The case study attempts to discover important themes by observing individuals, programs, organizations, or events in depth. Finally, the ethnographic research design analyzes a group of entities that share certain common characteristics and tries to understand certain internal patterns (Creswell & Creswell, 2018).

In the first part of the current research, the bibliographic analysis was used on the sample of 316 publications. However, since the majority of the publications consisted of journal articles (80.7%), the analysis mainly focused on this type of publication due to its existing peer-review process. The sample was obtained by utilizing the following search string in the Scopus database:

TITLE-ABS-KEY (AACSB, AND accreditation) AND (LIMIT-TO (DOCTYPE , "ar"))

The mentioned search string yielded a total of 255 research articles. After this, the detailed abstracts of all gathered articles were analyzed, and major topics were identified. The bibliography analysis revealed that AACSB accreditation was perceived as a tool for enhancing educational quality, institutional reputation, and faculty productivity, though it simultaneously raises questions about accessibility and the scalability of its benefits globally.

Apart from the bibliography analysis, the study utilized limited case study analyses, focusing on the business schools that either had gained the AACSB accreditation in the period of bibliography analysis (from 1986) or are currently in the process of obtaining this widely pursued quality recognition. The sample used in the research was obtained via a convenient sampling approach (Etikan et al., 2016), which was deemed appropriate given the sample size and the need to have accessible information about the business schools. The chosen schools were the ones that the authors have had previous interactions during each of the schools’ AACSB accreditation journeys. Finally, the elements of the ethnographic design are seen as

important since the chosen business schools originate from the region of the Middle East and had collaborated during the accreditation.

4 RESULTS AND DISCUSSION

4.1 BIBLIOGRAPHIC ANALYSIS

Some of the key research areas emerged with the bibliographic analysis. Addressing the question of how AACSB accreditation impacts business school performance, the underlying themes of quality improvement and strategic branding, among others, have been noted as widely recognized key themes in this body of literature. Generally, AACSB accreditation is held as a mark of quality whose purpose is to improve teaching standards and strengthen the research output as well as the international reputation of accredited universities. One of the major bibliographic focuses relates to the scope of accreditation and institutional performance. Accredited schools may often improve the quality and quantity of research publications; faculty members often use accreditation standards as a way of motivating themselves toward professional development. This professional development among faculty may sometimes be showcased through improved research outputs and contributions to scholarly activities (Elliott, 2013; Elliott & Goh, 2013; Jamali et al., 2023). Similarly, the strategic advantage performed by AACSB accreditation finds reflection in the differentiation it creates within the global education market. Studies underline how accreditation helps institutions, mostly outside the United States, compete in international markets with a signal of quality to prospective students and faculty (Okulova & Shakina, 2022). In regions such as Asia, this pursuit of AACSB accreditation by business schools reflects an attempt to align with global standards and foster competitiveness in attracting better-quality students and faculty talent (Ke et al., 2016). Other critics note that while accreditation provides the impetus for institutions to improve their processes, the associated financial and operational demands are so significant that it often becomes impossible for schools across the developing world to afford. Much of the critiquing brings forth the fact that AACSB accreditation is "elitist," as the high standards and resource requirements will only serve to exacerbate further educational inequities between institutions across developed and developing countries (Lombana & Zapata, 2017).

AACSB accreditation is largely viewed as a mark of quality that enhances teaching, research, and institutional branding for accredited business schools. It sets high standards, elevating different dimensions of institutional performance into a recognizable mark of distinction in the global education marketplace. There are a few big topics and themes that emerged as a result of this analysis. More results are placed in the appendix of this manuscript.

Quality improvement and standardization: Accreditation ensures that high-quality standards are adhered to, promoting the processes of continuous improvement in teaching methods, assessment practices, and institutional policies. Assurance of learning (AoL) and quality metrics are quite frequently reported as practices assisting schools in keeping curricula on par with industry expectations and ensuring a high standard of education.

Research productivity and faculty development: Increased research output and quality are associated with accredited institutions, as the requirement for accreditation motivates the faculty to be more productive in terms of publishing and being part of scholarly activities. The

second point is that professional development opportunities for the faculty are increased through standards that encourage research, teaching, and professional development.

International competitiveness and institutional branding: Accreditation is a tool used in the strategic branding of institutions to position them in attracting international students and faculty. AACSB status differentiates accredited schools from non-accredited ones, particularly in highly competitive and internationalized education markets like Asia (Ito et al., 2024)..

Student and market signaling: The AACSB mark signals quality assurance to prospective students, employers, and stakeholders, which helps schools attract high-quality applicants and meet employers' expectations for graduates. A handful of studies found some evidence that graduate enrollments may grow as a result of market demand due to AACSB accreditation (Cameron et al., 2023).

Financial and operational challenges. Even though accreditation provides many advantages, it also places significant financial and resource demands on institutions, therefore potentially making it less accessible to schools in underdeveloped areas. The critics argue that the cost associated with obtaining and maintaining accreditations acts as a barrier for small or resource-constrained institutions (McKee et al., 2005).

Institutional reputation and long-term impact: AACSB accreditation is associated with improved institutional reputation and perceived legitimacy, particularly for schools outside the U.S. desiring global recognition. Long-term advantages include developing stronger alumni networks and partnerships and the ability to compete at the global level because of the trust connected to meeting AACSB standards (Nigsch & Schenker-Wicki, 2013; Veretennik & Okulova, 2023).

Differentiation and competitive advantage: Accreditation is a way that one can give an edge due to differentiation among peers in both domestic and international markets. To some institutions, this differentiation implies continued appeal on the market and an increasing potential to attract top-tier talent (Cret, 2010).

Potential for educational inequality: The rigorous standard and costly process of AACSB may contribute to educational inequality, as some critics argue since only well-resourced schools will achieve or hold on to accreditation. Discussions of inclusiveness reflect a need that there must be a balance between rigor and accessibility of the standards for diverse institutions in different economic contexts (Lombana & Zapata, 2017; Perryer & Egan, 2015).

Having all of the above in consideration, we note that AACSB accreditation impacts virtually every aspect of business school activities, from quality and faculty development to international competitiveness and financial burdens. The accreditation fuels growth and differentiation but also raises red flags concerning accessibility and inclusiveness, more so for institutions in emerging markets.

4.2 CASE STUDIES

The current manuscript will utilize a convenient sampling method to illustrate the impact of being in the process of having finalized the AACSB accreditation on two quantitative measures of business schools' performance. Based on the authors' experience and interaction

with various business schools from the region of Middle East and Northern Africa (MENA), the following schools were used for descriptive analysis: the College of Business Administration within the American University of the Middle East (Kuwait), College of Business Administration at Gulf University for Science and Technology (Kuwait), College of Business and Economics at the American University of Kuwait (Kuwait), College of Business and Economics within the United Arab Emirates University (United Arab Emirates), and School of Business within the American University in Cairo (Egypt). The data were gathered from the official website of AACSB International, the respective public documents of the assessed schools, and their official web pages and reports. Additionally, the measures of performance, namely research output and international rankings, were obtained from the Scopus database and QS Top Universities web pages, respectively.

In terms of research output, the analysis took into account the average period between the accreditation eligibility report, which represents the first step in the AACSB accreditation process, and the year in which the initial accreditation was approved. We did not consider re-accreditation cycles, which occurred during the observed period for schools that obtained the AACSB accreditation in the earlier years, like the College of Business and Economics at the United Arab Emirates University (UAUEU) and the School of Business within the American University in Cairo (AUC).

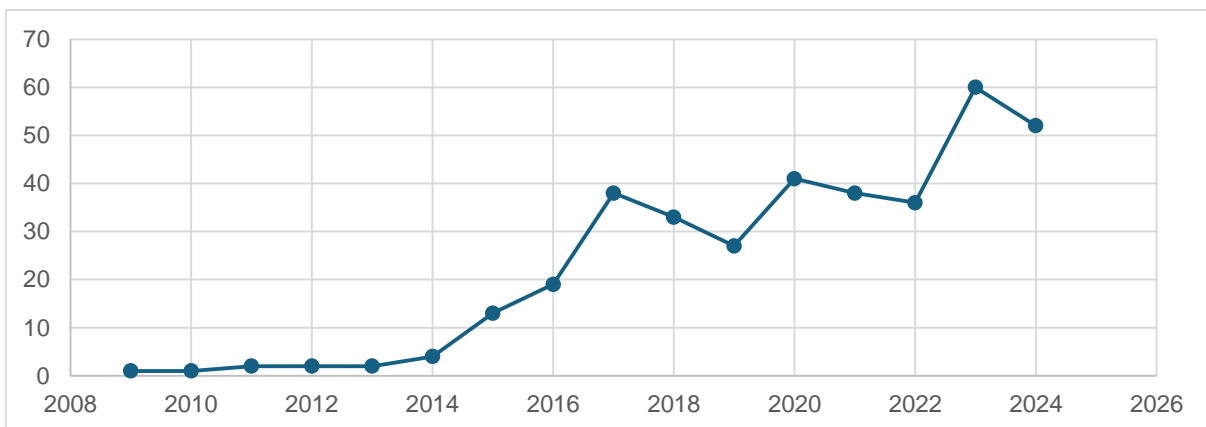


Figure 2. The research output of the College of Business Administration (AUM), accreditation started in 2016, obtained in 2021

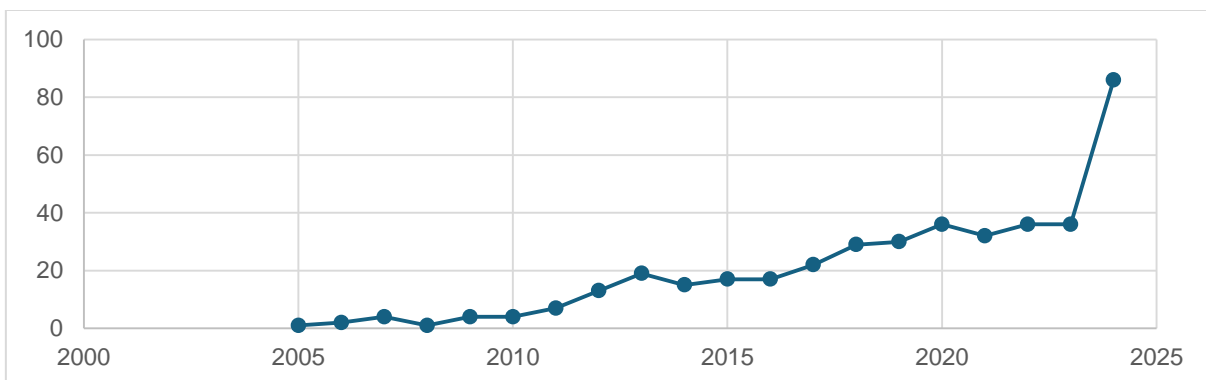


Figure 3. The research output of the College of Business Administration (GUST), accreditation started in 2009 (approx.), obtained in 2014

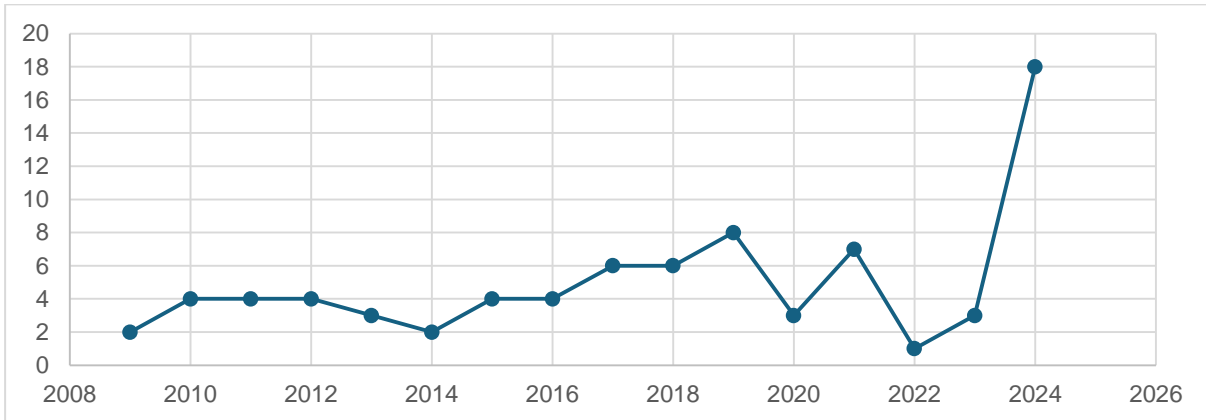


Figure 4. The research output of the College of Business and Economics (AUK), accreditation started in 2014 (approx.), obtained in 2019

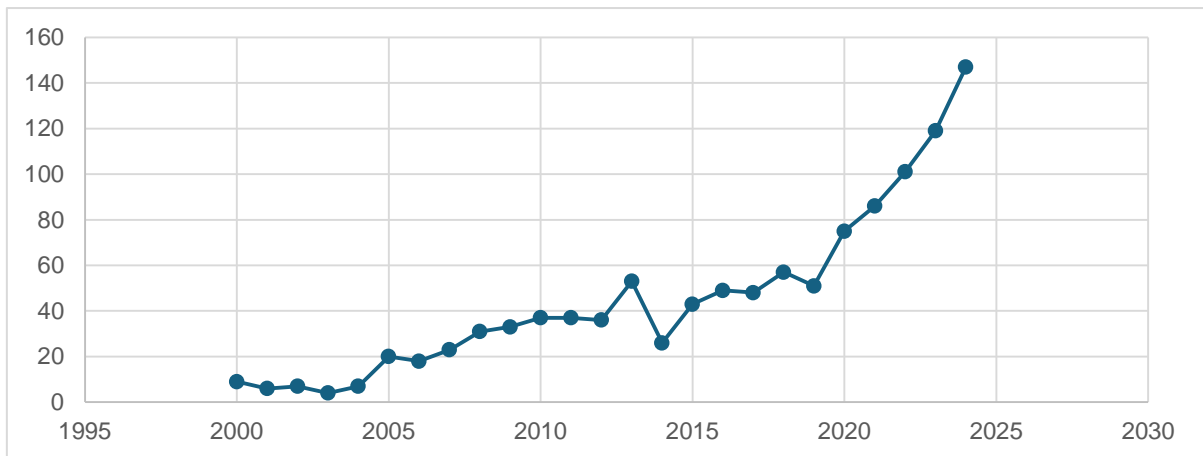


Figure 5. The research output of the College of Business and Economics (UAEU), accreditation started in 1996 (approx.), obtained in 2000

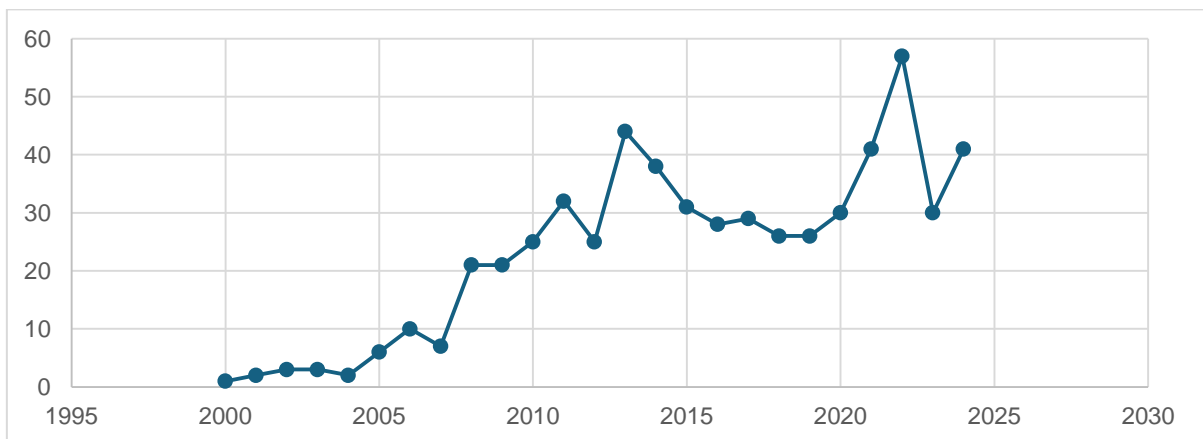


Figure 6. The research output of the School of Business (AUC), accreditation started in 2001 (approx.), obtained in 2006

Figures 2-6 represent the research output of the analyzed business schools. There is a noticeable trend of research publications increase, mainly from the period when the AACSB accreditation was initiated. The growth trend continues during the accreditation period and

afterwards. The AACSB accreditation places significant emphasis on the research output, both in terms of productivity and quality. The research framework that AACSB promotes focuses on general guidelines and leaves the decision of defining research quantity and quality in business schools' hands. The standard that provides this framework is STANDARD 3: FACULTY AND PROFESSIONAL STAFF RESOURCES, which just provides broad pointers in terms of faculty qualifications.

The second criterion, which is more of an indirect one, is the trend in international rankings. For the purposes of this study, we utilized the QS international rankings (www.topuniversities.com), which is a highly desirable list of universities within the MENA region.



Figure 7. QS ranking AUM

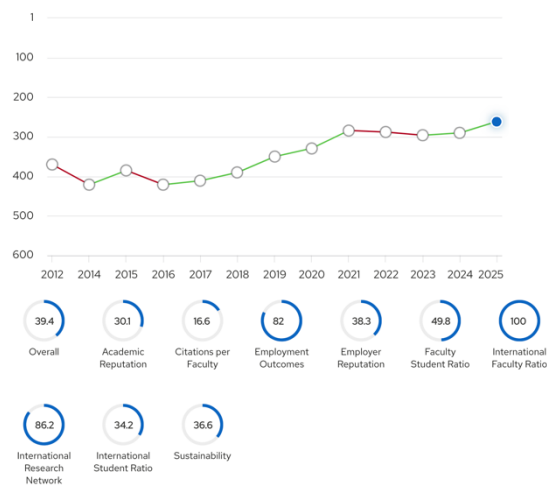


Figure 8. QS ranking UAEU

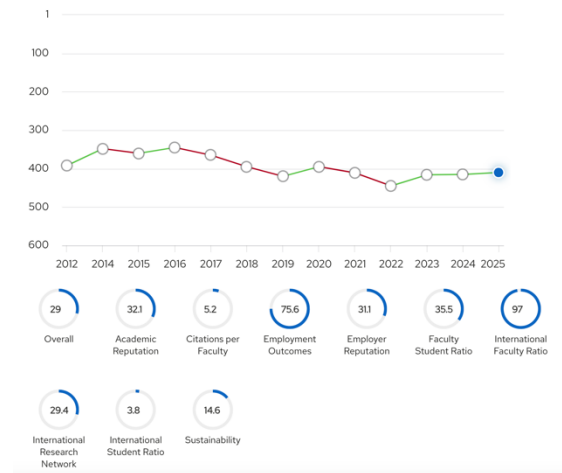


Figure 9. QS ranking AUC

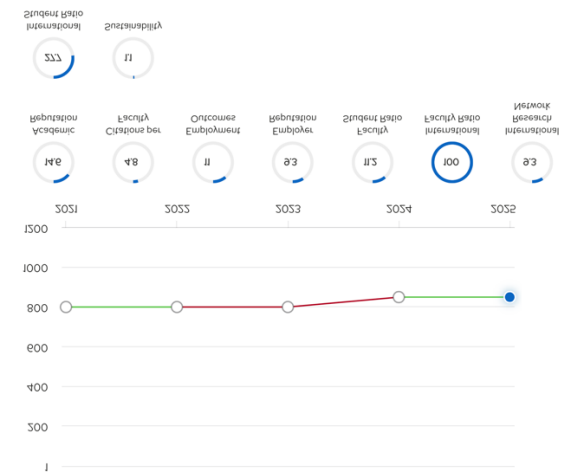


Figure 10. QS ranking GUST

Figures 7-10 depict the trend in QS rankings for four out of five assessed business schools from the MENA region. The American University of Kuwait is not ranked in this list as of November 2024. The appearance on international rankings usually coincides with business schools' engagement with the AACSB accreditation. One of the major components of every

international ranking is research quantity and quality. Since research output has been increasing significantly during the observed accreditation periods, it is to be expected that the rankings will improve partially due to this reason. However, since research output presents only a portion of overall rankings, it is noticeable that the American University in Cairo and Gulf University for Science and Technology have stagnant and even declining trends. This result is not in line with our expectations. However, our findings confirm that involvement in AACSB accreditation presents a positive push toward seeking legitimacy through international rankings.

5 CONCLUSIONS AND RECOMMENDATIONS

The findings highlight the significant value that AACSB accreditation brings to business schools in enhancing their research productivity and helping them establish a distinct strategic identity in an increasingly competitive academic landscape. Our analysis shows that for the schools with AACSB accreditation, there are likely to be important changes in the quantity and quality of their research, as well as in faculty development and international standing. Such advantages are particularly relevant in regions such as the MENA, where international accreditation dovetails with broader institutional goals and strengthens these schools' competitive positions on a global scale.

It also highlights some critical challenges. The financial and operational demands of accreditation can be large, especially for institutions in developing areas, which may make educational inequality worse. This raises the question of whether another, more inclusive model of accreditation is needed—one that keeps standards high while expanding access to ensure more equitable growth for global business education.

More research into how AACSB accreditation influences graduate employability, and the long-term success of alumni would therefore be helpful to demonstrate whether the advantages of accreditation continue to have a positive impact on students well beyond their graduation date. Further, examining the effect of accreditation on partnerships with industry and government may offer lessons for broader societal contributions of accredited institutions.

6 REFERENCES

- AACSB. (2021). *How AACSB Is transforming business school accreditation*. <https://www.aacsb.edu/-/media/documents/accreditation/aacsb-accreditation-white-paper-2021.pdf>
- AACSB. (2024). *Value of AACSB accreditation*. <https://www.aacsb.edu/-/media/documents/accreditation/value-of-accreditation/value-of-aacsb-accreditation.pdf?rev=af0ecb5e633e4e89b3b6ba8671126b2d>
- Abidi, O., Dzenopoljac, V., & Dzenopoljac, A. (2021). Discussing the role of entrepreneurial universities in COVID-19 era in the Middle East, *Management: Journal of Sustainable Business and Management Solutions in Emerging Economies*, 26/2, 55-66. <https://doi.org/10.7595/management.fon.2021.0014>
- Alajoutsijärvi, K., Juusola, K., & Siltaoja, M. (2015). The Legitimacy Paradox of Business Schools: Losing by Gaining? , *Academy of Management Learning & Education*, 14/2, 277-291. <https://doi.org/10.5465/amle.2013.0106>
- Azoulay, P., Jones, B. F., Kim, J. D., & Miranda, J. (2020). Age and high-growth entrepreneurship, *American Economic Review: Insights*, 2/1, 65-82.

- Cameron, M., McCannon, B. C., & Starr, K. (2023). AACSB accreditation and student demand, *Southern Economic Journal*, 90/2, 317-340. <https://doi.org/https://doi.org/10.1002/soej.12660>
- Chang, Y.-s., Lin, K.-j., & Tu, T.-w. (2016). The Impact of AACSB Accreditation on Business School Students in Taiwan, *The Asia-Pacific Education Researcher*, 25/4, 615-625. <https://doi.org/10.1007/s40299-016-0289-y>
- Chow-Chua, C., Goh, M., & Boon Wan, T. (2003). Does ISO 9000 certification improve business performance? , *International journal of quality & Reliability management*, 20/8, 936-953.
- Cornuel, E. (2007). Challenges facing business schools in the future, *Journal of Management Development*, 26/1, 87-92.
- Creswell, J. W., & Creswell, J. D. (2018). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches* (5th edition ed.). SAGE Publications.
- Cret, B. (2010). Accreditations as local management tools, *Higher Education*, 61/4, 415-429. <https://doi.org/10.1007/s10734-010-9338-2>
- Elliott, C. (2013). The impact of AACSB accreditation: A multiple case study of Canadian university business schools, *Canadian Journal of Administrative Sciences / Revue Canadienne des Sciences de l'Administration*, 30/3, 203-218. <https://doi.org/https://doi.org/10.1002/cjas.1257>
- Elliott, C. J., & Goh, S. C. (2013). Does accreditation promote organizational learning? A multiple case study of Canadian university business schools, *Journal of Management Development*, 32/7, 737-755. <https://doi.org/10.1108/JMD-03-2011-0028>
- Etikan, I., Musa, S. A., & Alkassim, R. S. (2016). Comparison of convenience sampling and purposive sampling, *American journal of theoretical and applied statistics*, 5/1, 1-4.
- Florida, R. (1999). The Role of the University: Leveraging Talent, Not Technology, *Issues in science and technology*, 15/4, 67-73.
- Hedrick, D. W., Henson, S. E., Krieg, J. M., & Wassell Jr, C. S. (2010). The Effects of AACSB Accreditation on Faculty Salaries and Productivity, *Journal of Education for Business*, 85/5, 284-291. <https://doi.org/10.1080/08832320903449543>
- Hendricks, K. B., & Singhal, V. R. (1997). Does implementing an effective TQM program actually improve operating performance? Empirical evidence from firms that have won quality awards, *Management Science*, 43/9, 1258-1274.
- Ito, H., Takeuchi, S., Yokoyama, K., Makita, Y., & Ishii, M. (2024). Impact of AACSB accreditation on education quality: perceptions of faculty in an accredited school in Japan, *International Journal of Educational Management*, 38/3, 769-785. <https://doi.org/10.1108/IJEM-05-2023-0258>
- Jacqmin, J., & Lefebvre, M. (2021). The effect of international accreditations on students' revealed preferences: Evidence from French Business schools, *Economics of Education Review*, 85, 102192. <https://doi.org/https://doi.org/10.1016/j.econedurev.2021.102192>
- Jamali, D., Samara, G., & Meho, L. I. (2023). Determinants of research productivity and efficiency among the Arab world's accredited business schools, *Management Review Quarterly*. <https://doi.org/10.1007/s11301-023-00365-1>
- Ke, S.-W., Lin, W.-C., & Tsai, C.-F. (2016). Research performance of AACSB accredited institutions in Taiwan: before versus after accreditation, *SpringerPlus*, 5/1, 1285. <https://doi.org/10.1186/s40064-016-2934-6>
- Lejeune, C., & Vas, A. (2009). Organizational culture and effectiveness in business schools: a test of the accreditation impact, *Journal of Management Development*, 28/8, 728-741. <https://doi.org/10.1108/02621710910985504>

- Lock, A. (1999). Accreditation in business education, *Quality Assurance in Education*, 7/2, 68-76. <https://doi.org/10.1108/09684889910269551>
- Lombana, J., & Zapata, Á. (2017). Acreditaciones internacionales en escuelas de negocios. Una revisión de la literatura, *Revista Lasallista de Investigación*, 14/1, 233-247.
- Lu, L., & Etzkowitz, H. (2008). Strategic challenges for creating knowledge-based innovation in China, *Journal of Technology Management in China*, 3/1, 5-11. <https://doi.org/10.1108/17468770810851476>
- McKee, M. C., Mills, A. J., & Weatherbee, T. (2005). Institutional Field of Dreams: Exploring the AACSB and the New Legitimacy of Canadian Business Schools, *Canadian Journal of Administrative Sciences / Revue Canadienne des Sciences de l'Administration*, 22/4, 288-301. <https://doi.org/https://doi.org/10.1111/j.1936-4490.2005.tb00375.x>
- Miles, M. P., Grimmer, M., & Franklin, G. M. (2016). How well do AACSB, AMBA and EQUIS manage their brands? , *Marketing Intelligence & Planning*, 34/1, 99-116.
- Miller, K., McAdam, M., & McAdam, R. (2014). The changing university business model: a stakeholder perspective, *R&D Management*, 44/3, 265-287.
- Nigsch, S., & Schenker-Wicki, A. (2013). Shaping performance: do international accreditations and quality management really help? , *Journal of Higher Education Policy and Management*, 35/6, 668-681. <https://doi.org/10.1080/1360080X.2013.844669>
- Okulova, O., & Shakina, E. (2022). Is there value in international accreditation beyond quality? An empirical analysis of the AACSB accredited schools, *Higher Education Quarterly*, 76/3, 612-625. <https://doi.org/https://doi.org/10.1111/hequ.12331>
- Perryer, C., & Egan, V. (2015). Business School Accreditation in Developing Countries: A case in Kazakhstan, *Journal of Eastern European and Central Asian Research (JEECAR)*, 2/2, 11. <https://doi.org/10.15549/jeecar.v2i2.95>
- Schumpeter, J. A. O. R. (1934). *The theory of economic development; an inquiry into profits, capital, credit, interest, and the business cycle*. Harvard University Press.
- Urbano, D., & Guerrero, M. (2013). Entrepreneurial Universities: Socioeconomic Impacts of Academic Entrepreneurship in a European Region, *Economic Development Quarterly*, 27/1, 40-55. <https://doi.org/10.1177/0891242412471973>
- Urgel, J. (2007). EQUIS accreditation: value and benefits for international business schools, *Journal of Management Development*, 26/1, 73-83. <https://doi.org/10.1108/02621710710721698>
- Veretennik, E., & Okulova, O. (2023). Of Performance and Impact: How AACSB Accreditation Contributes to Research in Business Schools, *Higher Education Policy*, 36/4, 758-780. <https://doi.org/10.1057/s41307-022-00284-y>
- Yahchouchy, G., & Dzenopoljac, V. (2022). Entrepreneurship and Social Entrepreneurship: A Trend or a Real Factor for a Prosperous Future? In N. Azoury & T. Hafsi (Eds.), *Entrepreneurship and Social Entrepreneurship in the MENA Region: Advances in Research* (pp. 49-74). Springer International Publishing. https://doi.org/10.1007/978-3-030-88447-5_3

7 APPENDICES

Table 1. Number of AACSB-related papers per journal (1986-2024)

SOURCE TITLE	
Journal Of Education For Business	55
Journal Of Accounting Education	24
Academy Of Management Learning And Education	7
Journal Of Higher Education Theory And Practice	7
International Journal Of Management Education	6
Quality Assurance In Education	6
Journal Of International Education In Business	5
Journal Of Teaching In International Business	5
Issues In Accounting Education	4
Journal Of Business And Finance Librarianship	4
Journal Of Economic And Administrative Sciences	4
Organization Management Journal	4
Business Process Management Journal	3
International Journal Of Educational Management	3
International Journal Of Management In Education	3
Journal Of Applied Research In Higher Education	3
Journal Of Emerging Technologies In Accounting	3
Journal Of Management Development	3
Journal Of Marketing For Higher Education	3
Journal Of Organizational Change Management	3
Prabandhan Indian Journal Of Management	3
Studies In Higher Education	3

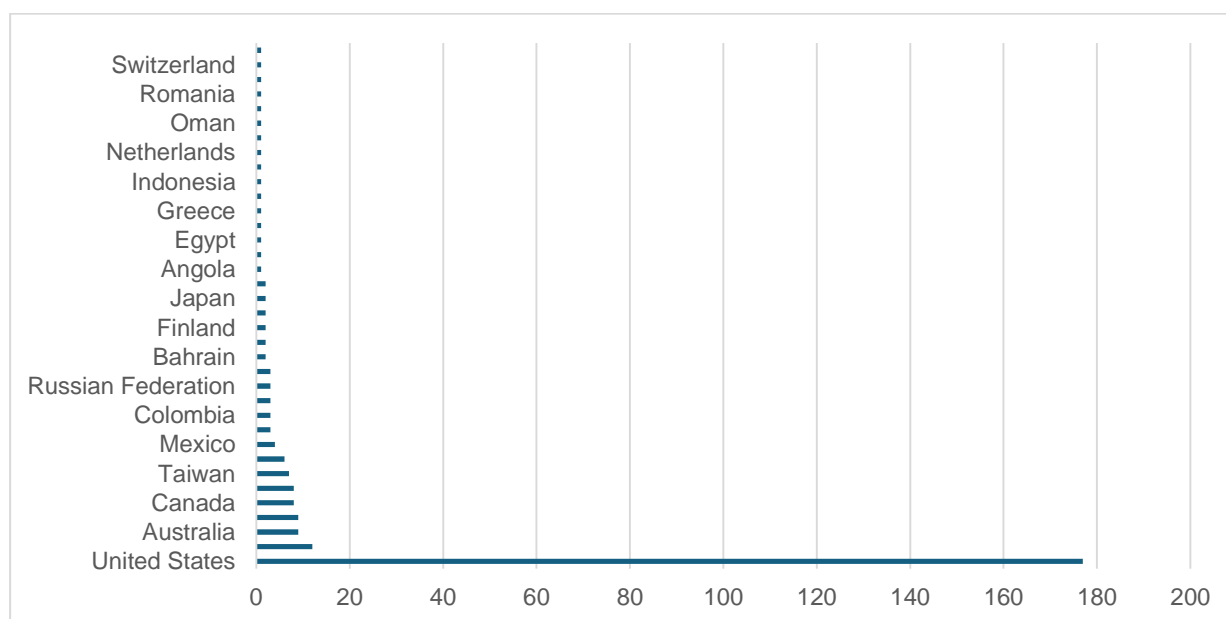


Figure 11. Publications per country (1986-2024)

Documents by subject area

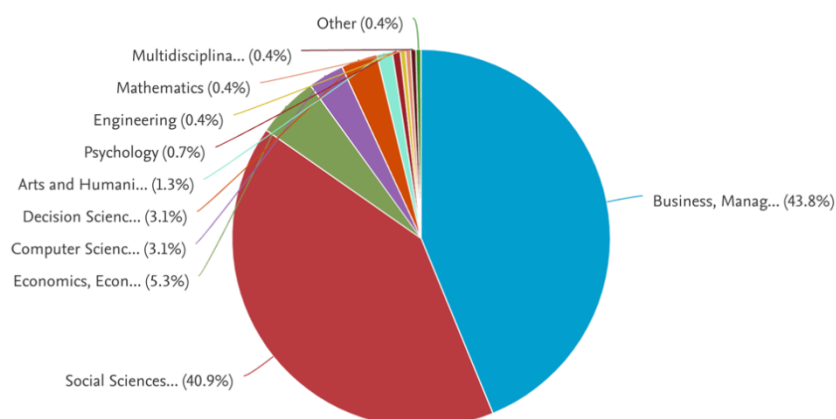


Figure 12. Publications by subject area (1986-2024)

Table 2. The impact of AACSB accreditation on research output (number of Scopus-indexed publications)

YEAR	AUM	GUST	AUK	UAEU	AUC
2024	52	86	18	147	41
2023	60	36	3	119	30
2022	36	36	1	101	57
2021	38	32	7	86	41
2020	41	36	3	75	30
2019	27	30	8	51	26
2018	33	29	6	57	26
2017	38	22	6	48	29
2016	19	17	4	49	28
2015	13	17	4	43	31
2014	4	15	2	26	38
2013	2	19	3	53	44
2012	2	13	4	36	25
2011	2	7	4	37	32
2010	1	4	4	37	25
2009	1	4	2	33	21
2008	n.a.	1	1	31	21
2007	n.a.	4	2	23	7
2006	n.a.	2	n.a.	18	10
2005	n.a.	1	n.a.	20	6
2004	n.a.	n.a.	n.a.	7	2
2003	n.a.	n.a.	n.a.	4	3
2002	n.a.	n.a.	n.a.	7	3
2001	n.a.	n.a.	n.a.	6	2
2000	n.a.	n.a.	n.a.	9	1
	Accreditation initiated				
	Accreditation completed				

THE EFFECTS OF DIGITALISATION ON ESG PERFORMANCE: THE CASE STUDY OF NIS A.D. NOVI SAD

Violeta Domanović*

University of Kragujevac, Faculty of Economics, e-mail: vterzic@kg.ac.rs,
ORCID number 0000-0002-9753-6260

Sladana Savović

University of Kragujevac, Faculty of Economics, e-mail: ssladjana@kg.ac.rs,
ORCID number 0000-0001-5819-6497

Abstract: *In recent years, digitalisation has become a key factor of companies' growth and development, as it enables optimal allocation of resources, effective control of costs and the realization of the United Nations Sustainable Development Goals (SDG). While the exact origination of the Fourth Industrial Revolution remain uncertain, it is clear that new technologies are already drastically changing people's lives and the way companies operate. The growing interest in digitalisation has encouraged more and more research on its impact on the development of companies. However, although research on the relationship between digitalisation and company performance is a current topic, there are insufficient comprehensive studies due to the lack of such an index that would cover all aspects of digitalisation. The existing literature that analyzes the effects of digitalisation mainly focuses on company profits, efficiency of internal business processes, company innovation and organizational performance, but not enough on Environmental, Social and Governmental (ESG) performance. Therefore, the subject of research in the paper is digitalisation and ESG performance. The goal of the research is to determine whether the digital transformation of the company's operations affects ESG performance. To this end, a case study was applied on the example of the company NIS a.d. Novi Sad, which allocates significant funds to the business digital transformation. The results of the research showed the positive effects of digitalisation on ESG performance measures, starting from planning, measurement and data analysis, control and reporting on the ESG performance, which significantly affects the proposal and undertaking of specific measures to improve ESG performance of companies in the future.*

Keywords: *Digitalisation, Performance, Sustainability, ESG performance, ESG reporting*

JEL Classification: *M15, M21*

* Corresponding author

1. INTRODUCTION

In recent times, bearing in mind the ecological seriousness, energy shortages and social conflicts, the issue of harmonious coexistence between the human community and nature is gaining more and more importance. The concept of sustainable development is gaining more and more importance among businesses, consumers and institutional investors. In all segments of business, investment and private decision-making, ESG performance measures are becoming an unavoidable factor. Environmental pollution, global warming, employee poverty and corporate scandals force companies to take care of environmental, social and governance issues (Xiao et al. 2024). In light of the rapid rise of digital technologies, competition between companies is intense and rapidly changing (Chen et al., 2023). In such a rapidly changing business environment, digital transformation has become a strategic imperative for companies that want to remain competitive, as it enables optimal resource allocation, effective cost control, and the realization of the United Nations' Sustainable Development Goals (SDGs). The rapid development of digital technology, marked by uncertainties and disruptions, heralds a new digital era. Digitalisation is one of the main trends of the changing society and business. This digital change has contributed to the creation of digital technologies, such as the Internet of Things, cloud services and mobile applications, artificial intelligence, big data, analytics, social media, and embedded devices. All of this has the potential to fundamentally change industries and societies (Tagscherer & Carbon, 2023).

As a comprehensive and rapid driver of organizational change, digital transformation in the Fourth Industrial Revolution is characterized by a comprehensive transformation of processes, business models and organizational structures using new technologies (Philip et al., 2023). Since it plays a key role in reshaping the production and business models of companies, digital transformation changes the way global resources are allocated and gradually integrates with the new wave of economic globalization. Digitalisation can not only help companies identify and exploit new opportunities, but can also improve problem-solving skills and encourage innovative thinking by sharing information and resources, which will enable efficiency gains (Wang et al., 2024). While the exact outcome of the Fourth Industrial Revolution remains uncertain, the new concept of I5.0 is emerging, representing a powerful new framework for understanding the role of technology in ESG performance disclosure (Asif et al. 2023). Industry 5.0 (I5.0) is emerging after numerous criticisms of I4.0 due to excessive technical and economic focus and insufficient attention to human dimension. The concept of Society 5.0 is closely related to the Sustainable Development Goals of the United Nations and, in particular, to Goal 9, which concerns industry, innovation and infrastructure in order to create sustainable and inclusive societies; goal 11 which calls for the development of sustainable cities and communities; goal 12, which promotes sustainable consumption and production, and goal 16, which promotes peace, justice and strong institutions (Asif et al. 2023).

Digitalisation promotes the exchange of data and information between companies, which leads to a better understanding of the market and competition and opens up new opportunities for interregional specialization and cooperation between companies, encouraging sustainable business development. In this regard, Hinings et al. (2018) proved that digitalisation leads to new digital organizational forms, lowering the costs and time of transactions, while Carmela et al. (2020) highlight the dominant challenges faced by companies in the agri-food industry in the adoption and application of digital technology, thereby creating lasting benefits for

economic and social sustainability. Digitalisation increases the efficiency of the knowledge management process and leads to better sustainability performance through the integration, utilization and renewal of knowledge.

Although there is a consensus that ESG performance not only increases operational efficiency, but also overall corporate performance and value, there is still insufficient research on the correlation between digital transformation and ESG performance (Liu, Chen & Hu, 2024, 5088). Therefore, the subject of research is the relationship between digitalisation and the company sustainability. The goal of the research is to determine whether and to what extent digitalisation affects ESG performance. To this end, a case study was applied on the company NIS a.d. Novi Sad, as an example of a company that allocates significant funds to the digital transformation of all business segments.

The paper is structured as follows: firstly, there is a literature review related to digitalisation in the modern business environment, as well as the effects of digitalisation on the business and sustainability performance, after which the research methodology is described, followed by the results and a discussion of the research results related to the effects of digitalisation on ESG performance and finally, the conclusion, in which the limitations, theoretical and practical contribution of the research results, as well as future directions of research are highlighted.

2. LITERATURE REVIEW

Digital transformation has implications for business strategy, organizational structure and corporate culture. Apart from the integration of digital technologies, digital transformation results in organizational and social changes within companies. The use of digital technologies can increase the internal efficiency of the company, create additional value for the customer and create new business models. With the increase in the ability to analyze huge amounts of data in real time, the reduction of setup needs, processing time and errors, higher productivity is expected to be realized (Tagscherer & Carbon, 2023). In the modern business environment, managers of large companies direct their efforts towards activities that will include the implementation of technology while they perform the activities, realizing the advantages with the support of technology. The fact is that technology is advancing rapidly, offering countless solutions to improve the work experience, including artificial intelligence, different platforms, and unique solutions for specific problems that may arise during the daily performance of tasks (Tech Mergers & Acquisitions Report, 2022). Digital transformation reduces agency costs and improves corporate goodwill, thus increasing the company's ESG score, but the impact of other dimensions of digitalisation on the corporate ESG score is not examined (Fang et al. 2023). On the other hand, digital transformation improves company performance and leads to increased company value by increasing operational and managerial efficiency, innovation and productivity (Hinings et al. 2018, Li et al. 2022, Liu et al. 2023). Digital transformation also leads to a reduction in emissions, so the companies can implement corporate social responsibility practices (Li & Wang, 2022).

Numerous studies focus on analyzing the impact of digital technology on business performance in a specific segment. At the company level, however, there is a lack of digitalisation index and the analysis methods are varied. Some parts of the literature use case studies; others use production functions or strategic analysis. For example, Khayer et al.

(2020) used a 'technology-organization-environment' framework based on Fred Fiedler's contingency theory, to assess how 'cloud computing' affects the performance of SMEs. Wamba-Taguimdje et al. (2020) analyzed the impact of artificial intelligence on business performance based on 500 case studies from the websites of IBM, AVS and Universal Robots. Carmela Annosi et al. (2020) performed an exhaustive review of the literature that includes 94 peer-reviewed articles in English language and concluded that there is a lack of suitable measurements for making a study on the digitalisation and business performance, and in this sense there are only partial indicators, which do not reflect the true and complete picture of digitalisation of business operations.

The growing interest in digitalisation has encouraged more and more research on its impact on the companies' development. The European e-Business Report (2008) identifies three main segments in the process of adding value based on ICT, namely: digitalisation or the adoption and application of information and communication technologies; value development based on ICT and the impact of digitalisation on performance (Martínez-Caro et al., 2020). However, although research on the relationship between digitalisation and company performance is a current topic, there are insufficient comprehensive studies due to the lack of an index that would cover all aspects of digitalisation (Carmela Annosi et al., 2020). The existing literature that analyzes the effects of digitalisation mainly focuses on company profits, internal business process efficiency, company innovation and organizational performance (Gao, Yan & Mo, 2023). New performance measurement models must take into account a number of issues such as the company sustainability in modern business conditions, as well as the effects of business digitalisation on company performance viewed from different perspectives, such as the perspectives in the Balanced Scorecard (BSC) model (Federico et al., 2020).

The impact of digital technologies, such as big data, intelligent manufacturing, artificial intelligence, and the Internet, on company performance has been extensively investigated in the literature (Gao, Yan & Mo, 2023; Wamba-Tabuimjde et al., 2020; Zhou et al. al., 2019). There is a consensus among researchers that these technologies provide several advantages to businesses, which manifold improve their performance. For example, Maroufkhani et al. (2019) argue that big data enables businesses to leverage business analytics to gain competitive advantage in the marketplace. Similarly, some authors have found that information and communication technology (ICT) enables industrial companies, especially those involved in long-life products, to adopt new business models based on the use of real-time data and rapid processing capabilities, or facilitates companies in developing the ability to manage customers, processes and performance, which contributes to the improvement of overall performance (Gao, Yan & Mo, 2023). Khayer et al. (2020) point out that "cloud computing" represents a platform on which companies access networks, servers, applications and services, improving core competence, leading to improved company performance. Moreover, Wamba et al. (2017) hypothesized that artificial intelligence encompasses a wide range of technologies, such as machine translation, chatbots, and self-learning algorithms, that improve financial, marketing, and administrative functions in a company. Martín-Peña et al. (2019) found that increasing the synergy between service-oriented and digital approaches can improve business performance. Hautala-Kankaanpää (2022) establishes that digitalisation of the supply chain can improve the business performance of the company, especially the ability to integrate digital resources with the business activities of the company. Sedera et al. (2016) believe that digitalisation enables the establishment of platforms such as the Internet of Things (IoT), integration platforms and supply chain platforms. These platforms enable the

integration of production and logistics control, data management, applications and processes between companies, thereby increasing the efficiency of the company's internal business processes.

The digital transformation of business has an increasing impact on the decision-making process of managers. Consequently, managers accept and implement new work methods that are in line with the prevailing digitalisation trends in the branch in which they operate. Lee et al. (2024) examine the mediating role of digitalisation in the relationship between intellectual capital and sustainability performance using the example of construction firms. This study establishes a new theoretical model aimed at examining the impact of the three components of intellectual capital (human, structural and relational) on digitalisation from a knowledge-based perspective and explores how intellectual capital and digitalisation affect sustainability performance, namely economic, environmental and social performance. The authors find a positive impact of intellectual capital on digitalisation and a positive impact of digitalisation on three-dimensional sustainability performance, emphasizing that digitalisation has a significant mediating role in the relationship between intellectual capital and sustainability performance.

In the process of digital transformation, companies introduce digital tools and technologies as new institutional components, encouraging compliance with the evolution of the market environment, all in the desire for increased external recognition and acceptance. At the same time, guided by the transaction costs theory, companies strive to reformulate their market relations by dealing with both external transaction costs and internal control costs, thereby simultaneously pursuing the dual goals of improving business performance (Gao, Yan & Mo, 2023). In this regard, Lu et al. (2023) find in their research that digital transformation can significantly improve ESG performance by increasing internal control and green innovation, primarily in the private sector and the manufacturing and high-tech sectors, as well as in companies with more independent directors. In addition, the authors find a positive moderating role of government support, but also a negative role of the degree of market development in the business environment of the company.

Digital transformation increases the transparency of production, business and investment activities of companies, so that they are more closely monitored by the public. After the digital transformation of companies, their external transparency increases, given that managers have to improve their environmental performance in order to gain market resources and prevent environmental penalties. Social performance implies that companies should take into account, not only profit, but also the interests of shareholders, employees, creditors, customers, local and wider social community. Digital transformation provides a digital platform for all stakeholders in order for the company to coordinate their interests, which facilitates their access to internal and external resources so that they can respond to the demands of all stakeholders as efficiently and effectively as possible. In addition, digitalisation increases the innovative ability of companies, thus impacting on the value for all stakeholders (Zhuo & Chen, 2023). Digital transformation enhances the specialization of companies, which results in higher productivity, better management and investment, as well as greater motivation to carry out socially responsible activities (Liu, Chen, & Hu, 2024). Regarding management performance in the ESG score, it is evident that digital transformation reduces information asymmetry and promotes innovation in management models, thus improving the internal management structure (Hinings et al. 2018). In addition, digital transformation enhances the integration of corporate resources through digital technology,

resulting in lower financing costs, stronger production and innovation capabilities, and improved corporate governance. With digital transformation, the quality of reporting on environmental issues increases, so that environmental performance is also better. With insufficient and unclear disclosure of environmental information, there is a suspicion that companies hide environmental problems and are unable to prove that their environmental performance meets environmental standards, which brings with it certain financial constraints (Meng & Zhang, 2022). Disclosure of corporate environmental information improves the financial performance of companies, increases their value, and further influences the attraction of investments, improvement of innovative ability and greater technical support for green activities (Luo et al. 2022). Fang et al. (2023) find that digitalisation of a company's operations improves the overall ESG score, but does not significantly affect environmental performance. Figure 1 shows the effects of digitalisation on ESG performance.

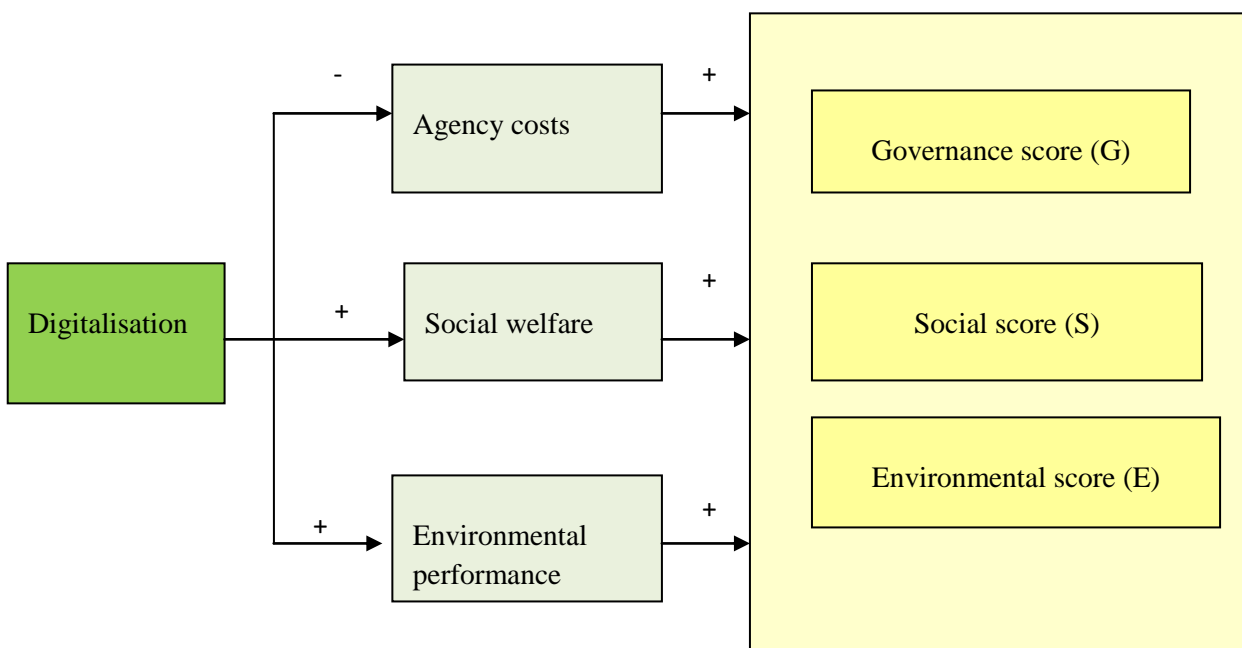


Figure 1: *The effects of digitalisation on ESG performance*

Source: Authors, based on Fang, M., Nie, H., & Shen, X. (2023). Can company digitalisation improve ESG performance? *Economic Modelling*, 118, 1-15. <https://doi.org/10.1016/j.econmod.2022.106101>

Based on the literature review, it can be concluded that the authors mainly examine the effects of discrete digital technology on different company performances at a theoretical level (Martínez-Caro et al., 2020; Duman & Akdemir, 2021). However, there is a gap observed in examining the effects of digitalisation on company performance from an empirical perspective, especially on sustainability performance, i.e. ESG performance. Therefore, in this research, the starting point is the following research question: *Does digitalisation contribute to the improvement of ESG performance?*

3. METHODOLOGY

Whether and to what extent digitalisation affects ESG performance will be analyzed using the example of the company NIS a.d. in the Republic of Serbia, which in 2019 made significant steps in the process of digital business transformation. First, the position of Chief Digital

Officer (CDO) was created (Annual Business Report, 2020), whose primary task is the transformation of the company with the application of innovation and digital technologies in business and thus increasing business efficiency. The company continuously works on improving business processes, which implies the introduction of various digital solutions and technologies, all with the aim of improving business efficiency. According to data from the Annual Business Report for 2023, the company's digital portfolio consists of about 120 digital projects, among which are projects focused on data management and analytics (Annual Business Report, 2023). Digital transformation has not bypassed the oil industry either, regardless of the fact that the products of the oil industry, oil and oil derivatives, can hardly become digital and that the oil industry must remain inclined to traditional methods, primarily when it comes to working with dangerous substances, occupational safety and environment protection. On the other hand, the oil sector faces numerous challenges in the modern business environment, such as changes in the oil price, significant market instability, the increased need for energy, as well as the ever-increasing demands that energy be produced and delivered in a way that will contribute to stopping climate change. In addition, there is competition in the energy sector, which imposes on all participants the need for constant innovation, implementation of the best technical-technological solutions and permanent improvement of product quality.

As the sustainability performance, ESG performance was chosen, where E refers to environmental performance, S to social and G to corporate governance performance. All data and information were taken from the Annual Report and the Sustainable Development Report in the period from 2020 to 2023, i.e. after the more intensive digital transformation of the company's business.

4. RESULTS AND DISCUSSION

Digitalisation brings not only challenges, but also numerous opportunities. At NIS, managers are very aware of the necessity of introducing and implementing numerous digital solutions, as well as the fact that digital technologies determine the new direction of the company's development and at the same time represent a tool for the realization of corporate strategic goals. In this sense, the managers see the advantages of digitalisation, such as improving economic performance, strengthening competitiveness in the market and creating value for shareholders and employees (Zalevski, 2020). In 2020, the company allocated as much as 25.3 billion dinars for the modernization and development of the company. In 2020, 14 digital projects were completed: Real-time operating center, Online Drilling, Mobile Operator, GPS Tracking, OTS (Crane Operator), Mobile operator, Drive. Go, Paketomati and Instant Payment (Annual Report for 2020, 9). In 2021, about 20 digital projects were completed, and within the digital laboratory, which is part of the Scientific and Technological Center of NIS, during 2020-2021, numerous projects were successfully implemented, of which projects related to the application of digital technologies stand out, such as machine learning, big data, advanced analytics, business intelligence (Annual Report for 2021, 2021, 8-9).

In the modern business environment, the NIS Company is aware that it is not enough to be just a buyer of innovative technologies and knowledge, but it is also necessary to develop them independently. In this sense, a digital laboratory was established within the Scientific and Technological Center of NIS, where NIS experts are engaged in scientific and research work within the framework of digital projects and examine the possibilities of their

application in the oil industry. In addition, the importance of connecting with the IT community was noticed, and in this sense the NIS Company supports the most important events in this area. The NIS Company is aware that people are the most important resource in the process of digital transformation, and in this sense they are constantly working to attract the best personnel with exceptional knowledge and skills. In the course of 2023, the realization of the digitalisation program of Functions for HSE was launched, which aims to improve the work of employees, as well as easier and safer management of contractors (Annual Report, 2023). In addition, the NIS Company is also working on changing the organizational culture in terms of encouraging innovation and the application of digital tools in work. Consequently, the NIS Company distinguishes only the advantages of the digitalisation process as an opportunity for further development, not only for the company, but also for the economy of the Republic of Serbia as a whole.

The NIS Company follows the latest research in the field of digitalisation and, according to its needs, has created its digital portfolio for various organizational parts and segments in the value chain, namely: oil and gas exploration and production, oil and gas refinery processing and oil and gas trade. For each segment, digital tools and technologies have been defined that will enable the most effective realization of the defined goals, namely: machine learning, artificial intelligence, Internet of Things, use of mobile devices, big data, drones and the like. Company managers expect that innovative digital technologies will increase business efficiency and efficiency in oil and gas exploration and production, increase the competence of employees to a higher level, strengthen the safety and reliability of plant operation, and what is of particular importance, improve communication with consumers in wholesale and retail, as the most important stakeholders. New digital tools will make it possible to offer consumers extremely high-quality services, which are of particular importance because NIS is a leader on the domestic market, and its business is also developing in neighbouring countries.

ESG performance of NIS a.d. Novi Sad in 2020

Based on the Annual Report in 2020, it can be seen that the company singles out the Corporate Governance, Human Resources, Environmental Protection, Industrial and Occupational Safety, Social Responsibility segments.

E component

In 2020, the company NIS invested more than 211 million dinars in various environmental projects in all business segments. The company has invested more than 290 million dinars in socially responsible projects.

S component

In 2020, NIS was declared the most desirable employer in the Republic of Serbia in a year marked by change and instability, which is a sign that the company is keeping up with the times and taking care of new generations. The company listens to the needs of employees and constantly works to improve their satisfaction and commitment. In this sense, it invests significantly in the training and development of employees in all segments, the Corporate University was founded, and it provides its employees with a high degree of social protection. The company's long-term goal is to increase the commitment of its employees and improve HR practices, which will provide NIS employees with the best possible work experience.

G component

The Board of Directors is made up of experts in their field. With their experience, competencies, motivations, ambitions, visions and personal contribution, each member makes the company always has one common goal. The members of the Board of Directors must meet the conditions prescribed by the Law, as well as the special conditions prescribed by the Statute. Aware of the importance of efficient and responsible corporate management, NIS is committed to the application of high standards in this area, which are based on internationally accepted principles and world practice experiences with continuous development and improvement of corporate management.

ESG performance of NIS a.d. Novi Sad in 2021

The company applies all standards requirements: SRPS ISO 9001:2015 Quality Management, SRPS ISO 14001:2015 Environmental Management, SRPS ISO 45001:2018 Occupational Health and Safety Management and SRPS EN ISO 50001:2018 Energy Management, as well as SRPS ISO 39001 Management road transport safety, SPRS EN ISO 22000:2018 Food safety management (Annual Report, 2021, 170). The applied management systems are connected in an integrated management system (IMS) which is based on a process approach.

E component

The development of NIS is based on the constant introduction of innovations and the application of new technologies. The Drive.Go mobile application enables paying for fuel without going to the payment point and was declared the innovation of the year. NIS a.d. Novi Sad continuously improves the environmental performance of processes, develops the environmental awareness of employees and encourages the application of the best available methods and technologies in investment projects that have a direct or indirect impact on the environment. By reducing emissions of polluting substances into the atmosphere, the quality of the air has improved and, indirectly, the degree of satisfaction of the residents nearby has increased. The level of compliance with the requirements of the legislation of the Republic of Serbia has been raised and the management of the environmental protection system in NIS has been improved. NIS takes care of environmental protection through various projects aimed at strict compliance with environmental standards, efficient and responsible use of available resources, increasing energy efficiency and the use of renewable energy sources. During 2021, 355.6 million dinars were invested in ecological projects.

S component

In 2021, the company also received external awards at the competition for business excellence. In addition, in 2021, NIS received three awards for being one of the most desirable employers in the Republic of Serbia. The "Respect, first of all" platform was declared one of the best HR projects in the Republic of Serbia. HR strategy, the new company values and value positions of NIS as an employer (diversity and inclusion initiative, employer brand strategy and learning and development strategy) has led to a large number of HR projects and initiatives. The implementation of these initiatives will enhance the experience of candidates and employees at NIS, from finding and selecting candidates to rewards, compensation and benefits for employees, development and advancement. In the NIS, great attention is paid to educational activities in order to improve digital culture and achieve digital transformation. In 2021, education was implemented, intended for all categories of employees, in the field of digital transformation, data management, digital technology and project and product management.

G component

In 2021, the company applies the Code of Corporate Governance, which is an amendment to the rules contained in the Law and the Statute of NIS a.d. Novi Sad. The Board of Directors takes care of the implementation of the principles established by the Code, monitors its implementation and the compliance of the organization and activities of the Company with the Code and the Law. NIS a.d. Novi Sad applies the highest standards in terms of information, respecting the principles of equal treatment of all users of information and ensuring that the published information is available to all interested parties in a simple way in the shortest possible time.

ESG performance measures of NIS a.d. Novi Sad in 2022

The company continues to invest in modernization, constant technological development and innovation. The company's digital portfolio contains more than 100 projects and initiatives that are in various stages of development and implementation. In 2022, NIS invested a total of 22.1 billion dinars in capital projects, which laid the foundations for further progress of the NIS Group in challenging macroeconomic circumstances.

E component

In 2022, the "Energy" Block was formed, whose tasks are to expand the capacity of NIS for the production and trade of electricity, the development of projects in the field of renewable energy sources and the management of the energy resources of the NIS Group. The main goal is decarbonisation through the energy transition process. During 2022, support for digital transformation will continue through several segments.

S component

In 2022, SAP Success Factor is implemented, which integrates talent processes, as well as development tools at the level of individuals, teams and the entire Company. Within the strategic program "Digital Academy", the Training and Development Department, in cooperation with the digital team and external partners from the country and abroad, realized all planned educational activities for different groups of employees. In addition, the company continued to provide strong support for community development. The company invested 360 million dinars in socially responsible projects and professional sports, with the priority being support for the national goal - improvements in the field of reproductive health and an increase in the birth rate in the Republic of Serbia. Thus, within the corporate campaign "Let new hopes be born", 40 health institutions in more than 30 municipalities were supported.

G component

In 2022, corporate governance performance is similar to previous years. The Board of Directors still takes care of the implementation of the principles established by the Code, monitors its implementation and the compliance of the organization and activities of the Company with the Code and the Law. The company applies the highest standards in terms of information, respecting the principles of equal treatment of all users of information and ensuring that the published information is available to all interested parties in a simple way in the shortest possible time.

ESG performance of NIS a.d. Novi Sad in 2023

In the course of 2023, the implementation of the digitalisation program of Functions for HSE was launched, which aims to improve the work of employees, as well as to make it easier and safer to manage contractors. In cooperation with the Science and Technology Center, research

is actively being conducted with the aim of approving and evaluating the potential of applying advanced digital technologies. In the field of data management and analytics, a new business process was implemented - "Data Management". Several projects were implemented, which made it possible to significantly reduce the time spent on routine data processing and contributed to faster, better and easier daily work of employees. Digital transformation remains an integral part of the corporate strategy for the future, a solid foundation for sustainable development.

Table 1 shows the key indicators of occupational safety and health and environmental protection in the period from 2020 to 2023.

Table 1. *HSE indicators*

<i>HSE indicators</i>	2020.	2021.	2022.	2023.
Injuries	86	102	84	112
Injuries with lost days	29	26	27	50
Fires	20	24	24	/
Number of traffic accidents	7	5	15	7
Environmental pollution	5	10	8	/
Coefficient of inspection visits	0,22	0,20	0,19	0,17
Visits of inspection authorities	637	754	647	540
Measures ordered during inspection visits	138	148	123	/

Source: Annual Report (Godišnji izveštaj o poslovanju kompanije NIS a.d. Novi Sad), <https://ir.nis.rs/izvestavanje/izvestaji-o-poslovanju>. Datum preuzimanja 03.09.2024; Sustainable Development Report (Izveštaj o održivom razvoju), <https://www.nis.rs/wp-content/uploads/2023/05/Izvestaj-o-odrzivom-razvoju-2022-kompres.pdf>, Datum preuzimanja 03.09.2024.

Table 2 shows the percentage change of selected ESG indicators in 2023 compared to 2022.

Table 2. *ESG indicators in 2023 compared to 2022*

HSE indicators	% change
Climate changes and the environment	
Direct CO2 emissions (scope 1)	-6%
Movement of carbon intensity in Block Research and production for scope 1	-7%
Movement of carbon intensity in Block Processing for range 1	+2%
Indirect CO2 emissions (scope 2)	+1%
Other indirect greenhouse gas emissions (scope 3)	+17%
Sulfur dioxide	-13%
Nitrogen oxides	-1%
Emission of powdery substances	-6%
Energy consumption within the company	-5%
Total number of spills	+150%
Affected water per ton of refined oil	+51%
Discharged waste water per ton of refined oil	+58%
Total waste generated	-12%
Total disposed waste	-12%

People and community	
Number of employees	+3%
Number of part-time employees	+7%
Employee turnover rate	-15%
Stop voluntary fluctuations	-11%
Forced turnover rate	-25%
Share of women in the total number of employees	+3%
Share of women in management	0%
Average training hours per employee	+44%
Average cost of training per employee	+14%
Employees to whom the collective agreement applies	0%
Investing in the community	Growth
Volunteer hours	+65%
Voluntary blood donation	+92%
Health and safety	
Fatalities	0%
LTIF	+64%
Tier 2 (Process safety events)	0%
Tier 3 (Process safety events)	+4%
Members of the Board of Directors	
Number of board members (11)	0%
Number of executive members (1)	0%
Number of non-executive members (10)	0%
Of which independent members of the Board (2)	0%
Number of meetings of the Board of Directors (22)	0%
Number of the Committees of the Board of Directors (3)	0%

Source: Annual Report (Godišnji izveštaj o poslovanju kompanije NIS a.d. Novi Sad), <https://ir.nis.rs/izvestavanje/izvestaji-o-poslovanju>. Datum preuzimanja 03.09.2024; Sustainable Development Report (Izveštaj o održivom razvoju), <https://www.nis.rs/wp-content/uploads/2023/05/Izvestaj-o-odrzivom-razvoju-2022-kompres.pdf>, Datum preuzimanja 03.09.2024.

According to Table 2, we can conclude that in 2023, the company improved mostly social performance; corporate governance performance remained the same as in 2022, while environmental performance had positive and negative trend in 2023 compared to 2022. Thus, digital projects had the greatest impact on social, neutral on corporate governance performance and varied impact on environmental performance.

5. CONCLUSIONS AND RECOMMENDATIONS

Digital transformation of business is an unavoidable factor in making strategic decisions. Consequently, managers accept and implement new work methods that are in line with the prevailing digitalisation trends in the branch in which they operate. In the process of digital transformation, companies introduce digital tools and technologies as new institutional components, encouraging compliance with the evolution of the market environment, all in the desire for increased external recognition and acceptance. Digitalisation offers several advantages for companies, such as reducing business expenses, collecting, processing and analyzing a large amount of data in the shortest possible time, as well as timely information about various stakeholders, overcoming language, cultural and other barriers, erasing national

borders and the like. In oil industry, the managers expect that innovative digital technologies will increase business efficiency and efficiency in oil and gas exploration and production, increase the competence of employees to a higher level, strengthen the safety and reliability of plant operation, and what is of particular importance, improve communication with consumers in wholesale and retail, as the most important stakeholders. New digital tools will make it possible to offer consumers extremely high-quality services.

The research results showed mainly the positive effects of digitalisation on ESG performance, especially social performance. Digital transformation requires significant investments, but in later years it will result in greater operational efficiency and greater satisfaction of all stakeholders. The results of the conducted research have a theoretical and practical contribution. In a theoretical sense, the results represent a useful addition to knowledge about the necessity of introducing and applying digital tools and technologies in all segments of the value chain. In a practical sense, the results represent a useful addition to knowledge about the impact of digitalisation on company performance from an empirical perspective, which can be useful to managers when making decisions about the introduction and implementation of various digital solutions. The research has certain limitations such as the limited examination of effects exclusively on ESG performance. In order to sustain the company, it is necessary to measure and analyze the effects of digitalisation not only on non-financial, but also on financial performance, which was the subject of the author's recent research for other purposes. In addition, a case study was applied on the example of only one company, on the basis of which no general conclusions can be drawn. Therefore, in future research it is necessary to analyze the effects of digitalisation on business and sustainability performance on the example of a larger number of companies in the branch, so that we could draw better conclusions specific for the branch.

REFERENCES

- Asif, M., Sercy, C., Castka, P. (2023). ESG and Industry 5.0: The role of technologies in enhancing ESG disclosure. *Technological Forecasting & Social Change*, 195, 122806, <https://doi.org/10.1016/j.techfore.2023.122806>
- Carmela Annosi, M., Brunetta, F., Capo, F., & Heideveld, L. (2020). Digitalisation in the agri-food industry: the relationship between technology and sustainable development. *Management Decision*, 58(8), 1737-1757, DOI 10.1108/MD-09-2019-1328
- Chen, Y., Wang, L., Ye, Y., & Tao, Y. (2023). Digital M&A and firm productivity in China. *Finance Research Letters*, 58, 104326, <https://doi.org/10.1016/j.frl.2023.104326>
- Duman, M. C., Akdemir, B. (2021). A study to determine the effects of industry 4.0 technology components on organizational performance. *Technological Forecasting & Social Change*, 167, <https://doi.org/10.1016/j.techfore.2021.120615>
- Evropski izveštaj o elektronskom poslovanju (European e-Business Report) (2008). <https://aei.pitt.edu/54205/1/2008.pdf>. Download date October, 31, 2024.
- Fang, M., Nie, H., & Shen, X. (2023). Can company digitalisation improve ESG performance? *Economic Modelling*, 118, 1-15. <https://doi.org/10.1016/j.econmod.2022.106101>
- Federico, F. G., Garza-Reyes, A. J., Kumar, A., Kumar, V. (2021). Performance measurement for supply chains in the Industry 4.0 era: a balanced scorecard approach.

International Journal of Productivity and Performance Management, 70(4), 789-807, DOI 10.1108/IJPPM-08-2019-0400.

- Gao, Da, Yan, Z., Zhou, X., Mo, X. (2023). Smarter and prosperous: Digital transformation and company performance. *Systems*, 11, 329, <https://doi.org/10.3390/systems11070329>
- Annual Report (Godišnji izveštaj o poslovanju kompanije NIS a.d. Novi Sad), <https://ir.nis.rs/izvestavanje/izvestaji-o-poslovanju>. Download date September, 3, 2024.
- Hautala-Kankaanpää, T. (2022). The impact of digitalisation on firm performance: Examining the role of digital culture and the effect of supply chain capability. *Business Process Management Journal*, 28(8), 90–109. <https://doi.org/10.1108/BPMJ-03-2022-0122>
- Hinings, B., Gegenhuber, T., Greenwood, R. (2018). Digital innovation and transformation: An institutional perspective. *Information and Organization*, 28(1), 52-61, <https://doi.org/10.1016/j.infoandorg.2018.02.004>
- Khayer, A., Talukder, S. Md., Bao, Y., & Hossain, N. Md. (2020). Cloud computing adoption and its impact on SME's performance for cloud supported operations: A dual-stage analytical approach. *Technology in Society*, 60, 1-15, <https://doi.org/10.1016/j.techsoc.2019.101225>
- Li, R., Rao, J., & Wan, L. (2022). The digital economy, company digital transformation, and company innovation. *Managerial and Decision Economics*, 43(7), 2875-2886. <https://doi.org/10.1002/mde.3569>
- Li, Z., & Wang, J. (2022). The dynamic impact of digital economy on carbon emission reduction: Evidence city-level empirical data in China. *Journal of Cleaner Production*, 351, 131570. <https://doi.org/10.1016/j.jclepro.2022.131570>
- Liu, Q., Liu, J., & Gong, C. (2023). Digital transformation and corporate innovation: A factor input perspective. *Managerial and Decision Economics*, 44(4), 2159-2174. <https://doi.org/10.1002/mde.3809>
- Liu, Z., Chen, Z., & Hu, L. (2024). Can company digital transformation improve ESG performance? *Managerial and Decision Economics*, 45, 5088-5103. DOI: 10.1002/mde.4307
- Lu, Y., Xu, C., Zhu, B., & Sun, Y. (2023). Digitalisation transformation and ESG performance: Evidence from China. *Business Strategy and the Environment*, 33, 352-368. DOI: 10.1002/bse.3494
- Luo, Y., Xiong, G., & Mardani, A. (2022). Environmental information disclosure and corporate innovation: The ‘‘Inverted U-shaped’’ regulating effect of media attention. *Journal of Business Research*, 146, 453-463. <https://doi.org/10.1016/j.jbusres.2022.03.089>
- Maroufkhani, P., Ismail, W.K.W., Ghobakhloo, M. (2019). Big data analytics and firm performance: A systematic review. *Information*, 10, 226. doi:10.3390/info1007022
- Martínez-Caro, E., Cegarra-Navarro, G. J., Alfonso-Ruiz, J. F. (2020). Digital technologies and firm performance: The role of digital organisational culture. *Technological Forecasting & Social Change*, 154, <https://doi.org/10.1016/j.techfore.2020.119962>
- Martín-Peña, M.L.; Sánchez-López, J.M.; Díaz-Garrido, E. (2019). Servitization and digitalisation in manufacturing: The influence on firm performance. *Journal of Business and Industrial Marketing*, 35(3), 564–574. <http://dx.doi.org/10.1108/JBIM-12-2018-0400>

- Meng, J., & Zhang, Z. (2022). Corporate financial information disclosure and investor response: Evidence from China's capital market. *Energy Economics*, 108, 105886. <https://doi.org/10.1016/j.eneco.2022.105886>
- Philip, J., Gilli, K., & Knappstein, M. (2023). Identifying key leadership competencies for digital transformation: evidence from a cross-sectoral Delphi study of global managers, *Leadership & Development Journal*, 44(3), 392-406.
- Sedera, D., Lokuge, S., Grover, V., Sarker, S., Sarker, S. (2016). Innovating with company systems and digital platforms: A contingent resource-based theory view. *Information and Management*, 53, 366–379, <http://dx.doi.org/10.1016/j.im.2016.01.001>
- Sustainable Development Report (Izveštaj o održivom razvoju), <https://www.nis.rs/wp-content/uploads/2023/05/Izvestaj-o-odrzivom-razvoju-2022-kompres.pdf>, Download date September 3, 2024.
- Tagcherer, F. & Carbon, C. (2023). Leadership for successful digitalisation: A literature review on companies' internal and external aspects of digitalisation, *Sustainable Technology and Entrepreneurship*, 2, 100039, <https://doi.org/10.1016/j.stae.2023.100039>
- Wamba, S.F.; Gunasekaran, A.; Akter, S.; Ren, S.J.F.; Dubey, R.; Childe, S.J. (2017). Big data analytics and firm performance: Effects of dynamic capabilities. *Journal of Business Research*, 70, 356–365. <http://dx.doi.org/10.1016/j.jbusres.2016.08.009>
- Wamba-Taguimdje, S.-L., Wamba, S. F., Kamdjoug, J. R. K., Wanko, C. E. T. (2020). Influence of artificial intelligence (AI) on firm performance: the business value of AI-based transformation projects. *Business Process Management Journal*, 26(7), 1893-1924, <https://doi.org/10.1108/BPMJ-10-2019-0411>
- Wang, J., Yuan, X., Huang, X, Liu, C. & Zhang, P. (2024). Can digitalisation facilitate cross-border M&A? Evidence from Chinese A-share listed companies, *Research in International Business and Finance*, 67, 102118, <https://doi.org/10.1016/j.ribaf.2023.102118>
- Xiao, S., Xu, J., & Li, R. (2024). Are digital trends driving corporate environmental, social, and governance practices? Evidence from China. *Business Strategy and the Environment*, 33, 5366-5385. DOI: 10.1002/bse.3756
- Zhou, Y.; Zang, J.; Miao, Z.; Minshall, T. (2019). Upgrading pathways of intelligent manufacturing in China: Transitioning across technological paradigms. *Engineering* 5, 691–701, <https://doi.org/10.1016/j.eng.2019.07.016>
- Zhuo, C., & Chen, J. (2023). Can digital transformation overcome the company innovation dilemma: Effect, mechanism and effective boundary? *Technological Forecasting and Social Change*, 190, 122378. <https://doi.org/10.1016/j.techfore.2023.122378>

JOB DESIGN AND HYBRID WORK MODELS DURING COVID-19: A STUDY OF THE SERBIAN IT INDUSTRY

Aleksandra Stevanović*

Faculty of Economics University of Kragujevac, aboskovic@kg.ac.rs,
ORCID number 0000-0001-7726-8783

Vesna Stojanović-Aleksić

Faculty of Economics University of Kragujevac, vesnasa@kg.ac.rs,
ORCID number 0000-0002-3304-5606

Jelena Erić Nielsen

Faculty of Economics University of Kragujevac, jelena_eric@kg.ac.rs,
ORCID number 0000-0003-4168-6216

Abstract: *The COVID-19 pandemic has reshaped the way organizations structure their work models, with remote and hybrid work becoming more prevalent. This study explores the impact of remote and hybrid work models on job enrichment in the Serbian IT (information communication technology) industry, focusing on five key job design characteristics: autonomy, task variety, task identity, task significance, and feedback. While previous research has reported mixed outcomes of remote work, the impact of these work models on overall job enrichment, especially in emerging markets like Serbia, has yet to be fully understood. Using data from IT industry employees, this study examines how different work arrangements (in-office, hybrid, and fully remote) affect their perceptions of job enrichment. Results from one-way ANOVA and post-hoc tests reveal that employees in hybrid work models report the highest levels of job enrichment, with significant differences between hybrid and remote workers. These findings suggest that hybrid work may offer a more balanced approach to job design by providing autonomy and flexibility while maintaining access to essential resources and feedback. The study emphasizes the importance of considering job enrichment in the design of hybrid work environments. Findings will also offer practical recommendations for organizations seeking to optimize their work models post-pandemic in order to maximize employee engagement and productivity in the future.*

Keywords: *job design, enriched job design, remote work, hybrid work*

JEL Classification: *M12, M14, D23, J81*

* Corresponding author

1. INTRODUCTION

The COVID-19 pandemic has had a profound impact on how organizations structure their work models, with both short-term and long-term effects (Demerouti & Bakker, 2023; Foss, 2021; Bailey & Breslin, 2021). With the onset of lockdowns, social distancing measures, and public health concerns, remote work rapidly became the default mode for many organizations across the globe. Initially viewed as a temporary solution, remote work quickly proved to be effective in many industries, accelerating the adoption of digital tools and technologies that enabled employees to continue their work outside traditional office spaces. However, in post pandemic world, many businesses began transitioning to *hybrid work models*, where employees split their time between remote and in-office work (Verma et al. 2023; Diab-Bahman & Al-Enzi, 2020).

This shift has not only influenced the way people work, but also how job design characteristics - such as autonomy, task variety, task identity, task significance, and feedback - are experienced. These core job characteristics, which have long been central to the study of organizational behavior (Hackman & Oldham, 1976), can influence employee motivation, performance, and overall well-being. While the existing literature has examined the impact of remote and hybrid work on employee outcomes (Choudhury et al., 2021; Gajendran & Harrison, 2007), the implications of these work models on overall *job enrichment* - defined as a high level of all five job design characteristics - remain an important area for analysis, particularly in emerging markets, which have distinct business environments compared to developed markets. Emerging markets, such as Serbia, are characterized by various changes in organizational structures, evolving labor markets, and different cultural attitudes toward work (Aleksić-Mirić et al. 2020; Janićijević, 2012).

Given the rapid adoption of hybrid work models, particularly in knowledge-based industries like IT (*information communication technology*), this study focuses on how employees in the Serbian IT industry have experienced job design during the COVID-19 pandemic. More specifically, it compares how employees in three distinct work models - no remote work (in-office), fully remote, and hybrid - experience overall job enrichment which encompasses autonomy, task variety, task identity, task significance, and feedback. The goal is to examine how varying hybrid work models relate to employees' perceptions of their job. Understanding how hybrid work influences job characteristics is crucial for organizations aiming to optimize their work models in the evolving workplace environment.

2. LITERATURE REVIEW

2.1 Job Design Characteristics and Job Enrichment

Job design is a key factor in employee motivation, engagement, and productivity. Morgeson and Humphrey's (2006) Job Design Questionnaire (JDQ) identifies five key job design dimensions: autonomy, task variety, task significance, task identity and job feedback.

- Autonomy is the degree of control employees have over their work tasks and schedules. Studies have shown that higher autonomy correlates with greater role breadth and consequently higher engagement and job performance (Bošković, 2021; Morgeson et al. 2005; Hackman & Oldham, 1976).

- *Task variety* is the extent to which a job involves different activities, reducing monotony and fostering creativity (Morgeson & Humphrey, 2006).
- *Task significance* refers to the the perceived importance of the work in contributing to lives of others (Hackman & Oldham, 1975).
- *Task identity* is the degree to which employees can identify the whole piece of work. (Sims et al., 1976).
- *Feedback from job* is the degree to which the job is designed to allow employees to receive information about their performance.

These characteristics are fundamental to creating a positive work environment. Nowadays, it is specifically significant to explore how they manifest in remote and hybrid work models.

One commonly recognized approach, derived from the original motivational theories, is "enriched work design" or "job enrichment" which refers to a configuration with high levels of all core job characteristics simultaneously (Oldham et al. 1976). Though this concept simplifies the complexity of individual job characteristics (Lamovsek et al. 2024), it is still a valuable framework for understanding the relationship between job design and other organizational phenomena, and is frequently used in research to examine its impact on motivation, performance, and well-being (May et al. 2004; Saks, 2006).

2.2 COVID-19 and Work Model Transitions

The transition to remote work during the COVID-19 pandemic was rapid and widespread, with many organizations adopting remote work out of necessity rather than preference. This shift raised questions about how job design would need to adapt to support employees effectively in a remote context. Studies have shown mixed outcomes, with some workers thriving due to increased flexibility, while others struggled with isolation, loneliness and reduced communication (Wang et al. 2021).

Employees are facing increased demands, leading to the higher need for resources to manage these challenges. The extended JD-R model suggests that health impairment can result from both high job demands and the interplay of demands across different life domains. Similarly, motivation is influenced not only by job resources but by their interaction across life domains. This points to the importance of a holistic approach to job design, particularly in remote and hybrid settings, where work-life balance is crucial (Demerouti & Bakker, 2023). These models may allow for greater flexibility but require careful attention to job design to ensure that enriched job design is maintained (Choudhury et al., 2022).

2.3 Impact of Remote and Hybrid Work on Job Enrichment

The shift to remote and hybrid work has significantly changed how employees experience key job design features. Remote work offers increased flexibility but can cause work-home interference, limit communication and access to resources (Wang et al., 2021). Hybrid models, combining remote and in-office work, provide a balance by offering both flexibility and necessary resources for collaboration (Choudhury et al. 2022). As these models evolve, understanding their impact on job enrichment remains a critical research focus.

Hybrid work models, by blending in-office and remote days, may offer a more balanced approach to job enrichment compared to remote or fully in-office setups. For example, remote work is often associated with higher autonomy, as employees can control their schedules and work environments (Gajendran & Harrison, 2007). However, this autonomy can be offset by the lack of resources typically available in the office (Wang et al., 2021). Hybrid work provides a middle ground, offering the independence of remote work while still ensuring access to the tools and support needed to perform tasks effectively (Allen et al., 2024). Lamovsek et al. (2024) highlight the importance of task variety and feedback from job in hybrid forms of work. Task variety is likely to be greater in hybrid models, as employees can switch between different environments, which may stimulate different types of work. In contrast, fully remote employees might experience a more narrow range of tasks due to the limitations of virtual tools and less face-to-face collaboration. Task significance can also be impacted by the sense of isolation in remote work, potentially diminishing employees' connection to the organization's larger goals. Hybrid work, by maintaining some in-person interactions, may better preserve this sense of meaning and purpose.

While task identity is not directly affected by the work setting, hybrid work models may create a context that indirectly enhances ownership by allowing employees to engage in tasks from start to finish in a more flexible and integrated way. In a hybrid model, employees can take advantage of both in-office resources and the uninterrupted focus that remote work offers. Finally, hybrid models may enable employees to access structured feedback from their tasks when in the office, while still offering the flexibility of remote work to reflect and improve.

Based on the literature review, the following hypothesis has been developed:

H1: Employees in hybrid work models will report the highest level of job enrichment

3. METHODOLOGY

An empirical study was conducted using a survey method, with data analyzed via SPSS 20.0. Descriptive statistics examined the sample structure, while Cronbach's alpha assessed scale reliability. We used one-way ANOVA to test the hypothesis.

3.1. Sample and data collection

The data were collected from a sample of 158 respondents, of whom 2 had missing data, so the final sample consisted of 156 respondents employed in the IT industry in the Republic of Serbia, at the end of 2020 and the beginning of 2021. Respondents were, on average, 32.61 years old, 41.7% were female, and most of them hold a university degree (47.4%).

3.2. Measures

The survey included scales from the *Job Design Questionnaire (JDQ)* (Morgeson & Humphrey, 2006), to assess various job characteristics: autonomy (3 items), task variety (4 items), task significance (3 items), task identity (4 items), and feedback from the job (3 items), totaling 17 items. These items were used to measure job enrichment ($\alpha = 0.869$). A seven-point Likert scale was used with the levels "7 = strongly agree" and "1 = strongly

disagree.” The translation-back-translation procedure was applied. Sample items are: *The job allows me to make my own decisions about how to schedule my work.*; *The results of my work are likely to significantly affect the lives of other people.*; *The job itself provides feedback on my performance.*

Remote/hybrid working level was measured based on the number of days an employee spends working remotely. This variable is grouped as follows:

- **In-Office Only (0 days)**
- **Hybrid Work (1-4 days)**
- **Full Remote Work (5-7 days)**

4. RESULTS AND DISCUSSION

First, we calculated the Cronbach’s alpha coefficient to check the internal consistency of the items used to measure the job enrichment variable. It was 0.869 indicating high reliability of the scale.

Afterward, to test the hypothesis, we used standard one-way ANOVA. Levene’s test results showed that for job enrichment, the p-value was 0.975 ($p > 0.05$), suggesting equal variances, and therefore we can proceed with analysis.

Table 1. ANOVA Test Results

	Sum of Squares	df	Mean Square	F	p
Between Groups	4.402	2	2.201	3.077	0.049
Within Groups	109.446	153	0.715		
Total	113.849	155			

Source: Authors’ calculations

The ANOVA results for job enrichment across the remote, hybrid, and in-office workgroups show that there is a statistically significant difference between the groups. The F-statistic is 3.077, and the p-value is 0.049, which is less than the typical significance level of 0.05. This indicates that the type of work arrangement (remote, hybrid, or in-office) has a significant effect on job enrichment, meaning that employees' perceived job enrichment varies depending on their work environment.

We have also calculated the based on the descriptive statistics which has shown that the hybrid group has the highest mean job enrichment score of 5.40, compared to the in-office group (4.98) and the remote group (4.89). This indicates that, on average, individuals in hybrid work arrangements report the highest level of job enrichment.

Additionally, the post-hoc test Tukey’s HSD test was applied to determine which specific groups differ significantly from each other (Table 2). No statistically significant differences were found between the in-office (0) and hybrid (1) groups ($p = 0.154$) or between the in-office (0) and remote (2) groups ($p = 0.856$), indicating that job enrichment is similar across these work arrangements. However, there is a significant difference between the hybrid (1) and remote (2) groups ($p = 0.038$), with the hybrid group reporting significantly higher job enrichment than the remote group.

Table 2. Post Hoc Test – Tukey HSD

Comparison	Mean Difference (I - J)	Std. Error	p-value	95% Confidence Interval
In-office (0) vs. Hybrid (1)	-0.42208	0.22696	0.154	[-0.9592, 0.1151]
In-office (0) vs. Remote (2)	0.08424	0.15829	0.856	[-0.2904, 0.4589]
Hybrid (1) vs. Remote (2)	0.50632*	0.20414	0.038	[0.0232, 0.9895]

Source: Authors' calculations

5. CONCLUSIONS AND RECOMMENDATIONS

This study examined the impact of remote, hybrid, and in-office work models on job enrichment in the Serbian IT industry. The results indicate that employees in hybrid work models report the highest levels of job enrichment. Unlike fully remote workers, who face challenges like isolation and limited access to resources (Wang et al., 2021), hybrid employees benefit from a balance of flexibility and in-person collaboration, which is likely to result in more positive outcomes. These findings contribute to the growing body of literature suggesting that hybrid work models may offer a more comprehensive approach to job enrichment compared to fully remote or traditional in-office settings.

This paper has several limitations. First, the cross-sectional design captures data at a single point in time, limiting the ability to draw causal conclusions or observe long-term trends. The sample size is limited as well, and increasing it would enhance the generalizability of the results. In addition, the crisis context may have introduced bias, as it likely contributed to an increase in job demands (Demerouti & Bakker, 2023). While this could affect the findings, the insights remain valuable for managerial decisions in future crises. Moreover, the concept of job enrichment used here does not allow for an in-depth analysis of individual job characteristics across different work models, though this choice was made to focus on broader trends. Finally, while the findings highlight differences in job design models, they do not measure outcomes such as performance or job satisfaction. Future studies could address these limitations by using longitudinal designs, expanding the sample, and exploring job characteristics in various work models, as well as their implications on employee outcomes.

REFERENCES

- Aleksić Mirić, A., Bogičević Milikić, B., & Jančićjević, N. (2020). Organisational learning in Serbia during the transition: The legacy of Božidar Cerović and his contribution to transition research. *Economic Annals*, 65(225), 73-104. <https://doi.org/10.2298/EKA2025073A>
- Allen, K. S., Grelle, D., Lazarus, E. M., Popp, E., & Gutierrez, S. L. (2024). Hybrid is here to stay: Critical behaviors for success in the new world of work. *Personality and Individual Differences*, 217, 112459. <https://doi.org/10.1016/j.paid.2023.112459>

- Bailey, K., & Breslin, D. (2021). The COVID-19 pandemic: what can we learn from past research in organizations and management?. *International Journal of Management Reviews*, 23(1), 3-6. <https://doi.org/10.1111/ijmr.12237>
- Bošković, A. (2021). Employee autonomy and engagement in the digital age: The moderating role of remote working. *Economic horizons*, 23(3), 231-246. <https://doi.org/10.5937/ekonhor2103241B>
- Choudhury, P., Foroughi, C., & Larson, B. (2021). Work-from-anywhere: The productivity effects of geographic flexibility. *Strategic Management Journal*, 42(4), 655-683. <https://doi.org/10.1002/smj.3251>
- Choudhury, P., Khanna, T., Makridis, C., & Schirmann, K. (2022). Is hybrid work the best of both worlds? Evidence from a field experiment. In SSRN electronic journal (No. 22–063). Cambridge: Elsevier BV. <https://doi.org/10.2139/SSRN.4068741>
- Demerouti, E., & Bakker, A. B. (2023). Job demands-resources theory in times of crises: New propositions. *Organizational Psychology Review*, 13(3), 209-236.
- Diab-Bahman, R., & Al-Enzi, A. (2020). The impact of COVID-19 pandemic on conventional work settings. *International Journal of Sociology and Social Policy*, 40(9/10), 909-927. <https://doi.org/10.1108/IJSSP-07-2020-0262>
- Foss, N. J. (2021). The impact of the Covid-19 pandemic on firms' organizational designs. *Journal of Management Studies*, 58(1), 270-274. <https://doi.org/10.1111/joms.12643>
- Gajendran, R. S., & Harrison, D. A. (2007). The good, the bad, and the unknown about telecommuting: meta-analysis of psychological mediators and individual consequences. *Journal of Applied Psychology*, 92(6), 1524-1541. <https://doi.org/10.1037/0021-9010.92.6.1524>
- Hackman, J. R., & Oldham, G. R. (1975). Development of the Job Diagnostic Survey. *Journal of Applied Psychology*, 60(2), 159–170. <https://doi.org/10.1037/h0076546>
- Hackman, J. R., & Oldham, G. R. (1976). Motivation through the design of work: Test of a theory. *Organizational Behavior and Human Performance*, 16(2), 250–279. [https://doi.org/10.1016/0030-5073\(76\)90016-7](https://doi.org/10.1016/0030-5073(76)90016-7)
<https://doi.org/10.1177/20413866221135022>
- Janićijević, N. (2012). The influence of organizational culture on organizational preferences towards the choice of organizational change strategy. *Economic annals*, 57(193), 25-51. <https://doi.org/10.2298/EKA1293025J>
- Lamovsek, A., Radevic, I., Mohammed, S.S., & Cerne, M. (2024). Beyond the office walls: Work design configurations for task performance across on-site, hybrid and remote forms of work. *Information Systems Journal, special issue*, <https://doi.org/10.1111/isj.12542>
- May, D. R., Gilson, R. L., & Harter, L. M. (2004). The psychological conditions of meaningfulness, safety, and availability and the engagement of the human spirit at work. *Journal of Occupational and Organizational Psychology*, 77(1), 11–37. <https://doi.org/10.1348/096317904322915892>
- Morgeson, F. P., & Humphrey, S. E. (2006). The Work Design Questionnaire (WDQ): Developing and validating a comprehensive measure for assessing job design. *Journal of Applied Psychology*, 91(6), 1321–1339. <https://doi.org/10.1037/0021-9010.91.6.1321>
- Morgeson, F. P., Delaney-Klinger, K., & Hemingway, M. A. (2005). The Importance of Job Autonomy, Cognitive Ability, and Job-Related Skill for Predicting Role Breadth and

- Job Performance. *Journal of Applied Psychology*, 90(2), 399–406. <https://doi.org/10.1037/0021-9010.90.2.399>
- Oldham, G. R., Hackman, J. R., & Pearce, J. L. (1976). Conditions under which employees respond positively to enriched work. *Journal of applied psychology*, 61(4), 395-403. <https://doi.org/10.1037/0021-9010.61.4.395>
- Saks, A. M. (2006). Antecedents and consequences of employee engagement. *Journal of Managerial Psychology*, 21(7), 600–619. <https://doi.org/10.1108/02683940610690169>
- Sims, H. P., Szilagyi, A. D., & Keller, R. T. (1976). The Measurement of Job Characteristics. *Academy of Management Journal*, 19, 195-212. <http://dx.doi.org/10.2307/255772>
- Verma, A., Venkatesan, M., Kumar, M., & Verma, J. (2023). The future of work post Covid-19: key perceived HR implications of hybrid workplaces in India. *Journal of Management Development*, 42(1), 13-28. <https://doi.org/10.1108/JMD-11-2021-0304>
- Wang, B., Liu, Y., Qian, J., & Parker, S. K. (2021). Achieving effective remote working during the COVID-19 pandemic: A work design perspective. *Applied psychology*, 70(1), 16-59. <https://doi.org/10.1111/apps.12290>

CAN NEUROSCIENCE BE APPLIED IN HRM: EXPLORING THE ATTITUDES OF HR PROFESSIONALS IN SERBIA

Nastasija Vučković

Faculty of Organizational Sciences, University of Belgrade, nv20233412@student.fon.bg.ac.rs

Tatjana Ivanović*

Faculty of Organizational Sciences, University of Belgrade, tatjana.ivanovic@fon.bg.ac.rs
ORCID number 0000-0002-4164-4422

Abstract: *The relationship between the human brain and human behaviour has always intrigued the researchers around the world. Technological innovations have propelled the growth of neuroscience and made possible its application in different fields, including human resource management (HRM). There are many HRM activities in which the application of neuroscience may be useful, such as recruitment and selection, training and development, talent management, performance appraisal etc. Neuroscience fundamentals offer valuable insights and guidance for HR professionals. Through applying principles from neuroscience, organizations can gain a deeper understanding of their employees in order to manage them more effectively. The aim of this paper is to explore how familiar HR professionals in Serbia are with the use of neuroscience in HRM as well as to examine their attitudes towards the possibilities for its application, the advantages and disadvantages of implementing neuroscience in this field. An empirical study was conducted among 67 HR professionals in Serbia in 2024 through an online questionnaire. The results of the survey have shown that the majority of respondents (79.1%) are not familiar enough with the use of neuroscience in the field of HRM. However, the results of the study are still encouraging since 88.1% of respondents show willingness to learn about the possibilities to use neuroscience in HRM if they were provided the opportunity. HR professionals in Serbia believe that neuroscience in HRM may be used mainly for measuring employee stress levels, improving employee performance, increasing employee engagement, and improving the employment process. However, lack of knowledge, lack of understanding, together with huge implementation costs, resistance to change and ethical concerns present major barriers to implementing this innovation. The research has proved that this field is still underexplored in Serbia, but the fact that HR professionals show readiness to be educated in this field if they were given the opportunity is promising. It may be concluded that the integration of neuroscience into human resource management is still in its early stages and requires significant development. Organizations should find ways to understand how to make the best use of neuroscience in managing their human resources as potential benefits are expected to be significant.*

Keywords: *Human resource management, Neuroscience, Organizational neuroscience, Employee, Human brain*

JEL Classification: *J 24, M 12, M 53, O 15, D 87*

* Corresponding author

1. INTRODUCTION

Unravelling the connection between the human brain and human behaviour has long been one of the most captivating challenges in scientific research around the world (Kandel et al., 2013). Neuroscience has made significant steps recently, allowing us to fundamentally rethink our understanding of human functioning. Neuroscience studies the function of the central nervous system and human brain allowing to better comprehend the roots of human behavior. During many years of research in this area, it has been discovered that the human brain has the potential to learn and achieve greater efficiency.

Technological innovations have propelled the growth of neuroscience and made possible its use in different fields, rather than medicine. Neuroscience methods have begun to spread to companies and open some new directions for organizational scientists and practitioners. Recent advances in neuroscience have transformed our understanding of human brain functioning, impacting various fields. Therefore, concepts such as Neuromanagement, Neuromarketing, Neuroeconomics have emerged. For instance, Cinici et al. (2021) analyzed neuroscience literature in the management fields published in English between 2000 and 2020, and found 60 documents related to management and organization area.

Human resource management is another area in which neuroscientific methods have found their application. The integration of neuroscience and human resource management is often referred to as "Neuro-HR" (Tewari & Mahapatra, 2018). However, the literature on the application of neuroscience in HRM is still scarce since few researchers have explored this topic (see, for example, Rock, 2010; Becker et al., 2015; Cheese & Hills, 2016; Lim et al., 2019; Alina et al., 2020).

The aim of this paper is to explore how familiar HR professionals in Serbia are with the use of neuroscience in HRM, and to examine their attitudes towards the possibilities for its application, as well as advantages and disadvantages of applying neuroscience in this field. Having in mind the lack of comprehensive information and research on the application of neuroscience in HRM, making it challenging to find relevant studies and articles, one of the aims of this research is to contribute to the literature in terms of filling the gap between neuroscience and HRM.

2. LITERATURE REVIEW

In today's complex and rapidly evolving business landscape, the demands placed on human resource managers and professionals are more significant than ever before. Neuroscience principles offer valuable insights and guidance for HR professionals. It is crucial for organizations to understand how to make the best use of neuroscience and apply its techniques in managing their human resources efficiently and effectively.

The progress of neuroscience has fostered the developed of different tools which can increase human potential (Rao, 2018). All behaviour is a manifestation of neural activity (Kandel et al., 2013). Individuals are affected by the internal and external environment through activating various neurotransmitters that lead to altered behaviour (Brann, 2016). Organizations may follow and evaluate the expected employee actions relying on action plans focused on human brain functioning. According to Henry and Plemmons (2012) neuroscience suggests that

almost each action an individual undertakes is the result of his/her previous experience, and that biological impulses cannot be directly controlled by individuals themselves.

Functional magnetic resonance imaging (fMRI), as the most often used neuroscientific method, makes it possible to better understand the way the brain works, how it learns, reacts to stress, incentives, punishments and rewards.

The role of neuroscientific methods in the practice of human resource management is diverse and can be applied in recruitment and selection processes, training and development, talent management, performance management etc. (Brann, 2016). Ward et al. (2015) suggest that neuroscience may be used in training and development, job design, high-performance assessment, motivating communications and conflict prevention. Petrou & Rammata (2021) conclude that neuroscience can be implemented in various HR-related areas in the public sector, such as recruitment, learning and training, performance evaluation, incentives and reward. Schaufenbuel (2014) examined linking neuroscience with effective leadership and came to conclusion that brain mapping may enable getting insights into brain function, helping leaders better guide people and organizations.

Neuroscience and neuroscientific methods can positively change the practice of human resources management, through developing certain skills and measuring different neurological characteristics that were not measurable before. Neuroscience can help HR professionals utilize various data to align achieving objectives with improving employee satisfaction, engagement, and commitment. The potential of neuroscientific methods is enormous and may only be limited by human imagination.

3. METHODOLOGY

The survey was aimed at examining how familiar HR professionals are with the use of neuroscience in HRM, as well as to investigate their attitudes towards the application of neuroscientific methods in HRM practice. In order to test our research questions, data was collected through an online questionnaire which was distributed to respondents in Serbia in August and September, 2024. Questionnaire was shared on social networks and other respondents were reached directly by e-mail. The questionnaire consists of 28 questions, including demographic questions and questions related to respondents' familiarity with the neuroscience and their attitudes towards the potential use of neuroscientific methods in HRM.

In total, 81 responses were received. However, only the responses of those who work in an HR department or perform HR-related activities were selected for the survey and further analyzed. Therefore, the sample consists of 67 HR professionals - 45 female (67.2 % of the sample) and 22 male respondents (32.8 %). Regarding the respondents' age, the largest part of the sample (43.3%) refers to the youngest respondents - those who are 25 and younger, and those who are 40 and older (26.9%). With regard to their position in the company, the sample was diverse - most of the respondents hold the position of HR coordinator (17.9%), recruiter (14.9%), HR analyst (14.9%), general manager (13.4%), employee relationship manager (13.4%), and employment manager (13.4%). Regarding the size of the company in which the respondents work, the percentage of small companies (with less than 50 employees) was 38.8%, medium-sized companies 35.8%, while large companies (with more than 250 employees) comprise 25.4% of the sample. These companies operate in various industries -

mainly production (23.9%) and sales (23.9%), followed by marketing (11.9%) and finance (10.4%).

4. RESULTS AND DISCUSSION

The results of the survey have shown that the majority of respondents (73.1%) are not familiar enough with the concept of neuroscience, while only 26.9% of the respondents are familiar with this concept (Figure 1).

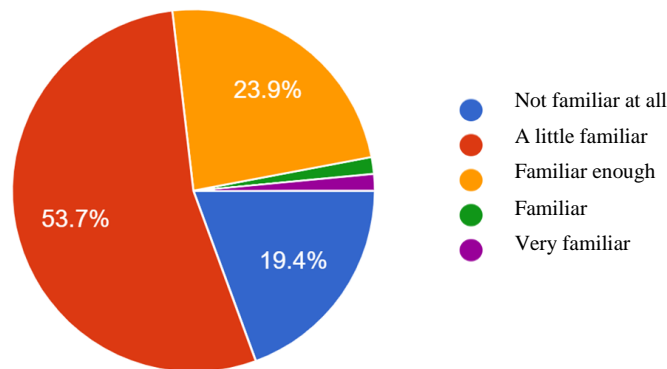


Figure 1: *How familiar the respondents are with the concept of neuroscience*
Source: own research

Further, when asked about the use of neuroscience in HRM, 40.3% of respondents claimed that they possess a little knowledge about the concept, while 38.8% of them have never heard about the application of neuroscience in the field of HRM (Figure 2). Only 6% of respondents stated that the company they work for has introduced some neuroscientific innovations in human resource management.

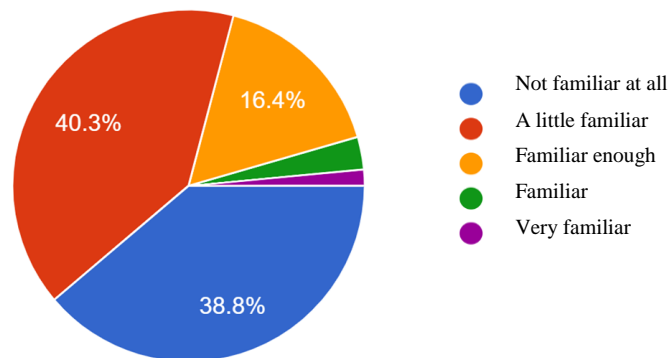


Figure 2: *How familiar the respondents are with the concept of using neuroscience in HRM*
Source: own research

In addition, 85.1% of respondents stated that they were never provided the opportunity to be trained in this field. However, even though the majority of respondents are not familiar with the use of neuroscience in HRM, 88.1% of them show willingness to gain knowledge and skills in this area. Totally 80.6% of respondents would agree to learn the basic principles of neuroscience if this would be useful for their position at work. The majority of surveyed HR

professionals (68.6%) agreed that they would undergo a training related to the application of neuroscience in HRM if they had the opportunity; while 58.2% would invest the time and/or money in training related to neuroscience and its applications in HRM.

The respondents believe that neuroscience may be used in the field of human resource management mainly for measuring employee stress level (49%), improving employee performance (47%), increasing employee engagement (35%) and improving the employment process (31%).

According to respondents' opinion, the main advantages of implementing neuroscience in HRM include increasing employee engagement (46.1%), increasing employee satisfaction (40.3%) and increasing performance and productivity (40.3%) (Table 1).

Table 1. *Advantages of implementing neuroscience in HRM*

Advantages	Percentage (%)
increasing employee engagement	46.1%
increasing employee satisfaction	40.3%
increasing performance and productivity	40.3%
improved decision-making	37.3%

Source: own research

On the other hand, the respondents listed lack of knowledge (47.8%) and lack of understanding (41.8%) as main barriers for implementing neuroscience in HRM (Table 2).

Table 2. *Disadvantages of implementing neuroscience in HRM*

Disadvantages	Percentage (%)
lack of knowledge	47.8%
lack of understanding	41.8%
huge implementation costs	35.8%
resistance to change	34.3%
ethical concerns	22.4%

Source: own research

The majority of respondents (52.2%) believe that neuroscience will eventually become accessible and understandable in all parts of the world and more than 70% of respondents believe that this concept will be applied in various spheres of business in the future.

5. CONCLUSIONS AND RECOMMENDATIONS

It may be concluded from the results of the research that the majority of HR professionals in Serbia are unfamiliar with this topic, complicating the collection of supportive data. This research showed that this field is still unexplored in this country, but, on the other hand, HR professionals have shown readiness to be educated to apply neuroscientific methods in their work if they were provided the opportunity. Organizations should be informed more on the benefits neuroscience may bring to their operations and therefore inspire HR experts to gain expertise in this area, ensuring future success.

This research contributes to scarce literature in this field as well as to raising the level of understanding of the concepts presented and their practical applicability. Connecting neuroscience with HRM represents a great opportunity for future research. It is of crucial importance for organizations around the world to understand the ways in which they can use neuroscientific methods from and apply it in managing their human resources in an efficient and effective way.

Managers can utilize neuroscientific methods to develop the most suitable approach to employees. Another area of business where managers can leverage neuroscience theories is learning and development. Neuroscience methods can provide a better understanding of thought processes that enable or hinder effective idea generation. Research using neuroscience theories has concluded that when employees learn together, the learning experience improves, positively influencing social interactions among employees. Additionally, neuroscience helps in designing educational content that fosters better learning and knowledge retention. Beyond learning and development, neuroscience can also be effectively applied to leadership programs and general HR practices.

In conclusion, the integration of neuroscience into human resource management is still in its early stages, and it is filled with promising opportunities and challenges (Tewari & Mahapatra, 2018). The potential benefits for companies are substantial. Ethical considerations and employee consent are critical issues, as the willingness of employees to undergo these methods for business improvement is essential. Nevertheless, neuroscience is an evolving field, which still requires significant development, and its application in business is yet to be explored.

REFERENCES

- Alina, T. P., Juarez, V. D., Mengual, R. A., Angela-Eliza, M., & Alexandru, C. (2020). Neuroscience Tools for Human Resource Management in Contemporary Organisations. *Risk in Contemporary Economy*, 13-21.
- Becker, W. J., Volk, S., & Ward, M. K. (2015). Leveraging neuroscience for smarter approaches to workplace intelligence. *Human Resource Management Review*, 25(1), 56-67.
- Cheese, P., & Hills, J. (2016). Understanding the human at work—how neurosciences are influencing HR practices. *Strategic HR Review*, 15(4), 150-156.
- Cinici, M. C., Baglieri, D., Marino, A., & Pareschi, L. (2021). The spotty progress of neuroscience in the management fields. In *Academy of Management*

- Proceedings* (Vol. 2021, No. 1, p. 14832). Briarcliff Manor, NY 10510: Academy of Management. <https://doi.org/10.5465/AMBPP.2021.212>
- Henry, S., & Plemmons, D. (2012). Neuroscience, neuropolitics and neuroethics: the complex case of crime, deception and fMRI. *Science and Engineering Ethics*, 18, 573-591.
- Kandel, E. R., Schwartz, J. H., Jessell, T. M., Siegelbaum, S. A., & Hudspeth, A. J. (2013). *Principles of Neural Science*. McGraw-Hill.
- Lim, D. H., Chai, D. S., Park, S., & Doo, M. Y. (2019). Neuroscientism, the neuroscience of learning: An integrative review and implications for learning and development in the workplace. *European Journal of Training and Development*, 43(7/8), 619-642. 10.1108/EJTD-03-2019-0033
- Petrou, F., & Rammata, M. (2021). The emerging impact of neuroscience in Human resource management and in the public sector. *SCIrEA Journal of Management*, 5(4), 89-106. DOI:10.54647/management63082
- Rao, B. S. (2018). Neuroscience and HR Concepts and Applications. *NHRD Network Journal*, 11(4), 49-55. <https://doi.org/10.1177/0974173918799136>
- Rock, D. (2010). Your brain at work: Strategies for overcoming distraction, regaining focus, and working smarter all day long. *Journal of Behavioral Optometry*, 21(5), 130.
- Tewari, S., & Mahapatra, G. P. (2018). Social Neuroscience and HR: An Introductory Perspective. *NHRD Network Journal*, 11(4), 6-13. <https://doi.org/10.1177/2631454118807354>
- Schaufenbuel, K. (2014). *The neuroscience of leadership* (Whitepaper). Chapel Hill, NC: UNC Kenan-Flagler Business School.
- Ward, M. K., Volk, S., & Becker, W. J. (2015). An overview of organizational neuroscience. *Organizational neuroscience*, 17-50. 10.1108/S1479-357120150000007001

EMPLOYEES' PERSPECTIVES ON DIMENSIONS OF AGILE WAY OF WORKING: EMPIRICAL EVIDENCE FROM THE ICT SECTOR

Milica Dukanac*

University of Kragujevac, Faculty of Economics, Kragujevac, milica.dukanac@ef.kg.ac.rs,
ORCID number 0009-0007-5664-41381

Dejana Zlatanović

University of Kragujevac, Faculty of Economics, Kragujevac, dejanaz@kg.ac.rs
ORCID number 0000-0001-6071-955X

Tjaša Štrukelj

University of Maribor, Faculty of Economics and Business, Slovenia, tjasa.strukelj.um.si,
ORCID number 0000-0001-6867-5061

Abstract: *The key dimensions of agile teams include self-organization, face-to-face communication, quick product turnaround, reflexivity, and a focus on simplicity in work. The study aims to examine the favorability and differences in employees' perspectives toward the individual dimensions of the agile way of working. The internal consistency was evaluated using Cronbach's α coefficient. Additionally, descriptive statistical analysis and ANOVA tests were applied. The results reveal a positive attitude toward reflexivity among ICT employees and a less favorable view of face-to-face communication. A statistically significant difference in self-management, based on income level, was found, with further analysis indicating that the difference in compatibility occurs between employees in lower and higher income groups. The study's limitations include its focus on employee attitudes in Serbia's ICT sector, which restricts applicability to other industries, suggesting that future research should incorporate additional variables for a more comprehensive analysis. The practical implications suggest that IT managers should foster a reflexive work culture, encourage face-to-face communication, and offer more autonomy to higher-income employees. To the authors' knowledge, there is a lack of research focusing on the individual dimensions of agility, contributing to the originality of the research.*

Keywords: *Agile way of working, Reflexivity, Self-management, Face-to-face communication, ICT sector.*

JEL Classification: *M12, M54, D23.*

* Corresponding author

1. INTRODUCTION

In the modern environment, the pace of change is accelerating due to the emergence of new technologies, shifts in business models, increasing workforce diversity, changing customer preferences, fierce competition, global markets, and shorter product lifecycles (Mani & Mishra, 2020). Many organizations in the software industry, especially those with complex engineering products and long development cycles, struggle to achieve rapid innovative solutions (Beaumont et al., 2017). Consequently, the agile way of working emphasizes initiating continuous, customer-focused innovations that are essential for companies to survive in today's dynamic market (Denning, 2019). Cockburn & Highsmith (2001) state that technology markets have become turbulent, dynamic, and uncertain, making the core idea of agile business a process that can initiate both necessary changes and respond to them quickly. Implementing agile management methodologies is highly adaptive, enabling teams to respond swiftly to changes while continuously monitoring the fulfilment of plans and anticipated requirements (Tabassum et al., 2024). Therefore, agile teams are particularly utilized within innovative organizational processes, such as new product development (Grass et al., 2020). Adopting agile thinking in team development and management has proven successful for many well-known companies (Mani & Mishra, 2020), such as Tesla, Netflix, and Amazon (Rigby et al., 2018). Peeters et al. (2022) emphasize the ability of teams to make independent business decisions as one of the most important characteristics of agile teams. In other words, the dynamic and rapid changes in the business environment mean that agile teams can make decisions autonomously rather than following a strict action plan imposed by a leader, enabling them to adapt to the team's needs (Gonzalez-Mulé et al., 2016). Agile business practices are now so widespread that most organizations in software development have at least some areas of agile management (Denning, 2019). Peeters et al. (2022) note that agile practices are most prevalent among ICT teams, as supported by numerous studies (Melo et al., 2013; Ramirez-Mora & Oktaba, 2018; Rao et al., 2011; Diebold & Dahlem, 2014). Therefore, this research will analyze the agile way of working within the ICT industry. While some studies have explored agile ways of working (Annosi et al., 2020; Swafford et al., 2006; Peeters et al., 2022), to the authors' knowledge, there is a lack of research focusing on the individual dimensions of agility. This gap in the literature represents a notable research void that this study aims to address. Accordingly, this research is focused on the dimensions of the agile way of working. The study's objective is to examine the favorability and differences in employees' perspectives toward the individual dimensions of agility. Specifically, the research question guiding this study is: How do respondents' attitudes towards different dimensions of agile way of working vary, and how do these attitudes differ based on income level?

The research included 153 employees from the ICT sector in the Republic of Serbia. The internal consistency of the statements used to measure the variables of the developed model was calculated based on the Cronbach's α coefficient. Descriptive statistical analysis and ANOVA tests were applied to examine respondents' attitudes towards the individual dimensions of agile working methods. The paper is structured into several interconnected sections. The literature review presents some key theoretical concepts related to agile business practices. Subsequently, the methodology employed in the study is discussed, detailing the creation of the questionnaire and the data analysis process. The results of the empirical research and their discussion are addressed in the fourth part of the paper. Finally, certain conclusions are drawn, and the implications and limitations of the research are identified.

The expected theoretical contribution of the paper lies in addressing the research gap related to the lack of studies that focus on examining the individual dimensions of the agile way of

working. The expected practical contribution of the study is reflected in its implications for ICT team managers on how the application of agile working dimensions can enhance teamwork and performance.

2. LITERATURE REVIEW

In the past decade, there has been an increase in empirical research focusing on the concept of agility (Hoda et al., 2017). Agility is the ability to achieve high efficiency and flexibility while maintaining high quality and meeting customer needs (Hopp & Oyen, 2004). A specific area of research has emerged, examining the social aspects of organizational agility (organizational structure, workforce characteristics, management, and leadership) based on the idea that adaptability to changes could be enhanced by focusing on the social-psychological aspects within teams (Gren et al., 2020). Vrontis (2012) states that agility provides a mindset and strategic approach that aligns with the complexities of today's market conditions, reintroducing context and purpose into strategic planning.

While traditional new product development teams rely on prior planning and monitoring progress at each stage of the innovation process, agile teams are fundamentally centered around adaptability (Grass et al., 2020; Rao et al., 2011). Given that change is constant, agile businesses can effectively seize emerging opportunities at both tactical and strategic levels (Vrontis, 2012). In the IT/IS/software sector, agile is regarded as a method for transforming project management, emphasizing an organization's capacity to swiftly adapt to specific customer expectations, thereby enhancing overall effectiveness (Naslund & Kale, 2020). Furthermore, the principles of agile methodology are fully compatible with building an entrepreneurial organization, which prioritizes a more balanced understanding of customer needs (Nielsen et al., 2022).

Based on the idea that software development teams should improve collaboration and client focus on responding to an unstable, rapidly changing environment and maintain high levels of productivity, innovation, and product quality (Peeters et al., 2022), Beck et al. (2001) developed the Agile Manifesto. According to the manifesto, as well as a review of relevant literature on agile practices (Peeters et al., 2022; Grass et al., 2020; Espinosa-Curiel et al., 2018), the following characteristics of agile teams are highlighted: self-organization, face-to-face communication, product turnaround, reflexivity, and simplicity in work.

Agile teams are characterized, to varying degrees, by self-management in the execution of business processes, as well as decision-making about goals and task delegation among team members (Grass et al., 2020), with the goal of timely responses to user requirements (Junker et al., 2023). Additionally, Hoda et al. (2012) emphasize self-organization as one of the vital characteristics of agile teams, while Beaumont et al. (2017) stress that clear roles, as well as the right balance of authority and responsibility, are crucial for the success of teams applying the agile concept, particularly in new product development. These self-managed work groups are identifiable social systems where members have interdependent relationships, develop various roles over time, and are empowered to manage their own tasks, producing measurable outcomes (Luis Alves Pais, 2010). Self-organizing behaviors foster self-reinforcement among team members, encouraging them to recognize and appreciate the actions that contribute to high levels of team performance and reinforcing effective team performance (Elloy, 2008). Furthermore, Espinosa-Curiel et al. (2018) note that agile teams primarily use oral, direct communication, which leads to higher employee motivation, a personal approach, flexibility,

and the avoidance of misunderstandings that can result in conflict among team members. Product turnaround refers to the frequency, consistency, and sustainability with which teams arrive at new solutions, ideas, and products (Peeters et al., 2022). Fiorineschi (2018) states that investments are typically directed towards acquiring new knowledge to upgrade existing products, linking each product to a valuable and evolving body of knowledge that reflects significant effort and resources and often serves as the firm's foundation. Reflexivity is defined as the extent to which team members collectively reflect on the team's goals, strategies, and processes, as well as the entire organization and environment, after which they adjust them to meet their needs (West, 2000). Reflexivity can positively impact innovation, as team members are encouraged to seek more efficient ways of conducting business activities (Schippers et al., 2015). Tien-Shang Lee (2008) states that team members face challenging tasks in developing new products within complex environments, where reflexivity becomes crucial for fostering innovation and generating creative ideas. Simplicity in work is defined as reducing unnecessary tasks (Beck et al., 2001) and refers to consuming only those resources that contribute to value creation (Peeters et al., 2022). Simplicity integrates all related processes, including product concept and design, manufacturing, and distribution, to effectively reach customers or end-users (Idris, 2013).

Despite the increasing focus on agile way of working, there is a lack of research that explores how different dimensions of agility are perceived across various demographic groups, particularly in terms of income. While existing studies have examined the general impact of agile practices and their characteristics, few have focused on how employees from different income groups view these dimensions and whether their perspectives vary based on their financial background. This gap in the literature leads to the following research question: How do respondents' attitudes towards different dimensions of agile work methods vary, and how do these attitudes differ based on income level?

3. METHODOLOGY

To identify employees' attitudes towards key dimensions of agile work practices (self-organization, face-to-face communication, product turnaround, reflexivity, and simplicity in work), an empirical study was conducted from May 17 to June 18, 2024, in the Republic of Serbia. The research focused on employees in the ICT sector, using a survey method to gather data on their perceptions of agile work practices. An online survey was employed, with a questionnaire as the primary data collection tool. Participants, all employees of companies operating within Serbia, were selected through convenience sampling. The survey was distributed electronically, with respondents informed in advance about the research project and assured of the confidentiality of their responses. Participation in the study was entirely voluntary. The statements used to measure the relevant variables in the research model were derived from an extensive literature review. The Reflexivity variable was assessed using four statements, e.g. *Before we start working, we ensure everyone on the team shares the same problem definition* (Kirkman et al., 2004). The Self-organization variable was measured with three statements, including *My team collectively decides how tasks are accomplished* (Morgeson & Humphrey, 2006). The Product turnaround variable was evaluated through two statements, e.g. *The products/services provided by this team are delivered consistently* (Peeters et al., 2022). Additionally, Face-to-face communication was assessed using two statements, e.g. *We prioritize face-to-face conversations within this team* (Peeters et al., 2022). Lastly, the Simplicity in the work variable was measured with two statements, e.g. *We strive to minimize unnecessary work within this team* (Peeters et al., 2022). Participants rated

their level of agreement on a five-point scale, where 1 indicated strong disagreement, and 5 signified complete agreement.

Data was analyzed using the Statistical Package for Social Sciences (SPSS 26.0). The statements' internal consistency measuring the model's variables was evaluated using Cronbach's α coefficient. Additionally, descriptive statistical analysis was employed to assess the favorability of respondents' attitudes towards agile work dimensions. Finally, an ANOVA test was applied to determine statistically significant differences in respondents' attitudes, segmented by their income level.

4. RESULTS AND DISCUSSION

The conducted empirical study included a total of 153 respondents employed in the ICT sector, of which 26.8 percent (41 respondents) were female and 73.2 percent (112 respondents) were male. Most respondents were aged 26-45 years (76.5 percent), 22.9 percent were aged 18-25 years, and a minor proportion of respondents were aged 46 years and above (0.7 percent). Regarding education levels, 24.8 percent of respondents had completed graduate-level studies, 60.1 percent had completed college or undergraduate studies, and 15 percent had completed high school. Additionally, 22.2 percent of the surveyed individuals had been employed at the company for less than one year, 58.2 percent had been employed for one to five years, and 19.6 percent had been employed for over five years.

Table 1 shows the reliability analysis results, which evaluated the internal consistency of the variables in the research model using Cronbach's α coefficient. All variables, Self-management, Face-to-face communication, Reflexivity, Product turnaround and Simplicity, exhibit values above 0,70, reflecting a high level of reliability. This aligns with Nunnally's (1978) guideline that Cronbach's α should exceed 0,70 to be deemed reliable.

Table 1: *Reliability analysis*

Factors	<i>Cronbach's α</i>
Reflexivity	0.743
Self-management	0.775
Face-to-face communication	0.913
Simplicity	0.862
Product turnaround	0.796

Source: Authors

From the presented Table 2, it can be concluded that respondents have the most favorable attitude towards the Reflexivity as a dimension of the agile way of working (mean = 4,1209). On the other hand, respondents have the least favorable attitude towards the Face-to-face communication as a dimension of the agile way of working (mean = 3,4379). The most homogeneous attitude among respondents is related to the Reflexivity (standard deviation = 0,77539), while the most diverse attitude is observed regarding Simplicity (standard deviation = 1,27018).

Table 2: Results of the descriptive statistical analysis

Factors	Mean	Std. Deviation
Reflexivity	4,1209	0,77539
Self-management	3,5904	0,84509
Face-to-face communication	3,4379	1,12291
Simplicity	3,6405	1,27018
Product turnaround	3,6732	1,18004

Source: Authors

Based on the analysis (Table 3), it can be concluded that there is a statistically significant difference between respondents, segmented by income level, regarding the Self-management, as the Sig. value is 0,023 (Sig. < 0,05). A more detailed Scheffe analysis (Table 4) reveals that the statistically significant difference in terms of the compatibility factor occurs between the employees earning below 60,000 dinars per month and employees with a monthly salary above 90,000 dinars, with a Sig. value of 0,023 (Sig. < 0,05). Comparing the mean values of these segments shows that employees with a monthly salary above 90,000 dinars have more favorable attitudes than the other two identified segments.

Table 3: Results of the ANOVA test

Factors	F	Sig.
Reflexivity	0,136	0,873
Self-management	3,872	0,023
Face-to-face communication	3,041	0,051
Simplicity	0,851	0,429
Product turnaround	0,393	0,676

Source: Authors

Table 4: Results of the ANOVA test: Post-hoc Scheffe test

Factors	Segment (income level)		Mean Difference	Sig.
Self-management	Below 60,000	Between 60,000 and 90,000	-0,95833	0,057
		Above 90,000	-0,96183	0,023

Source: Authors

The values presented in the table are expressed in dinars (RSD)

The descriptive statistical analysis results show that employees have a positive attitude toward reflexivity as a dimension of agile work methods, which aligns with previously conducted research. For example, Schippers et al. (2015) emphasize that the link between team reflexivity and innovation is crucial for effective performance, especially when elevated work demands arise, as teams often face challenges that cannot be addressed simply by increasing effort or adhering to established routines. Similarly, Hoegl & Parboteeah (2006) argue that teams that engage in greater reflexivity are not only better at utilizing the expertise and skills of their members, as ongoing reflection fosters awareness of individual strengths, but they also promote better communication among team members, significantly contributing to their overall effectiveness. Likewise, Tien-Shang Lee (2008) concludes that in the process of

developing new products, team members face challenging tasks in complex environments, where reflexivity is vital for generating innovative and creative ideas, allowing them to gain insights into their actual workflows and develop new understandings and methods that effectively respond to emerging conditions. On the other hand, employees in the ICT sector expressed a less favorable attitude toward face-to-face communication as a dimension of agile work methods. This is consistent with research conducted by Guo et al. (2009), who state that the implemented online dialogue technique can help team members strengthen their relationships and improve their perceptions of team meeting outcomes, demonstrating that video-conferencing virtual teams with shared mental models can function as effectively as traditional face-to-face teams, while also enhancing outcomes for face-to-face teams.

Similarly, Pazos & Beruvides (2011) indicate that there were no significant differences in overall performance or performance changes over time between computer-mediated (CS) and face-to-face (FTF) teams, nor were there differences in overall synergy or synergy changes; however, FTF teams reported greater average cohesiveness, while cohesiveness improved more rapidly in CS teams, suggesting that CS communication did not hinder the group's ability to collaborate effectively. In contrast to these findings, Warkentin et al. (1997) discovered that teams using a computer-mediated communication system (CMCS) did not perform better than traditional face-to-face teams under similar conditions and that the relational connections among team members significantly enhanced the effectiveness of information exchange, while both virtual and face-to-face teams demonstrate comparable communication effectiveness, members of face-to-face teams report greater satisfaction. The research results also indicate a statistically significant difference in respondents' attitudes, segmented by monthly income levels, regarding self-management as a dimension of agile working. This aligns with research by Harley (1999), which demonstrates that employees in higher hierarchical positions enjoy greater autonomy in their work. Sisodia and Das (2013) argue that employees granted a higher degree of autonomy show more outstanding job commitment. Palvalin et al. (2017) suggest that self-management practices have a more significant impact on the quality and quantity of individual and team output than communication and concentration environments, highlighting the importance of improving self-management skills to boost overall productivity, especially output quality. Furthermore, employees experience the most growth when their higher-order needs, such as autonomy and competence, are met (Taylor, 2015). Therefore, to enhance overall job satisfaction among employees at different hierarchical levels, companies should provide an appropriate level of autonomy and self-management tailored to the employees' abilities and competencies (Rizwan et al., 2014).

5. CONCLUSIONS AND RECOMMENDATIONS

In response to the research question and defined research objectives, the obtained results indicate the following relevant conclusions. A positive attitude toward reflexivity, as a dimension of agile working methods, has been identified among employees in the ICT sector. Conversely, the least favorable attitude was observed regarding face-to-face communication. Additionally, a statistically significant difference in respondents' attitudes segmented by income level was noted about self-management as a dimension of agility.

The conducted research adds value to the existing literature, addressing the gap in studies that focus on individual dimensions of agility. In this context, the study explores methods for enhancing specific dimensions of agile working practices within ICT teams. Additionally, the

findings facilitate the development of both theoretical and practical implications. The paper's theoretical contribution lies in eliminating the identified gap in the literature. In practical terms, IT team managers can significantly improve team performance, drive innovation, and enhance problem-solving capabilities by cultivating reflexivity. Encouraging a reflexive approach allows teams to stay agile and responsive to new challenges and opportunities, which is particularly crucial in the rapidly evolving IT sector. When teams are prompted to reflect on their work processes, they become more willing to challenge established methods, investigate alternative solutions, and embrace innovative ideas. This mindset is especially valuable in IT environments that frequently encounter complex technical issues, as it can result in creative breakthroughs and more efficient solutions.

Managers should foster a culture where team members feel safe sharing their insights, question assumptions, and discuss possible improvements without fear of criticism. This can be achieved through regular debriefs, post-project reviews, and open feedback sessions. By encouraging teams to reflect on past experiences and outcomes, managers help them understand effective practices clearly, leading to more informed and strategic decisions. To support this, managers can implement regular reflection intervals within project timelines, allowing teams to assess progress and adapt their strategies as needed. On the other hand, to enhance face-to-face communication in IT teams, managers should create open and engaging environments where team members feel confident sharing their ideas. Organizing regular, structured meetings, such as team-building activities and retrospectives, can help maintain alignment and focus within the team. Encouraging active listening and collaborative problem-solving fosters better understanding and promotes innovation. It is also essential for managers to prioritize face-to-face conversations for important issues and provide communication training to develop soft skills like emotional intelligence.

Additionally, facilitating informal interactions outside official meetings help build stronger team cohesion, enabling IT teams to collaborate more effectively and address challenges efficiently. Managers should consider granting employees with higher income levels greater autonomy and self-management opportunities. These employees often possess the experience, skills, and expertise necessary to make informed decisions, which can lead to improved organizational outcomes. By empowering high-income employees with increased autonomy, managers can foster a sense of ownership and accountability that enhances job satisfaction and motivation. This empowerment can also encourage innovation, as experienced employees are more likely to leverage their knowledge to drive creative solutions. Additionally, promoting self-directed work among these employees enables the organization to respond more agilely to challenges and opportunities in the business environment. Thus, managers should create frameworks that support self-management while providing the necessary resources and guidance to facilitate this autonomy.

The limitations of this study primarily lie in its focus on employee attitudes within the Republic of Serbia, which means that the conclusions drawn cannot be generalized. Furthermore, the research is restricted to teams within the ICT sector, thereby limiting the applicability of the implications to other industries. Additional variables such as creativity, innovation, and employee satisfaction could be included to enhance the scope of future research. This would provide a more comprehensive analysis of the effects of agile working methods on various other dimensions of team performance and organizational functioning.

REFERENCES

- Annosi, M. C., Foss, N. & Martini, A. (2020). When agile harms learning and innovation:(and what can be done about it). *California Management Review*, 63(1), p. 61-80. <https://doi.org/10.1177/0008125620948265>
- Beaumont, M., Thuriaux-Alemán, B., Prasad, P. & Hatton, C. (2017). Using agile approaches for breakthrough product innovation. *Strategy & Leadership*, 45(6), p. 19-25.
- Beck, K., Beedle, M. Bennekum, V. A., Cockburn, A., Cunningham, W., Fowler, M., Grenning, J., Highsmith, J., Hunt, A., Jeffries, R., Kern, J., Marick, B., Martin, R.C., Mellor, S., Schwaber, K., Sutherland, J. & Thomas, D. (2001). Manifesto for agile software development. Available at: <https://agilemanifesto.org> (accessed October 5, 2024).
- Cockburn, A. & Highsmith, J. (2001). Agile software development, the people factor. *Computer*, 34(11), p. 131-133. <https://doi.org/10.1109/2.963450>
- Denning, S. (2019). The ten stages of the Agile transformation journey. *Strategy & Leadership*, 47(1), p. 3-10. <https://doi.org/10.1108/SL-11-2018-0109>
- Diebold, P. & Dahlem, M. (2014). Agile practices in practice: a mapping study. In *Proceedings of the 18th International Conference on Evaluation and Assessment in Software Engineering* (p. 1-10). <https://doi.org/10.1145/2601248.2601254>
- Elloy, D. F. (2008). The relationship between self-leadership behaviors and organization variables in a self-managed work team environment. *Management Research News*, 31(11), p. 801-810. <https://doi.org/10.1108/01409170810913015>
- Espinosa-Curiel, I. E., Rodríguez-Jacobo, J., Vázquez-Alfaro, E., Fernández-Zepeda, J. A. & Fajardo-Delgado, D. (2018). Analysis of the changes in communication and social interactions during the transformation of a traditional team into an agile team. *Journal of Software: Evolution and Process*, 30(9), e1946. <https://doi.org/10.1002/smr.1946>
- Fiorineschi, L., Frillici, F. S., Gregori, G. & Rotini, F. (2018). Stimulating idea generation for new product applications. *International Journal of Innovation Science*, 10(4), p. 454-474. <https://doi.org/10.1108/IJIS-09-2017-0099>
- Gonzalez-Mulé, E., Courtright, S. H., DeGeest, D., Seong, J. Y. & Hong, D. S. (2016). Channeled autonomy: The joint effects of autonomy and feedback on team performance through organizational goal clarity. *Journal of Management*, 42(7), p. 2018-2033. <https://doi.org/10.1177/0149206314535443>
- Grass, A., Backmann, J. & Hoegl, M. (2020). From empowerment dynamics to team adaptability: Exploring and conceptualizing the continuous agile team innovation process. *Journal of Product Innovation Management*, 37(4), p. 324-351. <https://doi.org/10.1111/jpim.12525>
- Gren, L., Goldman, A., & Jacobsson, C. (2020). Agile ways of working: a team maturity perspective. *Journal of Software: Evolution and Process*, 32(6), e2244. <https://doi.org/10.1002/smr.2244>
- Guo, Z., D'ambra, J., Turner, T. & Zhang, H. (2009). Improving the effectiveness of virtual teams: A comparison of video-conferencing and face-to-face communication in China. *IEEE Transactions on Professional Communication*, 52(1), p. 1-16. DOI: 10.1109/TPC.2008.2012284
- Harley, B. (1999). The myth of empowerment: work organisation, hierarchy and employee autonomy in contemporary Australian workplaces. *Work, Employment and Society*, 13(1), p. 41-66.

- Hoda, R., Noble, J. & Marshall, S. (2012). Developing a grounded theory to explain the practices of self-organizing Agile teams. *Empirical Software Engineering*, 17, p. 609-639. <https://doi.org/10.1007/s10664-011-9161-0>
- Hoda, R., Salleh, N., Grundy, J. & Tee, H. M. (2017). Systematic literature reviews in agile software development: A tertiary study. *Information and software technology*, 85, p. 60-70. <https://doi.org/10.1016/j.infsof.2017.01.007>
- Hoegl, M. & Parboteeah, K. P. (2006). Team reflexivity in innovative projects. *R&d Management*, 36(2), p. 113-125. <https://doi.org/10.1111/j.1467-9310.2006.00420.x>
- Hopp, W. J. & Oyen, M. P. (2004). Agile workforce evaluation: a framework for cross-training and coordination. *Iie Transactions*, 36(10), p. 919-940. <https://doi.org/10.1080/07408170490487759>
- Idris, F. (2013). Applying the concepts of simplicity and discipline for creating customers' value in a low contact services company: an exploratory study. *Business Strategy Series*, 14(5/6), p. 144-150. <https://doi.org/10.1108/BSS-12-2011-0031>
- Junker, T. L., Bakker, A. B., Derks, D. & Molenaar, D. (2023). Agile work practices: measurement and mechanisms. *European Journal of Work and Organizational Psychology*, 32(1), p. 1-22. <https://doi.org/10.1080/1359432X.2022.2096439>
- Kirkman, B.L., Rosen, B., Tesluk, P.E. and Gibson, C.B. (2004). The impact of team empowerment on virtual team performance: the moderating role of face-to-face interaction, *Academy of Management Journal*, 47(2), p. 175-192. <https://doi.org/10.5465/20159571>
- Luis Alves Pais, C. (2010). Self-managed teams in the auto components industry: Construction of a theoretical model. *Team performance management: An international journal*, 16(7/8), p. 359-387. <https://doi.org/10.1108/13527591011090646>
- Mani, S. & Mishra, M. (2020). Characteristics and ingredients of an agile work force—a strategy framework. *Strategic HR Review*, 19(5), p. 227-230. <https://doi.org/10.1108/SHR-02-2020-0013>
- Melo, C. D. O., Cruzes, D. S., Kon, F. & Conradi, R. (2013). Interpretative case studies on agile team productivity and management. *Information and Software Technology*, 55(2), p. 412-427. <https://doi.org/10.1016/j.infsof.2012.09.004>
- Naslund, D. & Kale, R. (2020). Is agile the latest management fad? A review of success factors of agile transformations. *International Journal of Quality and Service Sciences*, 12(4), p. 489-504. <https://doi.org/10.1108/IJQSS-12-2019-0142>
- Nielsen, J. E., Nikolić, J., Slavković, M. & Zlatanović, D. (2022). How to make health organisations more agile during the pandemic? Challenges of managing entrepreneurial behaviour. In *6th feb international scientific conference*, p. 389.
- Nunnally, J.C. (1978). *Psychometric Theory*, McGraw-Hill, New York, NY.
- Palvalin, M., van der Voordt, T. & Jylhä, T. (2017). The impact of workplaces and self-management practices on the productivity of knowledge workers. *Journal of Facilities Management*, 15(4), p. 423-438. <https://doi.org/10.1108/JFM-03-2017-0010>
- Pazos, P. & Beruvides, M. G. (2011). Performance patterns in face-to-face and computer-supported teams. *Team Performance Management: An International Journal*, 17(1/2), p. 83-101. <https://doi.org/10.1108/13527591111114729>
- Peeters, T., Van De Voorde, K. & Paauwe, J. (2022). The effects of working agile on team performance and engagement, *Team Performance Management: An International Journal*, 28(1-2), p. 61-78.

- Ramirez-Mora, S. L. & Oktaba, H. (2018). Team Maturity in Agile Software Development: The Impact on Productivity. In *2018 IEEE International Conference on Software Maintenance and Evolution (ICSME)* (p. 732-736). IEEE Computer Society. doi: 10.1109/ICSME.2018.00091.
- Rao, K. N., Naidu, G. K. & Chakka, P. (2011). A study of the Agile software development methods, applicability and implications in industry. *International Journal of Software Engineering and its applications*, 5(2), p. 35-46.
- Rigby, D. K., Sutherland, J., & Noble, A. (2018). Agile at scale. *Harvard business review*, 96(3), p. 88-96.
- Rizwan, M., Jamil, M. I., Shahid, U., Saeedi, A., Faisal, N., Ul Islam, Z. & Mateen, A. (2014). The impact of the job stress, job autonomy and working conditions on employee satisfaction. *International Journal of Human Resource Studies*, 4(2), p. 196-207. Doi:10.5296/ijhrs.v4i2.5907
- Schippers, M. C., West, M. A. & Dawson, J. F. (2015). Team reflexivity and innovation: The moderating role of team context. *Journal of Management*, 41(3), p. 769-788. <https://doi.org/10.1177/0149206312441210>
- Sisodia, S. & Das, I. (2013). Effect of job autonomy upon organizational commitment of employees at different hierarchical level. *Psychological Thought*, 6(2). <https://doi.org/10.23668/psycharchives.1928>
- Swafford, P. M., Ghosh, S. & Murthy, N. (2006). The antecedents of supply chain agility of a firm: scale development and model testing. *Journal of Operations management*, 24(2), p. 170-188. <https://doi.org/10.1016/j.jom.2005.05.002>
- Tabassum, M., Raziq, M. M. & Sarwar, N. (2024). Emergent leadership in agile software development teams: leader identification through network analysis and aggregation approaches. *Benchmarking: An International Journal*, (ahead-of-print). <https://doi.org/10.1108/BIJ-07-2023-0470>
- Taylor, B. M. (2015). The hierarchical model of motivation: A lens for viewing the complexities of motivation. *Performance Improvement*, 54(4), p. 36-42. <https://doi.org/10.1002/pfi.21475>
- Tien-Shang Lee, L. (2008). The effects of team reflexivity and innovativeness on new product development performance. *Industrial Management & Data Systems*, 108(4), p. 548-569. <https://doi.org/10.1108/02635570810868380>
- Vrontis, D., Thrassou, A., Chebbi, H. & Yahiaoui, D. (2012). Transcending innovativeness towards strategic reflexivity. *Qualitative Market Research: An International Journal*, 15(4), p. 420-437. <https://doi.org/10.1108/13522751211257097>
- Warkentin, M. E., Sayeed, L. & Hightower, R. (1997). Virtual teams versus face-to-face teams: an exploratory study of a web-based conference system. *Decision sciences*, 28(4), p. 975-996. <https://doi.org/10.1111/j.1540-5915.1997.tb01338.x>
- West, M. A. (2000). Reflexivity, revolution and innovation in work teams. *Product development teams*, p. 1-29.

SOCIAL CAPITAL IN THE CONCEPT OF SUSTAINABLE MANAGEMENT

Tomasz Kusio*

Krakow University of Economics, kusiot@uek.krakow.pl

ORCID number 0000-0003-0508-6520

Abstract: *The presented study addresses the issue of systematization of the issues of social capital and the problem of its measurement. The significance of social capital in the context of globalization and digitalization takes on a new prominence. Therefore, it was important to address and renew the issues. Social capital has for now been addressed quite extensively in the literature, and the beginnings of its definition and conceptualization are assumed to be in the 1980s. The significance of the social reference dimension in the functioning of business entities had its scope, for example, in corporate social responsibility, or in the evolving role of social economics, where social stakeholder issues were articulated quite strongly. In the case of social responsibility theory, the importance of stakeholder satisfaction took on a new meaning in considering the goals of organizations. Issues of management universalism also largely point to the growing importance of the social element and the penetration of business management methods and techniques in nonprofit organizations. Social capital, as an economic concept, directly corresponds to the principles of management evolution, which is due to the fact that, in its essence, it concerns the social reference inside and outside the organization. The current changes that are occurring in management, which are a result of increasing globalization, but also the issues of the dominant role of digitalization make new horizons open for the issue of social capital, which can be seen, even in the issues of agility, open innovation or turquoise organization. In each of the above-mentioned descriptive trends in the functioning of economic units, social capital has its aspect in terms of both the intra-organizational level and the extra-organizational level. The purpose of this work is to present considerations of social capital in the intra- and extra-organizational dimensions in the context of an attempt to indicate its applicability. As a result of conducted considerations, based on the literature on social capital, it can be referred to individuals, groups or communities, which are even the result of networked cooperation. Social capital, despite the definitional references, should be strictly connected with the relations occurring between the representatives of an organization, group or even community. In addition to the mere capital resulting from these relationships, what is important is the quality of these contacts, their frequency and the level of trust of the parties to the relationship, which is mainly influenced by interactions based more on traditional contact between the parties. All of this, in effect, can only be addressed by trying to systematize the issues of classifying and measuring social capital.*

Keywords: *Management, Entrepreneurship, Social capital*

JEL Classification: *A13, C31, L26*

* Corresponding author

1. INTRODUCTION

The concept of social capital and the importance of this variable for the functioning of an organization derives from the advantage that an enterprise can achieve in the market by properly utilizing the relationships between people inside and outside the organization (Lizak, 2009). Thus, the research on improving an organization's competitiveness puts a great deal of emphasis precisely on improving the use of an organization's relationships with respect to both its internal and external environment.

One of the important factors influencing the growth of interest in organizations in the topic of social capital is the importance of this constant in the context of access to resources. Building an organization's position in the environment, accompanied by the need to break down barriers, is more effective when the organization is able to capitalize on its relationships just as effectively, that is, to gain easy access to know-how resources that result in a lower level of risk in decision-making when developing, or developing, markets. (Tsai, 2006).

The difficulty of measuring social capital is due, among other things, to the lack of a specific matter, having a certain value, physical size and applicability as a resource and productive tools. In the search for clarification of social capital, reference to human capital, to people, or more precisely, even to the attributes of this individual, which are manifested in the ability to create and strengthen relationships, is taken as its determinant (Woolcock, 2001). In turn, the carrier of social capital is the flow of information.

The importance of social capital is also recognized in the context of entrepreneurship, where entrepreneurial opportunities, opportunities that can further lead to business satisfaction, are the result or consequence of the very flow of information and thus access to sources of information resulting from existing relationships (Kurczewska, 2011).

In parallel to the issue of the flow of information and its effective use for the purpose of capitalization of knowledge, access to knowledge, social benefit, as well as stakeholder satisfaction also play an important place. Indeed, the level of stakeholder satisfaction can be a determinant of the decision-making actions of the company's management. The more the organization's relationship with its stakeholders is tightened, the more stakeholder satisfaction can contribute to the operation of the organization. From this point of view, social capital issues also play a significant role.

Another important area of interest that relates to social capital, to the importance of relationships, is the loyalty ties that companies form with their customers. On the one hand, the essence of building ties is to influence the creation of a positive image, the brand of the company, and on the other hand it is to contribute to building strategic ties with a commercial, sales background. Attaching customers to a company is at the same time increasing and cementing the potential of customers, i.e. creating a competitive position (Grzebieniak, 2012).

Relationship marketing, or rather relationship building, aimed at improving the competitive position of an enterprise is a specific, yet important, element in the creation of social capital. This is due to the fact that from the capital of these relationships comes an increase in the competitive position of the enterprise. In terms of creating customer relationships, the importance of relationships has a measurable financial effect, as the use and intensification of relationship capitalization leads to direct financial benefits from increased sales levels

(Grzebieniak, 2012). The research shows that as a result of effective relationship building at the interface between the organization and the external environment of the enterprise (enterprise-customers), there is also a mechanism for further deepening relationship building between the loyal customer and the new convinced customer.

Social capital is formed as a result of providing direction to the entrepreneurial behavior of individuals in order to induce actions and effects to achieve organizational goals. Thus, individuals acquire organizational roles that materialize in the flow of information that is a consequence of communicated relationships (Marcinkowska, 2012; Tkachenko, 2012).

The field of social capital has been and continues to be addressed in the literature not only because of the mere issue of trying to systematize this important research area, but also because of the significant benefits that result from capitalizing on this capital. In addition to the definition of capital, research also includes derivative issues such as, among others, the study of the characteristics of this capital, or its components (the development of communities, experience, trust, the development of relationships and information media, and now also the forms of this communication in particular resulting from the development of digitization). Therefore, the purpose of this work is to contribute to this research, which refers to an attempt to determine how to measure social capital. The principal material of the work is the results of the literature analysis in the field of social capital.

2. THE ESSENCE AND CONCEPT OF SOCIAL CAPITAL

Resources are defined, in part, as the set of available tangible and invisible factors - owned and controlled by an organization (Amit & Schoemaker, 1993). Resources can also be defined as the entirety of things, people, information and financial resources that an organization owns or can dispose of, despite the lack of ownership (Kozminski & Piotrowski, 1997). Capital, on the other hand, should be defined as a valuable good that enables economic activity and, as a part of this, the growth of capital value itself (Baruk, 2019). Pierre Bourdieu defines social capital as a set of actual and potential resources that are associated with the possession of a permanent network of more or less institutionalized relationships based on mutual knowledge and trust. He believes that this capital is associated with membership in a group that provides each of its members with the support of the collective's credibility capital (Bourdieu, 1986; Huang, 2019). The individual, through participation in such networks, was supposed to gain access to capital held by the collective of trust. An individual's success, in this sense, is the product of his or her own determination and the wealth and contacts possessed by belonging to the relevant group. Resources are thus defined in parallel with capital, which, however, as further analysis reveals, is not always the case.

Among the concepts relating to social capital, prominent among them (Baruk, 2019) are those derived from the considerations of J. Ross and G. Ross (1997), who point to such components of relational capital with the organization's surroundings as: relationship capital with customers, suppliers, business partners and investors. J. Nahapiet and S Ghosal (1988) consider social capital to be the sum of current and potential resources involved and acquired in networks of individuals and also social units. In this sense, the terms social capital and relational capital are used alternatively, which emphasizes the relational nature of social capital as will be emphasized in later sections of the paper.

J. Coleman (1988), in his theory of social capital, combines a sociological perspective (the individual as part of social relations) and an economic perspective (the individual pursues his own benefits). He defines it as the ability of people to cooperate with each other both within a group and within an organization to pursue common interests and facilitate joint action, increasing its effectiveness. All this takes place within a social structure, within which rational actors take actions in accordance with prevailing norms, rules and obligations, having mutual expectations and obligations to each other (including to help others), and creating a flow of information. An important role in the process of creating social capital is played by the family.

R. Putnam combines the theory of rational choice with the theory of culture which makes social capital consist of three main elements: trust, which facilitates interpersonal cooperation and supports coordination of activities, norms of reciprocity ("give and take", dilemma resolution, as well as networks of civic engagement that give rise to social trust and the aforementioned norm of reciprocity. The main question he poses is whether social capital can lead to solving the problems of social life, and possibly how (Putnam, 1997; Putnam, 2008; Tarrow, 1996). F. Fukuyama (1997) in his work "Trust. Social Capital and the Path to Prosperity" went beyond the area outlined by J. Coleman (1988), devoting attention to the relationship of social capital to economic, social and political activity. In addition, he also took into account the influence of different cultures and traditions on forms of economic activity. Accordingly, the meaning of his definition of social capital is the informal values and ethical norms shared by the members of a given group that enable mutual interaction. The key that makes it possible to increase the efficiency of group functioning is (gradually increasing) mutual trust. According to Fukuyama (1997, 2000, 2003), social capital is formed from the level of the family, through social groups to institutions, with the participation of tradition, culture, history, religion, customs, as well as market activities. The European Union includes in the composition of a company's relational capital: customers, suppliers, as well as development and research partners. This category of capital also includes the part of human and structural capital that is linked to external stakeholders. L. Gratton and S. Ghohal (2003) include contacts and close friendships with others as part of social capital.

Social capital can be discussed and qualified as an "invisible" resource due to the fact that it is inscribed in goods, or intangible resources. Among the components of intellectual capital, as M. Jablonski (2002) points out, in addition to human, organizational and innovative capital, the so-called "market capital" is also mentioned, which includes relationships with customers, relationships with suppliers, market competence and the so-called "other relationships. The indicated identification of capital referred to as "market", fits in with the components of social capital with the characteristics of external environment resources. With regard to the so-called "other relations," it seems that internal environment stakeholders should also be included, especially since the very definition of capital has been characterized as market capital.

Social capital is also considered to be norms, values, knowledge, preferences and other social characteristics, as well as network elements reflecting interpersonal relations in a given space (Westland & Bolton, 2003). From this point of view, social capital is a kind of descriptive characteristic and relationship status of a given spatial area. From this context of relating social capital to a geographic area, it can be considered that social capital is a descriptive component of a geographic region. Thus, it would be possible to conceptualize social capital in three dimensions: micro - where social capital refers to the enterprise and its internal environment, meso - this context continues to refer to the organization's environment, but includes the external environment, macro - in this context it is necessary to go beyond the

enterprise, the context includes the external environment further afield, including geographically. The macro context was, in the initial phase of defining social capital, most often mentioned due to the fact that they related social capital to the national environment, bearing in mind the influence of social, interpersonal norms of society.

Analyzing the successive ways of capturing social capital that scholars used in their research, it is also possible, similar to the conclusions drawn above, to note the diversity and a certain hierarchy in approaches: from the micro (Bourdieu) to the meso (Coleman) to the macro (Putnam, Fukuyama) scale (Sierocinska, 2013). It is also worth noting that Bourdieu, unlike other researchers, treats social capital as a resource of the individual, not of the collective, and defines the social capital of a group as the sum of the resources of its members, which is more in line with the relational context of understanding social capital.

Conceptualizing social capital in a social context means that it is defined as a set of social resources embedded in relationships (Frankowski, 2018). Social capital is also conceptualized in spatial terms and refers to the understanding of an organization's connections with other stakeholders who are located in a certain geographic environment. This includes both local and regional environments and is primarily embedded on the basis of geographic proximity. In this dimension, the growth of social capital determines the proximity and frequency of relationships with stakeholders and can be referred to in this context as relationships with internal stakeholders (relationships inside the company), as well as relationships with external stakeholders (relationships outside the company).

Taking into account, in turn, the evolution of the understanding of social capital, where it was initially referred practically only to large social collectives, and later only to smaller groups, collectivities, it seems legitimate to define social capital in relation to not-for-profit organizations, but also to business-oriented ones. Further consideration of social capital will be based on the context of the enterprise, as a group with certain social capital, but also those relationships that affect the operation of the enterprise, but involve external stakeholders.

3. AN ATTEMPT TO DEFINE GUIDELINES FOR MEASURING SOCIAL CAPITAL VS. THE CONCEPT OF SUSTAINABLE CAPITAL MANAGEMENT

In discussing issues of social capital, it is worth considering, in addition to the definitional reference to this capital itself, the question of what utilitarian dimension the consideration of the concept of social capital itself has (Au, 2019). The question of the utilitarian context of considering social capital concerns the benefits to the enterprise by virtue of the relationships it has and the use of those relationships (Karavay, 2021). Undertaking to discuss and consider issues of quantification of social capital in the context of the management of an enterprise, a business unit, should allow optimization in balancing capitals. These benefits should be subject to financial quantification, and financial or value-added quantification should occur sooner or later.

Issues of measuring social capital have been considered by researchers in the past, and have largely pertained to broad communities, such as residents of a country or region, with studies covering inclusive and exclusive social capital (Putnam, 2008). Exclusive capital refers to heterogeneous ties, i.e., between people from different institutionalized structures who direct their openness outward. Inclusive capital, or inclusive ties, are relationships directed within

groups, such as family groups, which result in enriching people with values and ideas shared by members of a community. Researchers have therefore disaggregated relationships, in the process of trying to measure it. Methods of measuring social capital also involved attempts to measure phenomena that were generated through social capital, as well as the absence of phenomena whose causal factor was social capital.

While in the initial formula the definition of social capital was strictly related to communities, collectivities in large territories, later definitional currents began to relate social capital to smaller groups, smaller communities, even attributing it to an individual, to a person. This was done by P. Bourdieu (Bourdieu, 1986; King, 2000; Reichenberg, 2020), where, according to the proposed definition, the social capital of an individual is expressed in the number of acquaintances a person has. Thus, he made a preliminary proposal to quantify social capital in the context of an individual. This quantification is not financial, but quantitative in nature. Bourdieu noted that social capital contributes to the creation of social inequality, that is, the quality of relationships, and thus the "quality" of acquaintances, matters to him. Other definitions, including that of the World Bank, point to institutions with which contacts are made, groups of people, nevertheless, it can be considered that any such institutional definition is followed by personal communication, which is consistent with Bourdieu's definition and can form the basis for measuring social capital.

In accordance with Bourdieu's (2001) systematization of the issues that Bourdieu (2001) carried out regarding social capital, he concluded that social capital should be considered those existing and potential resources attributable to an individual organization or group, which are based on relationships, trust, contacts, and credibility with other people. Thus, in terms of measurement issues, it can be considered that in addition to the relationships themselves, factors that determine these relationships are also important, such as precisely the level of trust, the frequency of contacts, the quality and type of these contacts, which in turn can also depend on the distance that separates two parties. Putnam (1995, 1997), on the other hand, considered social capital to be the value of social norms, trust, and networks that influence the facilitation of work and the coordination of tasks to achieve benefits, confirming the earlier considerations. From the point of view of the definitions that are presented by various researchers, there is a fairly clear trend towards concretizing social capital as that which refers to people, and in particular to the connections between people representing different types of organizations. For this reason, the issue of measuring social capital should also be looked at from a human perspective. The quality of human relations will be determined by the level of involvement of a party or parties in a bilateral relationship, who, through their relational openness, will seek opportunities to obtain knowledge and support for the problems and their solutions sought (Levi, 1996).

Active entrepreneurship leads to the creation of added value. Some authors point out that the measure of competitiveness is precisely the ability to generate and implement innovation (Rzepka, 2012). This is because innovative activity ensures the growth and development of enterprises in the long term, which in turn is in line with the strategic axiom of understanding competitive advantage. Moreover, the longer the time horizon, the more and more the enterprise is able to adapt its productive factors (resources) to new conditions (Begg et al., 1997). Relational action for the benefit of the units represented by the parties to the relationship serves to seek ways to increase the competitive position in the long term.

In the short term, only partial adaptation of productive factors to the market situation is possible. Thus, the adaptive efficiency of the enterprise is associated with the dynamics of adaptation to market changes, which, after all, also relates to social capital. Decision-making efficiency is related to effectively used relationships, communication to acquire information and process it. Thus, the quality of social capital will be indicated by the dynamics of its capitalization. The more often an organization's employee's contacts will be used both intra-organizational and extra-organizational (inclusive and exclusive), the greater the potential for capitalizing social resources, which means varying degrees of strength of connections.

The measurement of social capital, which should be classified into the main two categories (internal relations and external relations), can also be qualified as that with the employees of one's own organization and representatives of external institutions of a business, social, scientific or public benefit nature, among others, so stakeholders. In turn, depending on the extent to which the construction of the value of products and services is based on relationships with particular types of external partners (we are talking about social capital of an external nature - exclusive relationships), to such an extent will be important relationships held in this regard.

Active entrepreneurship, which was previously defined as having an impact on capitalizing and transforming them into capital, can be activated and functioning to a greater or lesser degree within an organization. What seems to be a determinant of the growth dynamics of active entrepreneurship is the perceived level of complementarity (Latusek, 2008), i.e. the ability to supplement the lack of knowledge, intangible resources, which through contacts and relationships with others can be supplemented. It is from organizations, from the environment in which the enterprise has ties, and which may have the resources to increase the value of the product offered by the home enterprise, that will be more preferred to maintain active contact. In this sense, active entrepreneurship refers to actively working to increase the level of social capital. Because of the recognition of involvement in relationships as a determinant of their characteristics, their strength, it can be considered that the level of social capital will be determined by the strength of ties, the quality of relationships.

Summarizing the considerations in the field of the possibility of measuring social capital in a quantitative context, we can distinguish the following factors that affect its size in an organization:

K_w - the number of contacts held by internal stakeholders of an enterprise,

K_z - the number of contacts held by external stakeholders of an enterprise,

R_w - the number of interactions initiated by internal stakeholders

R_z - the number of interactions initiated by external stakeholders

S - the strength of impact relating to the relationship

Making a similar type of assumption, the sum (quantitatively) of social capital "K" should be taken as the sum of contacts and the sum of relationships according to the following formula:

$$K = K_w + K_z + S(R_w) + S(R_z) \quad (1)$$

The function relating to relationships is concerned with how strong these ties are, and the measurement itself should be determined over time, taking a long-term perspective.

The measurement of social capital can be talked about in absolute terms, where the issues of relationships between representatives of the parent organization and representatives of other organizations with which the parent organization cooperates can be identified a certain number, but it can also be talked about the context of productivity, namely how the particular relationships between the parties have increased the value in terms of products and services, provided by the parent organization. The contacts, relationships held can thus lead to certain benefits, quantified in financial terms. One way to measure social capital can thus be to refer to the book value of an enterprise. A function of the market value of an enterprise is taken as the sum of the book value of that enterprise and intellectual capital, from which it follows that the value of intellectual capital is the difference between the market value and the book value of the enterprise. One of the components of intangible capital, such as intellectual capital, is social capital, referring to relationships and contacts (Dudycz, 2005). A similar formula for estimating the value of intangible capital including social capital can be presented in financial form. The difficulty is to separate from the value of total intangible capital, the one relating to relationships and contacts and this in financial terms, which may be the subject of further research and is a limitation in the work presented.

4. SUSTAINABLE MANAGEMENT OF SOCIAL CAPITAL

In the strategic, operational, or tactical goals formulated in enterprises, their duality is noticeable. This is because, on the one hand, they are functional-economic, and on the other hand, humanistic-social of the workforce. The formulated goals can be more or less complementary with each other, but they can also be competitive, and they can even contradict each other. The reason for this is their inhomogeneity and, as a result, the primacy of economic goals (Vulture, 1998). The indicated duality of the objectives formulated by business units already indicate the need to carry out balanced planning in the enterprise, which may perceive the need to balance functional-economic factors against humanistic-social ones. And given that social capital has the characteristics of capital in economic terms, one of its functions is to provide economic effects (Sabatini, 2006) and therefore influence the size of other capitals of the enterprise.

Associated with the search for and emergence of ties is the desire to improve the current situation, striving to create added value, affecting positively, positively, areas of the organization's functioning, which in turn is reflected in the formulated tactical, operational, or strategic goals.

One acceptable perspective is that relating to the qualification of innovations, namely: product, process, organizational and marketing. Tangible and intangible capitals, among them knowledge, are needed to conceptualize and implement innovations that, as a result, positively affect the value of the enterprise. Although it can be considered a normative statement that knowledge occurs as a result of information processing, knowledge itself is identified strictly with human beings or human resources (Kupisz, 2006), while information systems and other resources of technological nature should be considered as carriers of knowledge (databases,

computers, information systems). In this context, the need to obtain knowledge is a determinant of relational behavior. The need to replenish intellectual resources is a rationale for balancing other capitals. Similarly, the purchase of data like know-how or a license represents an action that leads to balancing the company's competitive situation in the market. Figure 1 presents a view of the function of relationships in the process of obtaining innovative concepts. In order to obtain innovative concepts, that is, in order to acquire added value to existing products or services, activities of a relational nature, whether intra-organizational or extra-organizational, are required. As a result of these, it can only be enough to transform knowledge into innovative solutions.

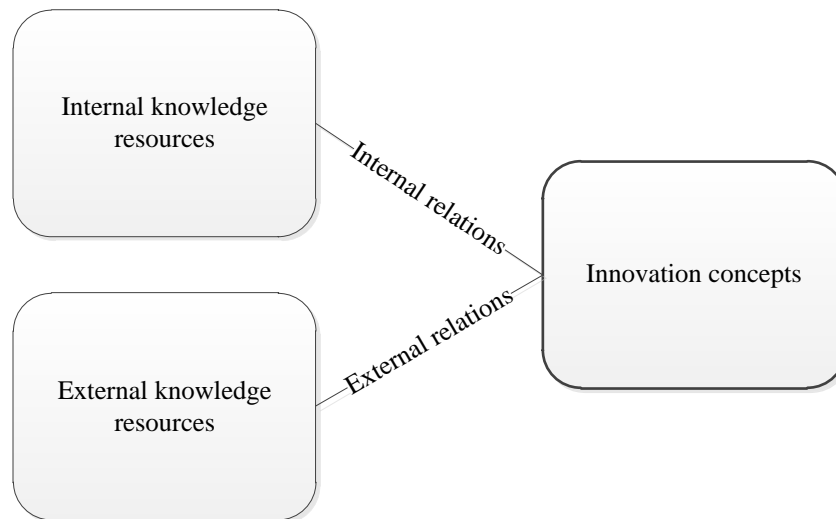


Figure. 1. *View of the function of relationships in the process of obtaining innovative concepts*
Source: Own elaboration

Although the growth of social capital is referred to in the context of exclusive ties, inclusive ties, according to researchers, have a negative impact on the development of social capital (Sabatini, 2006). However, in the context of the impact of intensifying interactions and increasing the productivity of knowledge resources in the enterprise through the intensification of ties, it is possible, in the context of organizations, to talk about the process of increasing the level of innovation. Innovation resources in this sense are subject to increase, along with an increase in the productivity of social capital. Thus, the mobilization of social capital resources positively affects the balancing in terms of competitive position, or in another context - increasing the level of productivity of social capital positively affects the increase in the level of knowledge capital in the organization, and at the same time increases the level of innovation capital of this organization. The driving force, determining the increase in the productivity of social capital resources, in this case, will be changes in the external environment, triggering the needs to increase the competitive position of the company.

The source of social capital is both the internal and external environment of the organization. In order for resources to be transformed into capital, it is necessary to strengthen them with materialized knowledge - Figure 2.

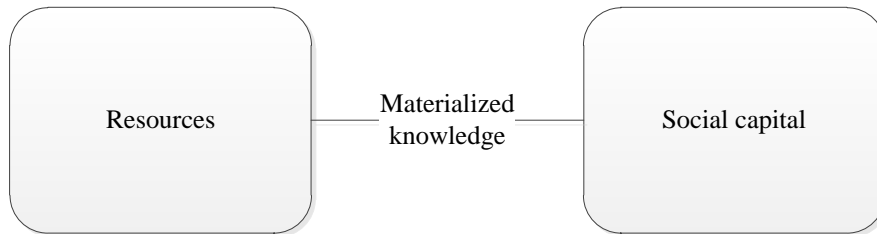


Figure 2 Transformation of resources into capital.

Source: Own elaboration

In order to maintain its own market position, as well as to strengthen it, it is recognized that resource redundancy is needed, and therefore the creation and maintenance of a resource surplus, which mainly concerns intangible resources (Olejniczak-Kita, 2013). The issue of social resource productivity is related to the issue of controlling, the essence of which boils down to reducing randomness and eliminating occasionality in the sphere of human capital management. Obtaining adequate productivity of human resources thanks to this includes, among other things, internal relations and those in the area of arrangements with the external environment (Vulture, 1998). In the external environment of the institution, we can mention the competitive or cooperative environment, with which the economic unit can conduct either joint activities (cooperation), or with which the unit is forced to compete, that is, fight for market share (Rzepka, 2012). In addition to cooperation and competition, there is the term cooptation, which combines the two concepts mentioned above. The issue of increasing the productivity of human resources is reflected in cooperation or competition or cooptation. Thus, increasing the productivity of social resources also includes relations with competition. The organization's links with the external environment means the organization's participation in a network, which may be more or less formalized.

The value of an organization stems from its participation in the network, the level of social capital available to companies, or more broadly to an organization that is a member of the network stems from the position the organization holds in terms of the network (Pachura, 2010). In this context, an organization's exclusive social capital is determined by its position in the network, that is, a structure oriented towards knowledge exchange and based on mutual relationships. Clusters are a specific form of interaction within the network. In the context of discussing the benefits that companies can achieve by virtue of interaction within clusters, the so-called Consequences of Supply Chain Management appears, which is directly applicable to the achievement of long-term or long-term competitive advantage, which in turn finds reference to strategic management, embedded in a long-term perspective (Fechner, 2007). The benefits that can be derived from the use of social capital can therefore be measured in the long term, from the perspective of achieving competitive advantages.

An attribute of the network as social capital is the structure of both the external and internal structure of the organization (Kukowska, 2013). The continuous development of entrepreneurship depends on the continuous development of social capital. In order to maintain competitiveness, in addition to factors such as human capital and social capital, relationships are important on different levels, stimulating and being stimulated to develop. Acting for the benefit of partners, participants in the organization's network determines the future benefits of the organization due to social capital. Thus, for the purpose of strengthening the competitive position of the organization, it is important to increase its social capital, which is expressed by both intra-organizational and extra-organizational relations, relations with the

environment. Thus, bearing in mind that also competitors can cooperate with the same actors of the environment, it seems all the more important to strengthen the relationship to make it stronger.

5. CONCLUSIONS AND RECOMMENDATIONS

In summary, one can list the main currents of understanding social capital, from identifying it with large groups of communities, such as regional, supra-regional, national communities, through smaller groupings - networks of individuals, to attributing social capital to the individual. In addition to the original classification of social capital as referring exclusively to social benefit, attempts have also begun to conceptualize social capital in relation to the functioning of economic units also geared toward profit.

In the context of trying to find regularities occurring between effective management and control of the balance of corporate capitals, the importance of social capital increases. Thus, solutions for measuring the size of this capital also become legitimate. Taking into account the conceptualization of capital in relation not only to the social collectivity of a given region, but also to the collectivity pertaining to a given organization, we can distinguish the employees of a given organization as a group affected by decisions related to the functioning of the organization. However, also taking into consideration the influence of members outside the organization, with whom activities are also related and decisions are made, this group also seems to be a factor that affects the definition of the organization's social capital.

When analyzing stakeholder theory its assumption can be used to both defining and measuring an organization's social capital. In this context, the social capital of an organization should be considered as the sum of the social capitals of the organization's internal and external stakeholders.

From the point of view of an organization such as an enterprise, the presence of social capital is essential. The purpose of the operation of an institutionalized profit-oriented organization is to capitalize the resources it possesses and multiply them, including, to a significant extent, the resources that make up its ownership capital. In order for the goal to be achieved it is necessary for the members of the organization to cooperate, to bring about the transformation of capitals, including social capital into physical, financial capital of the enterprise.

What can be considered as a result of considerations as a result of the literature analysis is the regularity that the higher the level of social capital, the higher the probability of obtaining other types of capital and the higher the level of these capitals in general.

Social capital is a concept that refers to relationships that occur between members of given communities, either in the institutionalized or territorial sense. Social capital should be distinguished from social resources, which means the parties to particular relationships, ties, but also those resources that can affect the existence of relationships between members of particular groups, or communities. As a result of active entrepreneurship, which is a causal factor in the activation of interactions, further resources are generated, namely trust, commitment, which have a positive impact on the capitalization of social resources. As a result of the occurrence of social capital and the capitalization of the resources that comprise it, both tangible and intangible results are produced, such as improved products and services, manufacturing processes, or organizational processes. These are the value-added outcomes

that result from the impact of social capital, among other things. The results in question can be business, social and public in nature.

Therefore, in the context of an attempt to assess the levels of a company's capitals, i.e. the so-called Balanced Capital Management and an attempt to make indications in terms of social capital, it seems that the rule of "the more the better" should apply here. What seems to be of great importance in the context of assessing the optimal level of social capital is the fact of using the potential of contacts and relationships, which make up the capital in question. Given that a function of the productivity of social capital is the growth dynamics of innovation capital, the issues of social capital management can be linked to the potential and commercialization capacity of the enterprise involved in these processes. Therefore, it can be considered that in further studies in terms of attempting to estimate the capital levels of an entity, it will be important to refer to the desired level of scalability of the entity, which may further constitute an interesting research direction.

The potential characterized by social capital is the more causal, the more it is subjected to relational influence. Therefore, the level of capitalization and causality not only increases with the level of relational resources, but also with the dynamics of their use, which can be defined, as active entrepreneurship. Therefore, active entrepreneurship should be considered as a variable that can transform resources into capital. Resources subjected to the influence of the human factor only cause resources to turn from passive to active and thus generate value. Social capital thus can be reproducible.

REFERENCES

- Amit, R., & Schoemaker, J.H. (1993). Strategic Assets and Organizational Rent, *Strategic Management Journal*, Vol. 14.
- Au, A. (2019). The embodiment of social capital at individual and communal levels: Action, rewards, inequality, and new directions, *International Journal of Sociology and Social Policy*, Vol. 39 No. 9/10, pp. 812-830.
- Baruk, A. (2019). *Kapitał intelektualny i compliance w procesach konstituowania doskonałości systemów społecznej odpowiedzialności organizacji*. Warszawa: PWE.
- Begg, D., Fischer, F., Dornbush, R. (1997). *Mikroekonomia*. Warszawa: PWE.
- Bourdieu, P. (1986). The Forms of Capital. *Handbook of Theory and Research for the Sociology of Education*, pp. 241–258.
- Bourdieu, P., & Wacquant, J. (2001). *Zaproszenie do Socjologii Refleksyjnej*, Warszawa: Oficyna Wydawnicza.
- Coleman, J. S (1988). Social Capital in the Creation of Human Capital. *American Journal of Sociology*, 94 Supplement, pp. 95 –119.
- Dudycz, T. (2005). *Zarządzanie wartością przedsiębiorstwa*. Warszawa: PWE.
- Fechner, J. (2007). *Zarządzanie łańcuchem dostaw*. Poznań: Wyższa Szkoła Logistyki.
- Frankowski, M. (2018). *Współdziałanie przedsiębiorstw w klastrach łańcuchach dostaw*. Warszawa: CeDeWu.
- Fukuyama, F. (1997). *Zaufanie. Kapitał społeczny a droga do dobrobytu*, PWN, Warszawa–Wrocław.
- Fukuyama, F. (2000). *Social Capital and Civic Society*, IMF Working Paper.
- Fukuyama, F. (2003). Kapitał społeczny, (in:) Harrison, L.E., & Huntington, S.P. (eds.). *Kultura ma znaczenie*, Kraków: Zysk i S-ka.

- Gratton, L., & Ghoshal, S. (2003). Managing Personal Human Capital:: New Ethos for the 'Volunteer' Employee. *European Management Journal*, 21, 1-10.
- Grzebieniak, A. (2012). Znaczenie marketingu relacji w marketingu społecznego w procesie zarządzania zakładem ubezpieczeń, *Przegląd Organizacji*, 4(867), pp. 40-44.
- Huang, X. (2019). Understanding Bourdieu — Cultural Capital and Habitus, *Review of European Studies*, vol. 11, no. 3, pp. 45–49.
- Jabłoński, M. (2002). Rola, struktura i pomiar kapitału intelektualnego organizacji. *Ekonomika i Organizacja Przedsiębiorstwa*, nr 11.
- Karavay, A. V. (2021). Social networks in modern Russia: scale, structure and functioning mechanisms. *Sociologicheskaja nauka i socialnaja praktika*. Vol. 9, No 4., pp. 42–60. DOI: 10.19181/snsp.2021.9.4.8605.
- King, A. (2000). Thinking with Bourdieu against Bourdieu: A 'Practical' Critique of the Habitus. *Sociological Theory*, vol. 18, no. 3, pp. 417–433.
- Koźmiński, A.K., & Piotrowski, W. (1997). *Zarządzanie. Teoria i praktyka*. Warszawa: PWN
- Kukowska, K. (2013). Funkcja sieci społecznych w kreowaniu przedsiębiorczości (in:) Nowicki, A., & Jelonek, D. (ed.), *Wiedza i technologia informacyjna w kreowaniu przedsiębiorczości*, Częstochowa: Sekcja Wydawnictw Wydziału Zarządzania Politechniki Częstochowskiej.
- Kupisz, P. (2006). Wycena kapitału intelektualnego w przedsiębiorstwach wielozakładowych sektora hitech (in:) Skrzypek, E. (ed.) *Sposoby osiągania doskonałości organizacji w warunkach zmienności otoczenia. Wyzwania teorii i praktyki*. Lublin: UMiS, pp. 45-57.
- Kurczewska, A. (2011). Od pomysłu do przedsięwzięcia – koncepcja sposobności przedsiębiorczych, *Przegląd Organizacji*, nr 5(856), pp. 16-19.
- Latusek, D. (2008). Pozyskiwanie wiedzy z otoczenia. Wywiad gospodarczy. Relacje z partnerami oparte na wiedzy (in:) Jemieliński, D. & Koźmiński, A.K. (ed.), *Zarządzanie wiedzą*, Warszawa: WAiP, pp. 243-271
- Levi, M. (1996). Social and Unsocial Capital: A Review Essay of Robert Putnam's Making Democracy Work, *Politics and Society*, 24, pp. 45-55.
- Lizak, D. (2009). Zasobowy charakter kapitału społecznego organizacji, *Przegląd Organizacji*, nr 1 (828), pp. 13-16.
- Marcinkowska, M. (2012). Kapitał społeczny przedsiębiorstwa – próba syntezy literatury przedmiotu, *Przegląd Organizacji*, 10(873), pp. 20-23.
- Olejniczak-Kita, K. (2013). Zasoby jako element budowania przewagi konkurencyjnej (in:) Borowiecki, R., Chadam, A., Kaczmarek, J. (eds.). *Zachowania przedsiębiorstw w obliczu nowych wyzwań gospodarczych. Restrukturyzacja. Zarządzanie. Analiza*. Kraków: Fundacja UEK, pp. 143-149.
- Pachura, P. (2010). *Regional Cohesion. Effectiveness of Network Structures*, London-New York: Springer Heidelberg Dordrecht.
- Putnam R. D. (1995). Bowling Alone: America's Declining Social Capital, *Journal of Democracy*, 6, pp. 65-76.
- Putnam, R.D. (2008). *Samotna gra w kręgle. Upadek i odrodzenie wspólnot lokalnych w Stanach Zjednoczonych*, Warszawa: Wydawnictwa Akademickie i Profesjonalne.
- Putnam, R.D. (1997). Democracy in America at century's end (in:) Hadenius, A. (ed.). *Democracy's Victory and Crisis*, Cambridge: Cambridge University Press, pp. 27-70.
- Qin, Y., Guo, P., Li, J., Liu, J., Jiang, S., Yang, F., Wang, R., Wang, J., Liu, H., Zhang, X., Wang, K., Wu, Q., Shi, W. (2022). The relationship between social capital and postpartum depression symptoms of lactating women in minority areas—A cross-

- sectional study from Guangxi, China. *Front. Psychol.* 13: 905028. doi: 10.3389/fpsyg.2022.905028.
- Reichenberg, M. (2020). Cultivating Images of Cultural Capital: Cultural Activities in Storybooks Featuring Young Characters with Disabilities, *International Journal of Research in Education and Science*, vol. 6, no. 3, pp. 369–380.
- Rzepka, A. (2012). Wpływ relacji międzyorganizacyjnych oraz potencjału innowacyjnego w aspekcie współpracy z biznesem (in:) Olesiński, Z. (ed.) *Wybrane aspekty rozwoju przedsiębiorczości akademickiej*, Rzeszów: Uniwersytet Rzeszowski.
- Sabatini, F. (2006). *Does Social Capital Improve Labour Productivity in Small and Medium Enterprises*, Roma: La Sapienza.
- Sęp, M. (1998). Gospodarowanie kapitałem ludzkim w przedsiębiorstwie. *Zeszyty Naukowe Akademii Ekonomicznej w Poznaniu*. Seria I. Zeszyt 260. pp. 132-145.
- Tarrow, S. (1996). Making Social Science Work Across Space and Time: A Critical Reflection on Robert Putnam's Making Democracy Work. *American Political Science Review*, 90, pp. 389-396.
- Tkachenko, E., A. (2012). Formation of the Mechanism of Management of the Intellectual Capital of Region, (in:) Lula, P., Miłkowska, B., Jaki, A. (eds.), *Knowledge. Economy. Society. Transfer of knowledge in the contemporary economy*. Krakow: Krakow University of Economics, pp. 303-308.
- Westland, H., Bolton, R. (2003). Local social capital and Entrepreneurship, *Small Business Economies*, Vol. 2, Issue 2, pp. 77-123.
- Woolcock M. (2001). The Place of Social Capital in Understanding Social and Economic Outcomes, ISUMA, *The Canadian Journal of Policy Research*, No 1
- Yi, Ch., & Tsai, Y. Ch. (2006). Effect of Social Capital and Absorptive Capability on Innovation in Internet Market, *International Journal of Management*, Vol 23, No 1.

ARTIFICIAL INTELLIGENCE FOR IMPROVING DECISION-MAKING PROCESSES IN PUBLIC ADMINISTRATION

Antonino Interdonato*

University of Messina, antonino.interdonato1@studenti.unime.it,

ORCID number 0009-0002-4481-6418

Abstract: *The integration of artificial intelligence (AI) in public administration represents one of the most promising innovations for enhancing the efficiency and effectiveness of decision-making processes. This study focuses on AI applications to optimize decision-making within public institutions, with particular focus on resource management, strategic planning, and emergency response. Using a multidisciplinary approach, the research analyses case studies of public administrations that have implemented AI-based solutions, highlighting the benefits achieved and the challenges encountered. Through the use of machine learning algorithms and decision support systems, public administrations can improve the accuracy of predictions, reduce response times, and optimize resource allocation. Preliminary results indicate that the adoption of AI leads to greater transparency and accountability in administrative decisions, while also promoting a more proactive and data-driven management approach. However, issues related to data privacy, cybersecurity, and the need for specialized skills to manage advanced technologies also emerge. This study contributes to the existing literature on innovation in public administration by proposing a framework for the effective implementation of AI in decision-making processes. Practical implications include recommendations for policymakers on how to overcome technical and organizational barriers, as well as strategies to ensure sustainable and ethical integration of AI in public systems.*

Keywords: *Artificial Intelligence, Public administration, Process automation, Civil servant, Workforce needs*

JEL Classification: *J08, J21, J24*

* Corresponding author

1. INTRODUCTION

Artificial intelligence, thanks to its ability to autonomously adapt to non-predetermined contexts, represents a technology which is capable of permeating all sectors of society. It has the potential not only to improve people's lives but also to optimize productivity in the workplace and significantly increase the efficiency of public institutions. Advances in Artificial Intelligence (AI) fuel the debate within the scientific community regarding the ability of this technology to replace workers, particularly in decision-making processes. This article focuses on the effects of process automation within the Public Administration (PA) and its impact on civil servants, as well as future dynamics concerning qualitative and quantitative workforce needs. It is undeniable that the PA of the future will increasingly be a hybrid PA, where adequately trained and motivated human personnel will govern AI systems designed to best serve the community. It is crucial to maintain an active role for public employees, who must supervise AI systems to correct any potential cognitive biases. The growing availability of data, combined with computational power, allows for the development of more sophisticated and powerful algorithms. These systems, based on machine learning and neural networks, have shown the ability to reach levels comparable to those of humans.

In the public sector, generative AI offers unprecedented opportunities to improve the effectiveness and efficiency of activities, creating synthetic representations of knowledge that can be used as baseline models to achieve various goals. AI algorithms can reveal hidden relationships and dependencies that may not be evident through traditional analysis. By identifying these patterns, decision-makers can gain a more comprehensive understanding of the dynamics of a particular situation (Giest and Klievink, 2022).

An important opportunity for the use of AI in decision-making processes is support for planning and impact analysis. AI techniques allow decision-makers to simulate hypothetical scenarios, which can help them anticipate future trends and identify potential risks (Bradt, 2009). This enables a thorough exploration of potential impacts and risks associated with each scenario, providing a comprehensive understanding of the potential consequences of various policy choices. AI systems allow inferences to be made about outcomes based on historical and real-time data, generating insights into the potential impacts of different policy interventions.

AI can enable better organization within the PA, offering public officials support in decision-making processes and providing tailored applications and personalized solutions for citizens. The development of AI systems will require qualified human resources in the near future and presents itself as a powerful driver of employment and training. The guiding principle should be to govern with AI, meaning to make AI tools available for public governance functions without losing control over decision-making.

Currently, the adoption of AI in the public sector across Europe is highly heterogeneous, with greater diffusion in central state administrations within each nation. In 2023, the TEHA Group and Microsoft Italy launched the "AI 4 Italy" initiative, a study aimed at quantifying the potential benefits of adopting Generative AI for Italy. The study estimates a potential impact on the country's productivity of up to 18.2% over the next 15 years, equivalent to an annual added value of €312 billion, corresponding to 5.7 billion hours of work. This is an exceptional opportunity for Italy, which is currently facing an acute phase of demographic decline and is

projected to see a reduction of nearly 4 million workers by 2040, barring changes in labour participation dynamics, including migration flows.

All industrial revolutions, and this is what we refer to when discussing AI, historically increase production on the one hand, while on the other, impact existing jobs, leading to the displacement of some roles from the labour market and fostering the creation of new jobs. This creates the need to manage the substitutive effect of AI and to strongly consider the issue of complementarity between human labour and AI, not only in terms of functionality and technological capabilities but also as a political choice in governing the impacts of AI.

2. LITERATURE REVIEW

The specific description of a generative model was provided in the second half of the 1960s in Hidden Markov Models (Baum & Petrie, 1966), where, given a statistical distribution of the data, the authors aimed to predict, and thus generate, time series that were statistically conditioned by the input data.

Scientific advances in model studies and the development of computational capabilities have made it possible to train neural networks through a stochastic learning process, even with very large datasets (Deng, et al., 2009), leading to improved performance (Hestness, et al., 2017) (Kaplan, et al., 2020), through scalable computational architecture and techniques capable of increasing the size of available datasets.

It is now common to encounter forms of AI that surpass human capabilities in various tasks (Webb, 2020), performing redundant work better and faster. These types of work can be identified according to the routine-biased technological change (Autor, 2013) as a central driver of labor market polarization and workforce shifts between occupations (Van Reenen, 2011). This provides an overview of occupational exposure to AI across different jobs (Felten et al., 2021), classifying technological change related to AI as complementary to human labour in some cases and substitutive in others.

The potential impact of AI on work, workers, and productivity can be monitored by studying the connection between various AI applications and the characteristics of each occupation (Felten et al., 2018b, 2023b; Tolan et al., 2020), including occupational skills, tasks, or abilities, as referenced in databases like O*NET. The connection between different AI applications and jobs is established through various types of links, such as identifying the overlap between job task descriptions and machine learning-based classifiers to estimate the automation potential of occupations (Meindl et al., 2021; Sytsma and Sousa, 2023; Webb, 2020). The adoption of AI in PAs is a clear case of ongoing and relentless study aimed at improving the efficiency of public services and optimizing resources. Currently, several solutions are under development: advanced generative models such as GANs, Diffusion Models, Transformers, and Graph Neural Networks (GNNs), which are being implemented in software that affects various aspects of PA, from simplifying procedures to personalizing services for citizens. One of the most important uses of AI in PA is predictive analytics, which, through machine learning algorithms, allows administrations to process large amounts of historical data to make accurate predictions about future trends. Another relevant area in literature concerns AI-based decision support systems (DSS). These systems assist public decision-makers by analyzing complex data and providing recommendations to improve

strategic choices. DSS can integrate real-time data, advanced simulations, and machine learning models to support decisions on particularly complex public policies.

In the public sector, transparency and explainability of algorithms are fundamental to their use. There are numerous applications where the input and output data are known, but the intermediate decision-making process remains shrouded in mystery (Martin et al., 2021), making them unsuitable for PA. In this context, the algorithmic key must be accessible to every citizen, especially to protect against potential algorithmic biases that could lead to incorrect decisions. Excluding human intervention from decision-making in an administrative procedure means entrusting an automated system to independently handle procedural tasks, ultimately producing decisions regarding the approval, processing, and outcome of the procedure itself.

According to the arguments presented thus far, such an activity can only be realized provided that specific requirements concerning the nature of the problem are met, and most importantly, that the fundamental rights of individuals are guaranteed. There are numerous contributions from legal scholars on this topic, especially regarding what is established by Regulation (EU) 2016/679, which outlines a fairly clear legal framework, also consistent with purely technological aspects. From this, several conclusions can be drawn: the first is that, to date, a completely automated management of an administrative procedure is essentially impracticable, as it is impossible to bypass the guarantee of human presence, "crystallized" by the principle of non-exclusivity of algorithmic decision-making throughout the entire decision-making process, as expressed in Article 22 of Regulation (EU) 2016/679.

For these reasons, it becomes essential to identify and correct biases in training data (Li & Vasconcelos, 2019) to prevent generative models from producing unfair or discriminatory outcomes, as described by the principle of fairness in generative models (Mehrabi, Morstatter, Saxena, Lerman, & Galstyan, 2021). Including these principles within a computational algorithm is not only a scientific concern but also a socio-economic one, as the engineering of such a model does not always bring benefits to society (Mittelstadt, Wachter, & Russell, 2023).

The volume of data generated by the activities of public entities (Maristella, 2016) is in a phase of constant growth, and the ability to collect, process, and extract useful information in real-time can bring enormous advantages in terms of efficiency and quality of services provided to citizens. Indeed, automating activities such as inspections and controls allows for faster and more standardized procedures, which too often slow down the operations of the public sector (Ruffini, 2010). For example, tax collection and payment management are key activities for PA but are often burdened by bureaucratic delays and procedural complexities (Bongi, 2023).

Regarding the estimates of the impact of the substitution effect, the alarming predictions contained in one of the first general studies on the risks of computerization, which indicated a potential automatability of 47% of jobs in the U.S. within a decade (Frey & Osborne, 2017), have been followed by studies that have downscaled the scope of the substitution effect (notably Autor, 2015). These later studies proposed more moderate estimates (Arntz et al., 2017), demonstrating that by shifting from an occupation-based approach to a task-based approach, it becomes clear that within a single job, workers perform various tasks—some of

which are automatable and others not. As a result, the high risk of automation should be limited to 9% of jobs in the US.

For the AI revolution in PA to succeed, there must be governance that carefully plans the integration of technology while respecting individuals, clearly communicating both the advantages and challenges, monitoring results, and continuously implementing improvements (Cutuli, 2024). A critical issue is the lack of technical skills within PAs. According to a 2021 report by the European Commission, the Reform Support, many institutions lack trained personnel to manage and develop AI-based systems, making large-scale implementation of these technologies difficult.

3. METHODOLOGY

This paper aims to analyse a practical case, specifically among Italian PA offices, where the Revenue Agency (Agenzia delle Entrate, AdE) was one of the first to adopt AI systems in decision-making processes. The use of intelligent systems by the AdE was introduced with Article 1, paragraph 682 of Law n. 160 of December 27, 2019, which stipulates that, for risk analysis, the AdE may use, technologies, processes, and interconnections with other databases at its disposal, including through the pseudonymization of personal data, in order to identify risk criteria which are useful for flagging cases for further investigation or initiating activities aimed at encouraging voluntary compliance.

To further implement this process, on March 16, 2023, the Council of Ministers approved the draft tax delegation law, which in Article 15 introduces: "the use of digital technologies, also supported by AI, in order to obtain, the availability of relevant information and ensure its timely use through full interoperability between databases," to "restrict control activities to subjects with a higher tax risk."

Fiscal risk analysis, as regulated by the "Notice on the logic underlying risk analysis models based on the data from the financial account archive," issued by the AdE following Directive 2023/74424, includes the techniques, procedures, and IT tools used to identify taxpayers with high fiscal risk. Once risky tax positions are identified, they are sent to the organizational divisions responsible for conducting further investigations and assessments to determine which subjects to target for inquiries.

Thanks to technological advances, the AdE annually conducts automated checks on more than 40 million tax returns. In addition, over 88% of the services provided by the central and local offices of the AdE are accessed online by taxpayers. It is therefore evident that the agency's traditional organizational structure has had to adapt to modern technologies.

To assess how these changes have impacted the workforce, this paper will analyse the composition and trends in AdE's staffing between 2019 and 2023. The aim is to understand how the demand for and evolution of, professional profiles has changed, both before and after the integration of intelligent tools into operational support systems. This analysis will be compared with the International Labour Organization (ILO) study by Gmyrek et al. (2023), which adopts a task-based approach to calculate an exposure index that evaluates both individual tasks and various occupations.

In the ILO study, tasks are classified according to four levels of exposure: very low exposure, low exposure, medium exposure, and high exposure. Based on these criteria, the study identifies the percentage of occupations that fall into categories with high automation potential or high augmentation potential, depending on their interaction with AI. This classification allows us to assess which tasks within a job can be automated and which require human input, providing a clearer understanding of the potential for efficiency improvements while maintaining the human element.

Thus, the technological transformation of the AdE serves as a case study to explore how PAs can successfully integrate AI and other digital tools, adapting workforce demands and operational structures to meet new technological challenges.

4. RESULTS AND DISCUSSION

The implementation of AI within the software, and consequently, the workflows and processes of the AdE, has, as previously mentioned, led to the necessity for the public entity to employ staff with specialized competencies. This has inevitably prompted a revision of workloads, with subsequent implications on personnel needs and recruitment plans. An analysis of the workforce in service as of December 31 of the studied years allows us to observe the following trends:

Table 1. Numerical trend of Revenue Agency staff roles for the years 2019-23

	2019	2020	2021	2022	2023
Managers	197	238	385	317	351
Officers	23088	20114	19319	19185	20866
Assistants	12895	10735	9633	8347	8088
Operators	178	173	176	177	200
Total workers	36322	31260	29513	28026	29505

Source: Revenue Agency (2019), Integrated activity and organization plan 2019 – 2021.
Revenue Agency (2020), Integrated activity and organization plan 2020 – 2022.
Revenue Agency (2021), Integrated activity and organization plan 2021 – 2023.
Revenue Agency (2022), Integrated activity and organization plan 2022 – 2024.
Revenue Agency (2023), Integrated activity and organization plan 2023 – 2025.

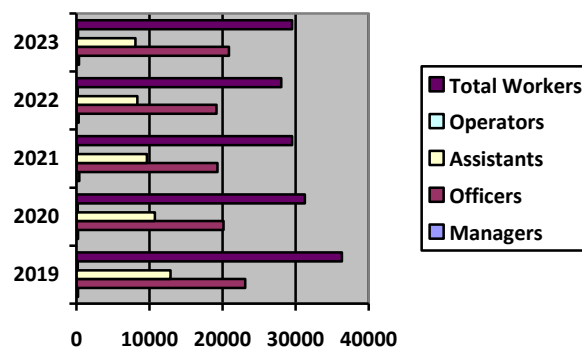


Figure 1: Numerical trend of Revenue Agency staff roles for the years 2019-23

Source: Author

The Area of Operators, which has played a marginal role for years due to the outsourcing of functions, includes employees who often belong to the so-called "special needs" (persons with disabilities or other protected statuses).

One key observation from the data is the notable trend toward verticalization of employment categories. Specifically, there has been a significant reduction of personnel in the Assistant Area, with a decrease of 37.1%. This decline can be attributed to the fact that these positions typically involve routine tasks, which are highly automatable and, therefore, classified in the "high automation" category. According to the ILO study, these workers can be defined as high exposure in relation to automation risks.

In contrast, there has been an increase in the workforce within the Officer Area, which now represents 70.72% of the total, despite a unitary reduction of 4,771 employees. Officers, who possess specialized training (now requiring a university degree), are responsible for analysing the results generated by automated data processes. As such, these workers can be categorized as medium exposure and classified as having augmentation potential in terms of their interaction with AI.

This trend aligns with the policies introduced by the Italian government. For instance, on May 9, 2022, the Agency for contractual representation of Public Administrations (ARAN) signed a collective bargaining agreement with various trade unions representing employees in central government functions. This contract introduced the role of "high-level professionals," who, through upskilling and reskilling initiatives, will help ensure that PAs have a workforce that is capable of handling more complex, high-value tasks. Although the AdE has acknowledged the necessity of these roles in its Triennial Staffing Plan, it has yet to specify the required number of positions or initiate any recruitment processes for these roles.

5. CONCLUSIONS AND RECOMMENDATIONS

The most likely hypothesis is that the impact of AI will not result in widespread job loss but rather a profound transformation in the nature of work, particularly in terms of quality and worker autonomy. The effect of AI on the labour market will depend on the capacity to design policies that ensure a smooth, equitable, and consultative transition, especially through professional training programs for workers.

A second key area of reflection pertains to human resources, around AI: there must emerge a robust ecosystem of talents and human expertise capable of addressing the various aspects—scientific, experimental, and regulatory. Governments and PA must equip themselves with well-trained personnel capable of understanding the mechanisms of AI and the risks they entail. In this regard, the EU Commission has funded a program called the AI4Gov Knowledge Hub, aimed at training a high-level public leadership capable of governing the complexities of AI.

Educational institutions and universities play a crucial role in this context, as they must offer targeted training programs that leverage AI as a tool for both workforce training and the maintenance of relevant skills. These programs must ensure the development of competencies required by emerging professions, particularly highly skilled positions in the PA, which will, in turn, be responsible for enabling the developments and adjustments necessary across different sectoral and organizational contexts of AI.

In Italy, the current situation regarding the availability of AI competencies presents significant challenges. The dissemination of AI-specific skills is below the OECD average, with Italy scoring 0.93 compared to the OECD reference index of 1. Specifically, the level of AI proficiency is significantly lower than that of India, which ranks first with a score of 3.22, well above the average. This indicator highlights a shortage of AI skills in Italy, which could limit the country's ability to compete effectively on an international level in the field of AI.

PAs need to be guided in the acquisition of AI systems and the design of new applications tailored to their needs through support pathways that acknowledge the current lack of professional expertise. These technologies must be deployed in key areas, with the goal of automating and improving processes, supporting strategic planning and resource management, providing decision-making support, and ensuring the creation of secure IT infrastructures developed by highly qualified and reliable individuals, potentially through national platforms that ensure the robustness and efficiency of the deployed technologies.

The formulation of policies and training for personnel will be of equal importance. In this context, delivering citizen services that promote participation and engagement, while ensuring privacy and transparency in processes, will be a priority objective.

In developing a strategy for PA, it will be necessary to implement a coherent set of actions with a multidisciplinary approach to fully exploit the opportunities offered by AI-based technologies. The aim will be to create a virtuous cycle between quality, privacy, security, and the proper management of data essential for AI techniques; to develop AI-based software technologies and tools that ensure interoperability, traceability of sources, credibility, accuracy, and relevance, fostering trust in decision-making tools that aggregate information from digital platforms; and to monitor and systematically improve the performance of developing and operational services using statistical quality measures. In this direction, beyond technical measures, it will be essential to implement "support" actions that, considering the still-limited dissemination of knowledge and skills within the PA, promote the effective use of AI and steer procurement and solution development processes, while encouraging reuse and sharing of best practices.

REFERENCES

- Arntz, D., Gregory, T., & Zierahn, U. (2017). Revisiting the risk of automation. *Economic Letters*, 159, 157-160.
- Autor, D. (2013). The "task approach" to labor markets: An overview. *Journal for Labour Market Research*, 46(3), 185–199.
- Autor, D. (2015). Why are there still so many jobs? The history and future of workplace automation. *Journal of Economic Perspectives*, 29(3), 3–30. <https://doi.org/10.1257/jep.29.3.3>
- Baum, L. E., & Petrie, T. (1966). Statistical inference for probabilistic functions of finite state Markov chains. *The Annals of Mathematical Statistics*, 37, 1554–1563.
- Bongi, A. (2023). *Intelligenza artificiale e fisco: Come cambiano compliance, controlli e riscossioni delle imposte*. Wolters Kluwer Italia.
- Bradt, G. B., & Vonnegut, M. (2009). *Onboarding: How to get your new employees up to speed in half the time*. John Wiley & Sons.

- Cutuli, C. (2024). *Intelligenza artificiale & pubblica amministrazione – Guida alle applicazioni dell'IA per il settore pubblico*. Istituto Siciliano Studi Ricerche e Formazione.
- Deng, J., Dong, W., Socher, R., Li, L.-J., Li, K., & Fei-Fei, L. (2009). ImageNet: A large-scale hierarchical image database. In *2009 IEEE Conference on Computer Vision and Pattern Recognition* (pp. 248-255).
- European Commission. (2021). *Data-driven approaches to combat tax evasion and fraud in Italy*. https://reform-support.ec.europa.eu/what-we-do/revenue-administration-and-public-financial-management/data-driven-approaches-combat-tax-evasion-and-fraud-italy_en, 10/03/2024.
- Felten, E., Raj, M., & Seamans, R. (2018). A method to link advances in artificial intelligence to occupational abilities. *AEA Papers and Proceedings*, 108, 54–57. American Economic Association.
- Felten, E. W., Raj, M., & Seamans, R. (2021). Occupational, industry, and geographic exposure to artificial intelligence: A novel dataset and its potential uses. *Strategic Management Journal*.
- Felten, E., Raj, M., & Seamans, R. (2023). Occupational heterogeneity in exposure to generative AI. *SSRN*. <https://doi.org/10.2139/ssrn.4414065>
- Frey, C. B., & Osborne, M. A. (2017). The future of employment: How susceptible are jobs to computerisation? *Technological Forecasting and Social Change*, 114, 254-280.
- Gmyrek, P., Berg, J., & Bescond, D. (2023). Generative AI and jobs: A global analysis of potential effects on job quantity and quality. *ILO Working Paper*, 96.
- Giest, S., & Klievink, B. (2022). More than a digital system: How AI is changing the role of bureaucrats in different organizational contexts. *Public Management Review*. <https://doi.org/10.1080/14719037.2022.2095001>
- Hestness, J., Narang, S., Ardalani, N., Diamos, G., Jun, H., Kianinejad, H., ... & Zhou, Y. (2017). Deep learning scaling is predictable, empirically. *arXiv preprint*, arXiv:1712.00409.
- Kaplan, J., McCandlish, S., Henighan, T., Brown, T. B., Chess, B., Child, R., ... & Amodei, D. (2020). Scaling laws for neural language models. *arXiv preprint*, arXiv:2001.08361.
- Li, Y., & Vasconcelos, N. (2019, June). REPAIR: Removing representation bias by dataset resampling. In *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR)*.
- Maristella, F. (2016). *Open data e trasparenza. Nuovi strumenti di integrità nella pubblica amministrazione*. Stamen.
- Martín, L. M., Załucki, M., Gonçalves, R. M., & Partyk, A. (Eds.). (2021). *Artificial intelligence and human rights* (1st ed.). Dykinson, S.L. <https://doi.org/10.2307/j.ctv282jgff>
- Mehrabi, N., Morstatter, F., Saxena, N., Lerman, K., & Galstyan, A. (2021, July). A survey on bias and fairness in machine learning. *ACM Computing Surveys*, 54.
- Meindl, B., Frank, M. R., & Mendonça, J. (2021). Exposure of occupations to technologies of the fourth industrial revolution. *arXiv preprint*, arXiv:2110.13317.
- Mittelstadt, B., Wachter, S., & Russell, C. (2023, January 20). The unfairness of fair machine learning: Levelling down and strict egalitari.
- Ruffini, R. (2010). *L'evoluzione dei sistemi di controllo nella pubblica amministrazione: Linee operative per lo sviluppo di audit e della gestione delle performance nelle pubbliche amministrazioni*. Franco Angeli Edizioni.

- Sytsma, T., & Sousa, E. M. (2023). Artificial intelligence and the labor force. *RAND Corporation Research Report*.
- Tolan, S., Bechmann, A., Levy, K., & Doorn, N. (2020). Measuring the occupational impact of AI: Tasks, cognitive abilities, and AI benchmarks. *JRC Technical Report*.
- Van Reenen, J. (2011). Wage inequality, technology, and trade: 21st century evidence. *Labour Economics*, 18(6), 730–741.
- Webb, M. (2020). The impact of artificial intelligence on the labor market. *Stanford Working Paper*. <https://doi.org/10.2139/ssrn.3482150>

BUSINESS EVENT EVENTQUAL PERCEPTION AMONG DIFFERENT AGE GROUPS: GENERATION Z PERSPECTIVE

Marijana Đurađević

Secondary Vocational School for Tourism and Hospitality in Vrnjačka Banja
ORCID number 0000-0001-9989-7980

Darko Dimitrovski*

Faculty of Hotel Management and Tourism in Vrnjačka Banja, University of Kragujevac,
darko.dimitrovski@kg.ac.rs
ORCID number 0000-0002-7930-1716

Vladimir Senić

Faculty of Hotel Management and Tourism in Vrnjačka Banja, University of Kragujevac,
vsenic@yahoo.com
ORCID number 0000-0003-3543-0249

Abstract: *The interest in business events, as a special type of tourism event rapidly evolved amid the COVID pandemic. Due to the COVID pandemic, visitors' attendance preferences have changed dramatically, and acknowledging which event service quality factors have given importance amid and post-COVID reality was paramount for their future organization. In this regard, particular attention was given to the Generation Z (Zoomers) attendees, as a segment that will definitively drive this sector in the future. Travel fairs (shows) were perceived as one of the most distinctive business events, attracting professional and wider audiences. Taking into account the preferences of this lucrative event market towards service quality is seen as essential for the long-term sustainability of these events. Since a positive attitude towards the service quality at the event was recognized to be a prerequisite for the visit, this study used EVENTQUAL as a framework for the assessment of each of its dimensions by different age groups, focusing in particular on generation Z particularities. The research aims to determine the differences in the perception of certain dimensions of service quality between business event visitors of different ages better to grasp the service quality preferences of Generation Z travel fair attendees. The survey was distributed to visitors of the 42nd Tourism Fair event in Belgrade and analyzed with the help of SPSS. By deploying exploratory factor analysis EVENTQUAL model items were rotated differently to its distribution in the initial sporting event research, showing particularities of service quality perception for this type of event. Moreover, findings of the post-hoc oneway-ANOVA test indicated that there are significant differences in the perception of the three dimensions of quality depending on the age of the visitors, particularly between Generation Z attendees and other generational cohorts. The implemented research highlighted the peculiarities of Generation Z attendees of travel fairs and further advanced the generational gap between younger and older travel fair attendees. The practical contribution of the work is reflected in the knowledge that enables managers to improve service quality per the requirements of Generation Z as the most prominent future attendees of these business events.*

Keywords: *business event, Serbia, age, event quality*

JEL Classification: *L83*

* Corresponding author

1. INTRODUCTION

Events have long been a part of urban life, thus, destinations gain numerous advantages by organizing them (Fytoulopoulou et al., 2021). Business events as a special type of event (Getz & Page, 2016) represent a very important sector of tourism activity (Kumar & Hussain, 2014) and one of the most important segments of modern tourism (World Travel & Tourism Council, 2022). In 2022, business travel growth of 41.1% is predicted, while an average annual rise of 5.5% is expected for the period between 2022 and 2032, which indicates that business travel will remain an important part of the travel ecosystem (World Travel & Tourism Council, 2022). Since, the largest number of studies refer to business events held in the USA (Tkaczynski & Rundle-Thiele, 2020), it is necessary to pay additional attention to the research of business events in the context of other countries, such as Serbia. Thus, the focus of this paper was the business event "Tourism Fair" - which is traditionally held in Belgrade, Serbia.

Due to the COVID pandemic, visitors' attendance preferences have changed dramatically, thus acknowledging which business event service quality factors were recognized as important amid and post-COVID reality will be paramount for their future organization. Various authors have looked at service quality at an event by acknowledging different dimensions in their research (Kim et al., 2016; Wen-Chiang et al., 2012). The EVENTQUAL scale involves the assessment of the quality of service at an event, which contains 22 items grouped into four dimensions: accessibility, tangibility, personnel, and complementary services (Calabuig Moreno et al., 2016). The EVENTQUAL quality model has so far been studied in the literature at the level of sports events (Calabuig Moreno et al., 2016; Calabuig Moreno et al., 2010). In this paper, the EVENTQUAL model was used to assess the quality of service in the context of business events.

Market segmentation at the event has been already addressed within the previous literature (Getz & Page, 2016). The largest number of authors dealt with market segmentation research in the context of events of a cultural and sporting character, while a scarce number of studies were devoted to business events (Tkaczynski & Rundle-Thiele, 2020). Since consumer judgment is often influenced by age (Li et al., 2017), there is a need to consider age preferences for specific event service quality criteria in the context of business events. Thus, this study aims to further understand the perception of the service quality of business-type events by visitors of different ages. The study's particular attention was given to the attendees belonging to Generation Z (Zoomers), as a segment that will definitively drive this sector in the future. Based on the study's insights into differences in the perception of event quality contrasting Generation Z attendees and other attendees' age groups, it could be utilized by business event managers to improve certain dimensions of quality.

2. LITERATURE REVIEW

2.1. Business events

Nicula and Elena (2014) point out that the following forms of business tourism can be distinguished: individual business trips and a wide range of event attendance such as conferences, seminars, team-building, product launches, annual meetings, fairs and exhibitions, incentive trips, and corporate events. Since there is no standardized terminology, business tourism is defined at the level of acronyms (Dimitrovski et al., 2022). The MICE

acronym is widely used in international practice and includes four keywords that characterize the field of business tourism (Kumar & Hussain, 2014): M (meetings)-meetings; I (incentive travel) - incentive travel; C (conventions) - conventions, conferences and congresses; and E (exhibition)-exhibitions/fairs. MICE events (Getz, 2008), gather a large number of people and are planned well in advance (Lu et al., 2020). MICE tourism has the potential to bring a large number of visitors whose expenditure at the destination is high. It can also extend the tourist season, help synergize ideas, and increase sales (World Travel & Tourism Council, 2022).

By the Middle Ages, there were a series of large fairs strategically located in cities, lasting several days to several weeks (Swarbrooke & Horner, 2012). A fair was defined as “a meeting held at a certain time and place to buy and sell goods; an exhibition of agricultural or industrial products often accompanied by various competitions and entertainment; an exhibition intended to inform people about a product or business opportunity; and an event, for the benefit of a charity or public institution, which includes entertainment and the sale of goods, also called a bazaar” (Getz, 2004, p. 35). There are consumer, trade, and mixed fairs (Dimitrovski et al., 2022). A trade fair involves the presentation of products or services to make sales or inform visitors (Swarbrooke & Horner, 2012). It is organized for a specific activity and provides a forum for the exchange of information between companies and potential clients (Arcodia & Robb, 2000). The fair enables communication between supply and demand, which provides feedback on a new product or satisfaction with an old product. Tourist fairs represent an important distribution channel, through which visitors are "marketed special offers for travel to desired destinations or at least travel information" (Rittichainuwat & Mair, 2012, p. 1236).

2.2. Event quality

Event Service Quality (ESQ) is used as a measure of general assessment and attitude toward the value or experience of certain event attributes (Chen et al., 2021). The unique experience of visitors at an event significantly affects the quality of service (Mokoena & Dhurup, 2017). In studies on the perception of service quality at events, some authors developed their own scales and those that adapted existing quality scales (Jae Ko et al., 2011). Given the large number of elements that make up a quality service, there is also a large number of dimensions used to assess the level of event quality. The combination of elements within a model is different, and there is often an overlap of certain dimensions that appear under different names within different models (Biscaia et al., 2023).

Some of the dimensions of service quality at an event may additionally generate repeat visits to the event. For example, professionalism and environment distinguished within the FESTPERF model can lead to repeat visits (Tkaczynski & Stokes, 2010). The program, contents, and entertainment represent the dimensions of the festival that most influence the overall experience at the festival, the satisfaction of visitors, and the intention to return (Wen-Chiang et al., 2012). Effectiveness and physical engagement included in the event experience scale (EES) were recognized as significant positive predictors of participants' intention to revisit a sporting event (Coetzee et al., 2019). The EVENTQUAL model implies an evaluation of the quality of services by spectators of sporting events, which contains 22 items grouped into four dimensions (Calabuig Moreno et al., 2016). The model shows the perception of the quality of sports events by spectators through four dimensions: tangibility, personnel, complementary services, and accessibility (Calabuig Moreno et al., 2016).

Accessibility means the ease and speed of getting to the desired location (Ribeiro et al., 2018). Theodorakis et al. (2001) developed a quality scale with five dimensions of service quality,

among others one that includes stadium accessibility. Andam et al. (2015) developed a reliable and valid model for measuring the service quality of sports conferences as tourism events. The participants evaluate the quality through four primary dimensions, among which is the quality of access. Within the quality of access dimension, Andam et al. (2015) obtained the highest loading factors for the following claims: access to contents during travel, access to the city, access to the conference city, and access to the conference venue. The accessibility dimension appears as a differentiated variable since it can be seen as access to seats, but also access to other attributes. Within it, the availability of parking and public services can be observed (Calabuig Moreno et al., 2016). Accessibility, as well as the location of the event itself, affect the satisfaction of tourists, where the informative dimensions of the event and the proximity of other tourist attractions are of particular importance (Dimitrovski, 2016). When it comes to the ease of access to a sporting event, there are differences in the perception of different age groups of visitors. A significant difference implies higher average ratings given by visitors between the ages of 18 and 24 compared to those older than 56 (Roca Cruz et al., 2018).

Personnel was also recognized as an important event service quality dimension. Tsauro and Lin (2004) emphasized the importance of customer contact with employees in creating and providing good service quality. The factor "employees" includes items specifically related to the behavior and appearance of employees. The appearance of employees is another important aspect of quality for guests, especially those who expect their uniforms to be clean, neat, and appropriately styled (Mei et al., 1999). The quality of employees at events is one of the dimensions that make up the basic structure of the construction of event quality (Esu, 2014). Staff service is a key factor that determines visitors' attitudes towards local festivals and their intentions to visit them again (Vesci & Botti, 2019). In the context of sporting events, the personnel dimension includes items related to knowledge, reliability, empathy, and professionalism (Calabuig Moreno et al., 2016). Due to the highly expressed contact between staff and visitors, when providing services in a festival environment, the importance of staff is evident (Tkaczynski & Stokes, 2010).

Tangibility as an EVENTQUAL quality dimension was also found to be of importance for the event's total quality. According to Crompton and Love (1995), the tangibility dimension is the most important. Tangibles include physical objects, equipment, and the appearance of personnel (Peng & Moghavvemi, 2015). Within the tangibility dimension, along with physical location, facilities, and staff, other common tangible service attributes, food and beverage, information services, bathrooms, and souvenirs were included as well (Neuhofer et al., 2021). Tangibles are often used by service providers to strengthen their reputation and demonstrate quality to the customer (Ali et al., 2021). Taking into account different types of events and their specificities, different interpretations of the tangibility aspect are expected. It is widely accepted that events offer many tangible and intangible benefits to the host (Jeong & Kim, 2020).

The dimension of *complementary services* appears in research studies under different names such as concessionaire services or additional services (Calabuig Moreno et al., 2016). The dimension of complementary services implies a different combination of elements depending on the very goals of the research (Calabuig Moreno et al., 2016). Event participants can evaluate the quality of services at the event through the quality of basic services, as well as through the quality of auxiliary services (Kim et al., 2016). Complementary services may include efficiency, cleanliness and adaptation to the needs of spectators, toilets, cafeteria services and product sales (Calabuig Moreno et al., 2010). In addition to the information

service, program, facilities, souvenirs and food at the event also affect the quality of the event (Yoon et al., 2010).

2.3. Generation Z

Consumer judgment is often influenced by age (Li et al., 2017). The most common demographic variable used for investigating events is age, followed by gender, education, income and geographic origin of the subjects (Tkaczynski & Rundle-Thiele, 2020). For example, at the level of the gastronomic manifestation, Smith and Costello (2009) connect the motives of the visit with the age of the visitors. Kruger et al. (2014) investigated motives for attending the business event "Wedding Expo" based on the age of attendees. Age affects the way of informing about the event, which can significantly affect the perception of quality (Li et al., 2017). The younger population at festivals attaches more importance to music, while the older population prefers other elements (Kinnunen et al., 2019).

In the literature, young people born from the late 1990s to the early 2000s are called Gen Z, Zoomers, post-millennials, Zers, iGeneration, Internet Generation, Share Generation and similar, but most often labeled Generation Z (Mavrogenis et al., 2024). Generation Z includes every person born between 1997 and 2012 (Sharma & Kanchwala, 2022). Generation Z represents the successors of Generation Y and the predecessors of Generation Alpha (Mavrogenis et al., 2024). In 2019, Generation Z accounted for 32% of the total world population, i.e. 2.47 billion of the 7.7 billion people on the planet, which exceeds the number of both millennials and baby boomers (Entina et al., 2021). Generation Z is the generation that is most different from all other generations in history (Sharma & Kanchwala, 2022). This target market is specific in many ways: they are the most educated generation in history; they are very digitally literate; they cannot be reached through TV, as they are informed through social networks, less Facebook (given that it is older than them), make purchasing decisions more impulsively; remember pop-up ads for less than two seconds (Sharma & Kanchwala, 2022). Understanding Generation Z's behavior in tourism can propose paths how to improve their experience (Chin et al., 2024). If you succeed in gaining the trust of Gen Z customers, you may develop a good mood that will result in purchase intention (Chin et al., 2024). Given the particularities of this target group, it is very important to examine their perception of quality dimensions, to improve it and adapt it to their requirements, because these are the generations that make up the future of consumer and tourist fairs.

3. METHODOLOGY

3.1. Context of the study

The research was conducted in the context of a business event - one of the four types of events according to Getz and Page (2016). "Travel Fair" is a business event that has been held in Belgrade for more than 40 years. The event was held in Belgrade under the slogan "Path under feet" as part of the Belgrade Fair from February 20 to February 22, 2020. It presents numerous attractive and exotic destinations, accompanied by an interesting program at the stands. The fair represents the largest tourist event in Southeast Europe with more than 900 exhibitors, of which 250 are foreign, with the presence of a significant number of business visitors from all parts of the world. The tourism fair occupied 30,753 m² of exhibition space (Belgrade Fair, 2020).

Figure 1. Business event „Travel Fair”



Source: Beogradski sajam (2020). Retrived August 2 2022. from <https://belgust.rs/beogradski-sajam-turizma-2020>

3.2. Survey procedure

Implementation of empirical research primarily involved the collection of data using the survey method. Before distribution, about a month before the event, the questionnaire was tested to formulate statements that would be unambiguous to the respondents. The questionnaire was tested through a 12-member focus group, which consisted of participants from previous events, as well as event organizers and representatives of tourist organizations (TO). The proposed questionnaire was given to the members of the focus group to look at it and give their opinion if the questionnaire is suitable for evaluating the quality of a certain type of event. These stakeholders gave their opinion on the questionnaire itself, more precisely, they stated whether the questions contained in the questionnaire correspond to a certain type of event. Since the initial EVENTQUAL scale contains 22 items, based on the recommendation of the focus group, due to the limited applicability of one item in the context of a business event, this item was discarded from further analysis, coming to the 21-item EVENTQUAL scale. After completing the first step of the research, a pilot test was conducted, that is, the questionnaire was distributed to a sample of twenty respondents at the level of each event, to visitors who visited the event before. As a result of the feedback received, several minor modifications were made to the initial statements, leading to the final version of the questionnaire.

Therefore, for this research, a survey was conducted using the method of causality ratios. The essence of "quota" sampling is reflected in the fact that the researcher first identifies certain categories of the population. By looking at the structure of previous visitors in a conversation with the organizer of the event, a profile of the visitors of the event was created, which was later used for defining the sample. With "quota" sampling, it is of particular importance to include as many relevant categories as possible in the sample to represent the population well (Vuković & Štrbac, 2019). Even before the distribution of the questionnaire, the organizers were familiar with the research, thus they gave their consent for its implementation.

Considering that all the events lasted several days, the survey was conducted during one day. The questionnaire was distributed during the 42nd International Tourism Fair in 2020 and was filled out by 207 visitors during one day of the fair, on Saturday, February 22, after the actual visit to the event.

In the first part of the questionnaire, the respondents were given answers to their socio-demographic characteristics, more specifically about their age group. After declaring their age, event visitors expressed their opinion about the quality of service at specific events based on 21 quality dimensions of the EVENTQUAL scale (Calabuig Moreno et al., 2016), using a seven-point Likert scale. All the statements were adapted for this study, to fully reflect the context of the business event.

To avoid the problem of the validity of the obtained results, which is related to the absence of answers from some respondents, for the research, 300 questionnaires were prepared and distributed to reach the target size sample. The number of respondents who were ready to participate in the research is 207, which per the number of distributed questionnaires of 300, makes a response rate of 69%.

3.3. Analytical method

The collected data were processed using the Statistical Package for Social Sciences (SPSS 23). First of all, it was determined whether the collected data were of normal distribution using the Shapiro–Wilks test, based on which adequate statistical analysis, i.e. parametric or non-parametric tests, was further used. Descriptive statistics includes the displayed values of mean value and standard deviation. In the situation of normal distribution of the obtained data, Oneway-ANOVA analysis of variance was deployed for several populations of event visitors. With the help of Anova- Post hoc analysis, statistically significant differences between different age cohorts of event visitors related to the perception of business event quality were assessed.

4. RESULTS AND DISSCUSION

Table 1 shows the results of a descriptive statistical analysis of a sample of visitors to the "Travel Fair" event. Results include Skewness and Kurtosis values, as well as Mean Value (M) and Standard Deviation (SD) values.

Table 1. Results of descriptive statistical analysis on the sample of visitors to the "Travel Fair" business event

Items	Skewness	Kurtosis	Mean Value (M)	Standard Deviation (SD)
1. I have easily arrived at the facility	-1,418	1,960	5,95	1,377
2. It has been easy to get my ticket	0,058	0,038	5,31	0,902
3. I got the entry that I wanted	-0,302	-0,615	5,07	1,029
4. There is sufficient space for visitors at the event	-1,222	2,790	5,64	1,135
5. It is easy to walk inside the facility (signalling, corridors...)	-1,457	2,002	6,07	1,240
6. There are enough personnel in the facility to look after attendees	-1,688	2,830	6,21	1,174
7. The facility employees are well trained	-1,640	2,561	6,19	1,239

8. The facility employees do their job properly	-1,614	2,553	6,15	1,235
9. The facility employees are friendly	-1,672	2,323	6,28	1,122
10. Once entering the facility, I felt impressed	-1,107	1,041	5,77	1,312
11. The design of the space is good	-1,314	1,269	5,89	1,378
12. Accessibility to the stands is good	-1,354	1,439	6,13	1,159
13. In general, the sound system is good	-0,744	-0,012	5,61	1,346
14. In general, the facilities are clean	-1,101	0,247	5,74	1,590
15. The facility is perfect for the events of this type	-1,762	2,524	6,24	1,258
16. The information provided about the development of the event is good	-0,819	0,063	5,71	1,291
17. I felt comfortable with the other attendees	-1,432	1,413	6,05	1,355
18. The food and beverages service met my needs	-0,424	-0,540	5,21	1,455
19. The space can be quickly vacated	-1,207	1,000	5,69	1,520
20. The food and beverages service employees did their jobs properly	-1,431	2,380	5,92	1,260
21. Toilet hygiene is satisfactory	-1,054	0,211	5,79	1,498

Source: Authors research

According to Hair (2010), the distribution of respondents' answers is normal if the coefficient of asymmetry is from -2 to +2 and the coefficient of flattening is from -7 to +7. The results indicate Skewness values from -1.688 to 0.058, and Kurtosis values from -0.635 to 2.830. For the item "The staff is friendly and polite" the highest value of the mean was identified, i.e. the highest degree of agreement of respondents with the item ($M = 6.28$), while the lowest mean value ($M = 5.02$) was observed for the item "Food and beverage service staff are working your job professionally". The highest level of homogeneity of respondents' attitudes is in the statement "I got the ticket without any problems", as indicated by the values of the standard deviation ($SD=0.902$). The lowest degree of homogeneity is observed in the statement "The staff in charge of food and beverage service do their job professionally" where the value of the standard deviation is ($SD=1.754$) (Table 1).

Table 2. Results of the One Way-ANOVA test for the age of attendees to the "Travel Fair" business event

Item	F	p
1. I have easily arrived at the facility	1,821	0,110
2. It has been easy to get my ticket	1,288	0,270
3. I got the entry that I wanted	1,202	0,309
4. There is sufficient space for visitors at the event	0,744	0,591
5. It is easy to walk inside the facility (signaling, corridors...)	1,098	0,363
6. There are enough personnel in the facility to look after attendees	0,761	0,579
7. The facility employees are well trained	2,964	0,013**
8. The facility employees do their job properly	1,062	0,403
9. The facility employees are friendly	1,741	0,127
10. Once entering the facility, I felt impressed	1,377	0,234
11. The design of the space is good	1,333	0,252

12. Accessibility to the stands is good	1,546	0,177
13. In general, the sound system is good	2,999	0,012**
14. In general, the facilities are clean	1,647	0,149
15. The facility is perfect for the events of this type	2,156	0,060
16. The information provided about the development of the event is good	3,775	0,003**
17. I felt comfortable with the other attendees	4,308	0,001**
18. The food and beverages service met my needs	2,278	0,048**
19. The space can be quickly vacated	2,471	0,034**
20. The food and beverages service employees did their jobs properly	2,192	0,057
21. Toilet hygiene is satisfactory	8,864	0,000**

Notes: ** Statistical significance on the level of 0,05

Source: Authors research

The findings identified seven items that have a statistically significant difference (Sig<0.05).

The identified items are:

- The facility employees are well trained;
- In general, the sound system is good;
- The information provided about the development of the event is good;
- I felt comfortable with the other attendees;
- The food and beverages service met my needs;
- The space can be quickly vacated;
- Toilet hygiene is satisfactory.

To compare the age cohorts in which the largest differences in average values were manifested, table 3 shows the results of the ANOVA analysis - Post hoc Tukey test (Table 3).

Table 3. Results of ANOVA - Post hoc Tukey test for the age of attendees to the "Travel Fair" business event

Items	Age cohorts statistical difference was manifested	Mean Value (M)	p
In general, the sound system is good	Age cohort 1 18-24 Age cohort 6 ≥65	5,94-4,00	0,048**
The information provided about the development of the event is good	Age cohort 1 18-24 Age cohort 3 35-44	5,91-6,00	0,005**
	Age cohort 2 25-34	6,02-5,13	0,006**
	Age cohort 3 35-44		
I felt comfortable with the other attendees	Age cohort 1 18-24 Age cohort 3 -35-44	5,59-6,54	0,001**
Toilet hygiene is satisfactory	Age cohort 1 18-24 Age cohort 2 25-34	5,03-5,88	0,014**
	Age cohort 1 18-24 Age cohort 3 35-44	5,03-6,45	0,000**
	Age cohort 1-18-24 Age cohort 4-45-54	5,03-6,36	0,000**

Notes: ** Statistical significance on the level of 0,05

Source: Authors research

The comparison of mean values for age cohorts was shown in Table 3, thus, six age cohorts of respondents were distinguished: Age cohort 1-18-24; Age cohort 2-25-34; Age cohort 3-35-44; Age cohort 4-45-54; Age cohort 5-55-64 and Age cohort 6-65 and above. Table 3 shows that statistically significant differences between age cohorts are manifested, in particular between Generation Z (Age cohort 1-18-24) and older age cohorts. For the item "Toilet hygiene is satisfactory", a statistically significant difference $p=0.000$ can be evidenced between Generation Z ($M=5.03$) and attendees aged 35 to 44 ($M=6.45$); and between Generation Z ($M=5.03$) and attendees aged 45-54 ($M=6.36$); and finally, between Generation Z ($M=5.03$) and attendees aged 25 to 34 ($M=5.88$). This indicates that Generation Z attendees to business-type events, attach greater importance to the hygiene of toilet facilities. The statement "The sound system is good" shows the largest statistically significant difference between Generation Z attendees ($M=5.94$) and those aged 65 and over ($M=4.00$). Based on these findings it could be concluded that Generation Z attendees prefer the sound quality of the business event, in particular since most of the stands have their music and this quality attribute contributes largely to their event experience.

5. CONCLUSION AND RECOMMENDATIONS

Based on the study findings it could be concluded that perception of business event quality, at least some of its elements, differs by age. In particular, significant generational differences in business event attendee's quality expectations were recognized between Generation Z and older age cohorts. These differences are most pronounced in how attendees rate quality aspects of toilet hygiene and sound quality. Generation Z attendees (age cohort 18-24) expressed a lower level of satisfaction (5.03) in contrast to older cohorts such as those aged 35-44 ($M = 6.45$), 45-54 ($M = 6.36$), and 25-34 ($M = 5.88$) towards toilet hygiene. These findings suggest that Gen Z places a higher importance on cleanliness and hygiene standards at business events. Cleanliness of toilets was already identified as an important event quality dimension in previous studies, however in the sporting event context (Calabuig Moreno et al., 2010). Generation Z's concern in this regard comes as a result of a health-conscious mindset that has been particularly induced by the outbreak of the COVID-19 pandemic. Since our study was deployed amid the pandemic, the importance of hygiene issues was expected. Conversely, older generations' attendees were more flexible to hygiene as they attended business events in times when hygiene expectations were not so demanding as they are today. Generation Z hygiene requirements may also reflect cultural shifts toward higher health expectations in professional settings that were produced with the outbreak of the pandemic.

A significant generational difference was also evidenced regarding sound system preferences. Generation Z attendees ($M = 5.94$) rated the sound quality higher than attendees aged 65 and over ($M = 4.00$), giving greater importance to the sound aspect of business event quality. Taking into account the vital role of audio-sensory stimuli in the exhibition's setting, such as a travel fair, our findings confirm the previous notion of the value audio sensory stimuli for event attendees' experience in a trade fair environment (Sihvonen & Turunen, 2022). This is also in line with previous findings that the younger population festivals attach more importance to sound stimuli, such as music, while the older population prefers other elements (Kinnunen et al., 2019). Generation Z has grown up exposed to different types of auditory stimuli, conversely to older attendees who may prefer discrete sound due to a lower level of sensitivity to noise.

Findings also indicate that information provided about the event was good and comfortable interaction with the other attendees were also aspects that Generation Z attendees differ from older generations. In particular, generation Z attendees were less satisfied with the communication channel of the travel fair, so it could be assumed that they preferred more modern ways of event information dissemination in contrast to what has been done in the context of the Travel Fair. Moreover, they have also expressed a lower level of comfort when it comes to the interaction with the other attendees, which could be attributed to the pandemic health issue concerns, common for this age cohort.

Our findings provide a practical implication of the importance for business event organizers, concerning both cleanliness and sound quality dimensions. Nowadays, attendance at business events transcends common networking opportunities and considers expectations that favor the cleanliness of sanitary facilities and high-quality sensory stimuli. Thus, event organizers should prioritize these factors to ensure a customized engaging experience in which both details of cleanliness and those related to audio stimuli are tailored to specific audience needs. Therefore, the event organizer must consider these preferences when designing business events by balancing the requirements of diverse audience groups, both Generation Z and more traditional expectations of older generational cohorts.

The limitation of the study was related to the fact that the study was proposed as cross-sectional, deployed in the circumstances of the Covid-19 pandemic. Thus, the generalizability of the findings in the post-covid environment was seen as limited. Thus, future studies should examine the post-pandemic context of business event service quality and contrast the data with the data analyzed in this study.

REFERENCES

- Ali, B. J., Gardi, B., Othman, B. J., Ahmed, S.A., Ismael, N.B., Hamza, P.A., Aziz, H.M., Sabir, B.Y., & Anwar, G. (2021). Hotel service quality: The impact of service quality on customer satisfaction in hospitality. *International Journal of Engineering, Business and Management*, 5(3), 14-28.
- Andam, R., Montazeri, A., Feizi, S., & Mehdizadeh, R. (2015). Providing a multidimensional measurement model for assessing quality of sport tourism services: Empirical evidence from sport conference as sport event tourism. *Interdisciplinary Journal of Management Studies (Formerly known as Iranian Journal of Management Studies)*, 8(4), 607-629.
- Arcodia, C. & Robb, A. (2000). A future for event management: a taxonomy of event management terms. In Allen, J., Harris, R., Jago, L. & Veal, J. (Eds.) *Events Beyond 2000: Setting the Agenda* (pp. 152-160).
- Biscaia, R., Yoshida, M., & Kim, Y. (2023). Service quality and its effects on consumer outcomes: a meta-analytic review in spectator sport. *European Sport Management Quarterly*, 23(3), 897-921.
- Beogradski sajam (2020). Retrived August 2 2022. from <https://belquest.rs/beogradski-sajam-turizma-2020>
- Chin, C. H., Wong, W. P. M., Cham, T. H., & Kumarusamy, R. (2024). Is online shopping a trick or treat? Understanding the perceptions of generation Z towards purchasing through tourism e-commerce platforms. *Asian Journal of Business Research Volume*, 14(2).

- Coetzee, W. J., Lee, C., & Faisal, A. (2019). Predicting intentions to revisit and recommend a sporting event using the event experience scale (EES). *Event Management*, 23(3), 303-314.
- Crompton, J., & Love, L. (1995). The predictive validity of alternative approaches to evaluating quality of a festival. *Journal of Travel Research*, 34 (1), 11-24.
- Calabuig, F., Burillo, P., Crespo, H. J., Mundina, J., & Gallardo, L. (2010). Satisfacción, calidad y valor percibido en espectadores de atletismo. *International Journal of Medicine and Science of Physical Activity and Sport*, 10(40), 577-593.
- Calabuig Moreno F., Crespo Hervas, J., Prado, V., Mundina, J., Valantine, I., & Stanislovaitis, A. (2016a). Quality of Sporting Events: Validation of the Eventqual Scale. *Transformations in Business & Economics*, 15(2), 21-32.
- Chen, X., Yim, B. H., Tuo, Z., Zhou, L., Liu, T., & Zhang, J. J. (2021). "One Event, One City": Promoting the Loyalty of Marathon Runners to a Host City by Improving Event Service Quality. *Sustainability*, 13(7), 3795.
- Dimitrovski, D. (2016). Urban gastronomic festivals—Non-food related attributes and food quality in satisfaction construct: A pilot study. *Journal of Convention & Event Tourism*, 17 (4), 247-265.
- Dimitrovski, D., Milićević, S., & Lakićević, M. (2022). Niche tourism. Vrnjačka Banja: Faculty of Hotel Management and Tourism in Vrnjačka Banja.
- Getz, D. (2004). *Event Management and Event Tourism*. Canada: School of Business University of Calgary
- Getz, D. (2008). Event tourism: Definition, evolution, and research. *Tourism Management*, 29(3), 403-428.
- Getz, D., & Page, S. J. (2016). Progress and prospects for event tourism research. *Tourism Management*, 52, 593-631
- Entina, T., Karabulatova, I., Kormishova, A., Ekaterinovskaya, M., & Troyanskaya, M. (2021). Tourism industry management in the global transformation: Meeting the needs of generation Z. *Polish Journal of Management Studies*, 23.
- Esu, B. B. (2014). Analysis of event quality, satisfaction and behavioural intentions of attendees of calabar festival, Nigeria. *International Journal of Management and Social Science Research Review*, 1(1), 1-13.
- Fytopoulou, E., Tampakis, S., Galatsidas, S., Karasmanaki, E., & Tsantopoulos, G. (2021). The role of events in local development: An analysis of residents' perspectives and visitor satisfaction. *Journal of Rural Studies*, 82, 54-63.
- Jae Ko, Y., Zhang, J., Cattani, K., & Pastore, D. (2011). Assessment of event quality in major spectator sports. *Managing Service Quality: An International Journal*, 21(3), 304-322.
- Jeong, Y., & Kim, S. (2020). A study of event quality, destination image, perceived value, tourist satisfaction, and destination loyalty among sport tourists. *Asia Pacific Journal of Marketing and Logistics*, 32(4), 940-960.
- Kim, S. K., Yim, B. H., Byon, K. K., Yu, J. G., Lee, S. M. & Park, J. A. (2016). Spectator perception of service quality attributes associated with Shanghai Formula One. *International Journal of Sports Marketing and Sponsorship*, 17(2), 153-171.
- Kinnunen, M., Luonila, M., & Honkanen, A. (2019). Segmentation of music festival attendees. *Scandinavian Journal of Hospitality and Tourism*, 19(3), 278-299.
- Kruger, S., Saayman, M., & Ellis, S. M. (2014). The influence of travel motives on visitor happiness attending a wedding expo. *Journal of Travel & Tourism Marketing*, 31(5), 649–665. <https://doi.org/10.1080/10548408.2014.883955>

- Kumar, J., & Hussain, K. (2014). A review of assessing the economic impact of business tourism: Issues and approaches. *International Journal of Hospitality and Tourism Systems*, 7(2), 49-55.
- Li, J., Ali, F., & Kim, W. G. (2017). Age matters: how demographics influence visitor perception and attitude at the destination level. *International Journal of Innovation and Learning*, 21(2), 149-164.
- Lu, S., Zhu, W., & Wei, J. (2020). Assessing the impacts of tourism events on city development in China: A perspective of event system. *Current Issues in Tourism*, 23(12), 1528-1541.
- Mavrogenis, A. F., Papadimos, T. J., Saranteas, T., Hernigou, P., & Scarlat, M. M. (2024). Scroll, snap, scalpel: generation z orthopaedics shaping life, learning, and surgery differently. *International Orthopaedics*, 1-9.
- Mei, A. W. O., Dean, A. M., & White, C. J. (1999). Analysing service quality in the hospitality industry. *Managing Service Quality: An International Journal*. 9(2), 136-143.
- Mokoena, B. A., & Dhurup, M. (2017). Service quality dimensions in spectator sport: An analysis of the twenty-twenty cricket league matches in South Africa. *International Journal of Social Sciences and Humanity Studies*, 9(2), 1309-8063.
- Neuhofner, B., Egger, R., Yu, J., & Celuch, K. (2021). Designing experiences in the age of human transformation: An analysis of Burning Man. *Annals of Tourism Research*, 91, 103310.
- Nicula, V., & Elena, P. R. (2014). Business tourism market developments. *Procedia Economics and Finance*, 16, 703-712
- Peng, L. S., & Moghavvemi, S. (2015). The dimension of service quality and its impact on customer satisfaction, trust, and loyalty: A case of Malaysian banks. *Asian Journal of Business and Accounting*, 8(2), 91-121
- Ribeiro, T., Correia, A., Biscaia, R. & Figueiredo, C. (2018). Examining service quality and social impact perceptions of the 2016 Rio de Janeiro Olympic Games. *International Journal of Sports Marketing and Sponsorship*, 19(2), 160-177.
- Smith, S., & Costello, C. (2009). Segmenting visitors to a culinary event: Motivations, travel behavior, and expenditures. *Journal of Hospitality Marketing & Management*, 18(1), 44-67.
- Rittichainuwat, B., & Mair, J. (2012). Visitor attendance motivations at consumer travel exhibitions. *Tourism Management*, 33(5), 1236-1244.
- Roca Cruz, A., Cabello Manrique, D., Gonzalez, J. & Courel-Ibáñez, J. (2018). Estudio de satisfacción de los asistentes a la Universiada de Invierno Granada 2015. Retos: nuevas tendencias en educación física, deporte y recreación, 33, 247-251.
- Sharma, J., & Kanchwala, F. (2022). Consumer Behaviour and Response to Advertisements and Media Channels: Generation XV/S Generation Z. *Aweshkar Research Journal*, 29(2).
- Sihvonen, J., & Turunen, L. L. M. (2022). Multisensory experiences at travel fairs: What evokes feelings of pleasure, arousal and dominance among visitors? *Journal of Convention & Event Tourism*, 23(1), 63-85.
- Swarbrooke, J., & Horner, S. (2012). *Business travel and tourism*. Routledge.
- Theodorakis, N., Kambitsis, C., Laios, A. & Koutelios, A. (2001). Relationship between measures of service quality and satisfaction of spectators in professional sports. *Managing Service Quality*, 11(6), 413-438.
- Tkaczynski, A. & Stokes, R. (2010). FESTPERF: a service quality measurement scale for festivals. *Event Management*, 14(1), 69-82.

- Tkaczynski, A., & Rundle-Thiele, S. (2020). Event market segmentation: a review update and research agenda. *Event Management*, 24(2-3), 277-295.
- Tsaur, S. H., & Lin, Y. C. (2004). Promoting service quality in tourist hotels: the role of HRM practices and service behavior. *Tourism Management*, 25(4), 471-481.
- Vesci, M., & Botti, A. (2019). Festival quality, theory of planned behavior and revisiting intention: Evidence from local and small Italian culinary festivals. *Journal of Hospitality and Tourism Management*, 38, 5–15.
- Wen-Chiang, C., Cheng-Fei, L., & Ling-Zhong, L. (2012). Investigating factors affecting festival quality: A case study of neimen song jiang jhen battle array, Taiwan. *African Journal of Marketing Management*, 4(2), 43-54.
- World Travel & Tourism Council (2022). *Economic impact 2022: Global trends*. Oxford Economics: Return of Business Travel
- Yoon, Y. S., Lee, J. S., & Lee, C. K. (2010). Measuring festival quality and value affecting visitors' satisfaction and loyalty using a structural approach. *International Journal of Hospitality Management*, 29(2), 335-342.

CURRENT TRENDS IN THE POST-COVID-19 CONSUMER BEHAVIOR

Veljko Marinković

University of Kragujevac, Faculty of Economics, vmarinkovic@kg.ac.rs,
ORCID number 0000-0003-4749-7053

Biljana Chroneos Krasavac

University of Belgrade, Faculty of Economics, biljana.krasavac@ekof.bg.ac.rs,
ORCID number 0000-0002-1486-4825

Jovana Lazarević*

University of Kragujevac, Faculty of Economics, jsavic@kg.ac.rs,
ORCID number 0000-0002-2300-2813

Abstract: *The COVID-19 pandemic caused significant changes in consumer behavior. Consumers exhibit new or adapted habits in the post-pandemic period compared to the period before or during the pandemic. Additionally, some old habits have strengthened under the influence of the pandemic. Hence, this paper aims to describe several trends in consumer behavior following the pandemic and highlights differences between the pandemic and the post-pandemic period regarding observed trends. In other words, the paper focuses on trends in consumer behavior that were either established or further encouraged by the pandemic worldwide. Primary data were collected via a survey of 167 respondents from Serbia. The findings reveal that in the post-pandemic period, consumers increasingly engage in online shopping, use social media as a shopping channel, and utilize contactless payment (mobile wallet, card) and food delivery services. However, grocery delivery services remain less widely adopted. Compared to the pandemic period, these observed trends intensified, except for grocery delivery, which was not prevalent during or after the pandemic. The study's results demonstrate that the pandemic has accelerated certain consumer behavior trends in Serbia, reflecting global patterns. Given that the pandemic offers a unique opportunity to gain valuable insights into consumer behavior, the results of the study can help companies across various industries develop optimal business strategies to adapt to evolving consumer preferences.*

Keywords: *consumer behavior trends, COVID-19 virus pandemic, post-pandemic consumer behavior, Serbia*

JEL Classification: *M31*

* Corresponding author

1. INTRODUCTION

With the emergence of the COVID-19 virus pandemic, everyday life around the world changed significantly. Governments introduced protective measures like lockdowns or travel restrictions to protect their citizens. These measures forced people to change their daily habits, including how they shop. In other words, consumers had to adjust their shopping behavior and move away from the usual routines they had followed before the pandemic. In restricted conditions, consumers tend to improvise, resulting in innovative ways to satisfy their needs. In this regard, Sheth (2020) states that it was inevitable that some habits die because consumers under the pandemic conditions discovered more convenient, affordable, and accessible alternatives. Similarly, according to Mortimer et al. (2024), the pandemic influenced consumers' shopping mall experience, referring to this as a shift from 'traditional' to 'transformed'. On the other hand, most of the habits were expected to return to normal or to come back in as recreation or a hobby.

Regardless inevitable influence that the pandemic had on consumer behavior, Mason et al. (2021a) indicate that previous research has given little attention to the pandemic influence on consumer behavior but mostly focused on the pandemic impact on behavior for preventive health. On the other hand, the pandemic provides a chance to gain valuable consumer behavior insights. Thus, the idea of the work is to identify how the COVID-19 virus pandemic influenced several consumer behavior trends. The motivation for the work stems from the need to generate knowledge and give recommendations to companies on how to respond to current trends in consumer behavior on the market, especially in the case of new crises. The paper will focus on trends in consumer behavior that existed during the pandemic and that the pandemic further encouraged to develop. Thus, the paper aims to identify differences in observed trends during the pandemic and in the post-pandemic period. For these purposes, 167 respondents were surveyed in Serbia. Related to the paper structure, after the introduction section, the theoretical background is presented. Further, the methodology of the paper is explained, followed by the results section. The last part of the paper represents the discussion of obtained results, conclusions, contributions, and the most important limitations and recommendations for future studies.

2. LITERATURE REVIEW

Consumer behavior has been profoundly disrupted by the pandemic, as evidenced by many habits consumers have modified in response to the new circumstances. A review of the literature on the pandemic's effects reveals several trends in consumer behavior that either emerged or intensified during this period. One of the most evident examples of the pandemic's influence on changing consumer purchasing behavior is online shopping (Lazarević & Marinković, 2021). In this regard, Diaz-Gutierrez et al. (2023) state that the pandemic accelerated the growing trend of online purchases. The authors observed whether online purchasing behavior changes are expected to stay post-pandemic and concluded that most people plan to continue shopping online after the pandemic. Also, the authors classified consumers based on their shopping frequency before, during and after the pandemic and determined changes related to their online food shopping between the early and late pandemic. To be precise, the percentage of consumers who will get back to pre-pandemic shopping frequency decreased, while the number of consumers who increased shopping frequency during the pandemic, and expect to maintain it post-pandemic, grew. Similarly, Gupta and Mukherjee (2022) observed the long-term changes in consumer shopping preferences post

COVID-19 pandemic and identified increased online shopping as one of the consequences. Higuera-Castillo et al. (2023) concluded that there are differences between Spaniards and Portuguese in adopting e-commerce and not buying in a physical shop in the post-COVID era. Starting from a disaster management perspective, Sorrentino et al. (2022) revealed two habits that people will maintain in their new, post-pandemic lifestyle: online shopping and home cooking. As a trend closely related to online shopping, social media shopping has gained significant attention since the outbreak of the pandemic. In this regard, Mason et al. (2021a; 2021b) determined that consumers have increased their utilization of social media for identifying product needs, comparing product options, evaluating product risks, and purchasing products, while Elshaer et al. (2024) identified the growth of social media commerce (exchange of goods and services online through social media platforms) as one of the trends that emerged during the pandemic, with a tendency to continue growing in the post-COVID era.

Besides online and social media shopping, the way consumers purchase food also changed by the pandemic influence. Regarding this, using food and grocery delivery services got more often in pandemic times. Several studies proved this fact. For example, Ben Hassen et al. (2023) determined an increase in online food shopping during the pandemic, particularly in high-income countries. The results of the study conducted by Sharma et al. (2023) indicate that consumers who were satisfied with online food delivery services during the pandemic have a strong intention to continue utilizing this food shopping option post-pandemic. Further, Jensen et al. (2021) proved the increase in online grocery shopping during the pandemic, especially among younger, full-time employed consumers, with college education and children. Also, authors concluded that consumers tend to use this convenience in future, regardless of pandemic conditions. According to the study conducted by Seo (2024), the availability of a wide range of food products in online grocery stores encourages continued online shopping post-pandemic, suggesting that online grocery stores may become the preferred choice for purchasing groceries in the future.

In addition to the previous trends that were strongly influenced by the pandemic, the use of contactless payment received significant attention during this time, primarily due to safety concerns. In this regard, Li et al. (2024) highlight a growing preference for contactless payment during the pandemic, as consumers seek safer and more hygienic payment alternatives. Regarding post-pandemic times, Szumski (2022) concluded that a decrease in the use of cash payments can be expected after the pandemic, while the three most frequently used payment methods will be credit/debit card payments, mobile app payments, and e-wallet payments (smartphone, tablet). Similarly, Wisniewski et al. (2024) indicate that the risk of spreading infection through cash not only led to a shift in payment methods during the pandemic but also influenced consumers' future intentions to make cashless transactions, even after the pandemic is over.

In contrast to the empirical findings provided by the aforementioned studies, several studies revealed that consumers tend to return to pre-pandemic habits. For example, Tinonetsana and Msosa (2023) revealed that significant number of consumers reported reverting to their pre-pandemic shopping habits, favoring in-store purchases again. Bridges and Fowler (2022) demonstrated that during the pandemic, more consumers adopted online grocery shopping. However, according to their study there is a growing desire of consumers to shop for groceries in person post-pandemic, so this trend is expected to increase relative to online shopping. Similar conclusions were highlighted in several other studies as well (Adibfar et al., 2022; Sorrentino et al., 2022; Zielke et al., 2023).

3. METHODOLOGY

The surveying method and convenience sample for collecting primary data were used. The survey was performed after the pandemic period in Serbia. Regarding this, it is important to note that respondents were surveyed in a single moment about their behavior during and after the pandemic, following the approach used in previous studies (Marinković et al., 2023; Khan et al., 2023) to observe changes in consumer behavior under pandemic circumstances. The questionnaire used for collecting primary data consists of 30 statements measured on a five-point Likert scale and 4 questions regarding the characteristics of the respondents. Items for measuring observed variables are adapted from relevant sources (Mason et al., 2021a; Shishah & Alhelaly, 2021; Sorrentino et al., 2022). Related to data analysis, descriptive statistics was used to describe post-pandemic consumer behavior observed through several trends. Further, reliability analysis was used to determine the reliability of the observed research variables. Finally, the paired-samples t-test indicates whether there are differences in the observed trends during and post-pandemic.

Regarding sample structure, the sample comprises 167 respondents, mostly females (89 or 53,3%). Related to respondents age, most of the sample are respondents between 18 and 35 years (78 or 46,7%), then between 36 and 55 years (71 or 42,5%), while 18 respondents have 56 years or more (10,8%). Respondents mostly have a faculty degree (83 or 49,7%), then a master's degree (36 or 21,6%), 32 respondents have secondary education (19,2%), and only 16 respondents have a PhD (9,6%). Most of the sample are employed (81 or 48,5%), followed by students (42 or 25,1%), 35 respondents are unemployed (21%), and only 9 are pensioners (5,4%).

4. RESULTS AND DISCUSSION

Post-pandemic or current trends in consumer behavior were analyzed in the first step using descriptive statistics. The results obtained are presented in Table 1.

Table 1. *Post-pandemic trends in consumer behavior (actual behavior)*

Trend	Mean	St. deviation
<i>Online shopping</i>	4,40	0,77
I shop online.	4,50	0,81
I use the convenience of buying from home.	4,53	0,75
I buy online products for which in-store purchase is not necessary.	4,17	1,00
<i>Food delivery</i>	3,01	1,40
I use food delivery at home.	3,33	1,63
I like to use food delivery at home.	3,33	1,53
I order food at least once a week.	2,37	1,36
<i>Grocery delivery</i>	1,61	1,12
I order groceries at home.	1,62	1,19
I like to use the convenience of receiving groceries at home.	1,70	1,21
I order groceries at least once a week.	1,50	1,07

<i>Social media shopping</i>	3,60	1,24
I use social media to identify needed products.	3,54	1,42
I use social media to gather information to compare products.	3,65	1,34
I use social media to purchase products.	3,63	1,49
<i>Contactless payment</i>	3,45	1,33
I use contactless payment (mobile wallet, card).		
I believe that contactless payment is important.	3,30	1,55
I prefer using contactless payment compared to other payment methods (cash).	3,71	1,44
	3,33	1,35

Source: Authors

When we look at post-pandemic consumer behavior, consumers mostly like to use the convenience of buying from home (the highest value of mean, 4,53). Also, consumers shop online, use social media to gather information to compare and purchase products, use contactless payment (mobile wallet, card), and believe that the same is important. Post-pandemic consumer behavior is also reflected in using food delivery services, but not very often. On the other hand, consumers don't order groceries at least once a week (the lowest value of mean, 1,50); in fact, they don't order groceries at home at all. Results related to the observed post-pandemic trends indicate that consumers mostly perform online shopping, use social media as a shopping channel and use contactless payment, occasionally use food delivery, and don't use grocery delivery at home.

In the next step, reliability analysis was performed to determine the internal consistency of the statements forming observed research variables. The results are provided in Table 2.

Table 2. Reliability analysis

Variable	During the pandemic (Cronbach's alpha)	Post-pandemic (Cronbach's alpha)
Online shopping	0,921	0,879
Food delivery	0,886	0,912
Grocery delivery	0,927	0,961
Social media shopping	0,870	0,847
Contactless payment	0,895	0,908

Source: Authors

According to the given values of Cronbach's alpha coefficient, all research variables have a satisfactory reliability level above 0,7 (Nunnally, 1978). The most reliable is variable grocery delivery observed in the post-pandemic period ($\alpha= 961$), while the least reliable is variable social media shopping, also observed in the post-pandemic period ($\alpha=0,847$).

The final analysis, paired-samples t-test, was performed to identify differences between the observed trends during and post-pandemic. The results are given in Table 3.

Table 3. Paired samples t-test

Variable	During pandemic (mean)	Post-pandemic (mean)	sig
Online shopping	3,73	4,40	0,000*
Food delivery	2,60	3,01	0,000*
Grocery delivery	1,56	1,61	0,467
Social media shopping	3,26	3,60	0,000*
Contactless payment	2,78	3,45	0,000*

Source: Authors

The differences between trends exist if the p-value is below the 0,1 threshold. If we look at Table 3, obtained p-values indicate differences in four out of five trends, precisely in online shopping, food delivery, social media shopping, and contactless payment. Further, mean values show that in the post-pandemic period, these trends are stronger than in the period during the pandemic. The highest difference exists related to contactless payment (mean values 2,78 and 3,45 during and post-pandemic, respectively), followed by the difference when observing online shopping (mean values 3,73 and 4,40 during and post-pandemic, respectively). Food delivery and social media shopping also differ in the observed periods, i.e. they intensified in the post-pandemic period, but with smaller differences compared to previous trends. Variable grocery delivery showed no difference in observed periods (p-value is higher than 0,1). This trend was not present among consumers in the period during the pandemic, or now (post-pandemic).

5. CONCLUSIONS AND RECOMMENDATIONS

The COVID-19 pandemic brought transformative changes to consumer behavior, leading to new or intensifying existing habits. This study was conducted to identify how the pandemic has influenced specific consumer behavior trends, and thus generate knowledge and provide recommendations for companies to effectively respond to market changes, especially in the context of new crises. By focusing on data from Serbian consumers, the study provides insights into how trends such as online shopping, social media shopping, using food and grocery delivery services, and contactless payment changed by the pandemic influence. In other words, the research aims to highlight differences in observed consumer behavior trends during the pandemic and in the post-pandemic period. Results related to the actual (post-pandemic) consumer behavior indicate that consumers increasingly engage in online shopping, utilize social media to search for product information and purchases, adopt contactless payment methods, and occasionally use food delivery services, reflecting their desire for ease and efficiency in the post-pandemic shopping experience. Similar results were obtained by previous studies (Diaz-Gutierrez et al., 2023; Mason et al., 2021a; 2021b; Sharma et al., 2023). On the other hand, results show that consumers do not frequently order groceries online, in fact, they do not order groceries at all. In other words, grocery delivery at home remains an underutilized option for consumers in the post-pandemic period. Opposite from previous, this result is not in line with other studies (Jensen et al., 2021; Seo, 2024). Regarding differences in the observed periods, results first show a significant increase in utilizing contactless payment methods reflecting the growing consumer preference for safer, more convenient payment methods in response to the pandemic's impact on health and safety. Further, results indicate

that consumers increasingly use online shopping in the post-pandemic period. In other words, there is a notable shift towards greater acceptance and utilization of online shopping as a preferred purchasing method among consumers. Next, in the post-pandemic period, consumers use food delivery services more, suggesting greater popularity of the same after the pandemic. The difference also exists when it comes to social media shopping which suggests that consumers are increasingly using social media as a channel for gathering information and making purchases after the pandemic. Following the above-mentioned, it can be concluded that observed trends intensified under the influence of the pandemic. Precisely, these habits emerged strongly during the pandemic, offering consumers a sense of security and protection from the virus compared to traditional shopping methods, but even post-pandemic they have continued to persist and thus establish themselves as the new reality in the market. The study results are consistent with previous research that confirmed the persistence of observed habits in the post-pandemic period (Szumski, 2022; Gupta & Mukherjee, 2022; Sorrentino et al., 2022; Elshaer et al., 2024). On the other hand, using grocery delivery services remained the same, as consumers did not engage in this service either during or after the pandemic, suggesting a continued resistance to embrace and use this convenience. This result is not similar to those obtained by Jensen et al. (2021) or Seo (2024), but it is in line with study conducted by Bridges and Fowler (2022).

Several theoretical and practical implications can be derived from the study. The theoretical implications of this study are reflected in expanding existing knowledge about the effects of the pandemic on consumer behavior. Specifically, the research provides an understanding of how the pandemic has shifted consumer shopping behavior in the market by observing several consumer behavior trends. Before mentioned gives valuable insights into how the pandemic has left lasting effects on shopping habits, highlighting the ongoing shifts in consumer preferences and behaviors. Hence, these insights are highly valuable for timely responses in future crises, leading to relevant practical implications. The first one relates to the greater use of contactless payment methods since this trend showed the greatest difference in the observed periods. Hence, companies (retailers in the first place) must integrate and promote contactless payment options for their consumers, thus supporting their increased health consciousness and preferences for safer shopping methods. To achieve this, companies should ensure that devices for contactless payment are regularly serviced and fully operational at all times, as well as to ensure secure data protection systems for online payments. This can contribute significantly to consumers' sense of security when making payments. Additionally, providing discounts for using contactless payment (for example, mobile phones) could encourage more consumers to use this payment method. Next, given the increase in online shopping in the post-pandemic period, companies should improve their online shopping channels in several ways. First, companies can invest in a user-friendly website or application for better shopping experience, making it easier for consumers to search, shop, etc. It is also important to offer adequate customer support (through live chat, email, or phone) to resolve issues quickly, and to simplify delivery and possible returns, thus making online shopping more attractive and satisfying for consumers. As for contactless payment methods, companies should ensure data security for online transactions, and discounts, free shipping, or special prices online to further encourage online shopping. Following the results of increased social media shopping, companies can strengthen their digital marketing by using social media for presentation and selling, which can help attract and engage more online and social media shoppers. Regarding more often use of food delivery services, companies should respond quickly to orders by collaborating with reliable delivery partners or having their delivery teams. This will help ensure that food arrives promptly and fresh, while also reducing delivery costs. Finally, recommendations for

encouraging consumers to use grocery delivery services are to give special discounts to first-time users, ensure that fresh groceries are always available and keep track of expiration dates, ensure that delivery times are convenient, and offer special prices for online grocery purchases.

The study has certain limitations. Firstly, the small sample size limits the ability to make general conclusions for the entire population. Additionally, consumer behavior was observed at a single point in time rather than across successive intervals. This approach only allows a comparison between consumer habits during and after the pandemic, without including the pre-pandemic period to understand observed trends before the pandemic's influence. Lastly, the study focuses on just a few consumer behavior trends, while consumer behavior is a much broader and more complex field. Considering the highlighted limitations, several recommendations can be given for future research. First, expanding the sample size is necessary for more representative conclusions. Next, future studies should also consider including the pre-pandemic period in consumer behavior analyses, although it can only be measured at a single point in time, as in this study, since the pandemic has ended. Additionally, a wider range of consumer shopping behaviors should also be examined. In this regard, future studies could explore consumer habits related to stockpiling behavior, buying eco-friendly, health and wellness products, impulse buying, etc. Moreover, the results could become more relevant if the direct impact of pandemic-related factors (perceived risk, awareness, information) on specific consumer behaviors were measured, depending on the study's focus.

REFERENCES

- Adibfar, A., Gulhare, S., Srinivasan, S., & Costin, A. (2022). Analysis and modeling of changes in online shopping behavior due to Covid-19 pandemic: A Florida case study. *Transport Policy*, 126, 162-176. <https://doi.org/10.1016/j.tranpol.2022.07.003>
- Ben Hassen, T., El Bilali, H., & Allahyari, M. S. (2023). Food shopping during the COVID-19 pandemic: an exploratory study in four Near Eastern countries. *Journal of Islamic Marketing*, 14(8), 2084-2108. <https://doi.org/10.1108/JIMA-12-2021-0404>
- Bridges, E., & Fowler, K. (2022). Grocery Shopping before, during and after the Pandemic: A Qualitative Study. *Family and Consumer Sciences Research Journal*, 51(1), 35-50. <https://doi.org/10.1111/fcsr.12453>
- Diaz-Gutierrez, J. M., Mohammadi-Mavi, H., & Ranjbari, A. (2023). COVID-19 impacts on online and in-store shopping behaviors: Why they happened and whether they will last post pandemic. *Transportation Research Record*. <https://doi.org/10.1177/03611981231155169>
- Elshaer, I. A., Alrawad, M., Lutfi, A., & Azazz, A. M. (2024). Social commerce and buying intention post COVID-19: Evidence from a hybrid approach based on SEM–fsQCA. *Journal of Retailing and Consumer Services*, 76, 103548. <https://doi.org/10.1016/j.jretconser.2023.103548>
- Gupta, A. S., & Mukherjee, J. (2022). Long-term changes in consumers' shopping behavior post-pandemic: an exploratory study. *International Journal of Retail & Distribution Management*, 50(12), 1518-1534. <https://doi.org/10.1108/IJRDM-04-2022-0111>
- Higuera-Castillo, E., Liébana-Cabanillas, F. J., & Villarejo-Ramos, Á. F. (2023). Intention to use e-commerce vs physical shopping. Difference between consumers in the post-COVID era. *Journal of Business Research*, 157, 113622. <https://doi.org/10.1016/j.jbusres.2022.113622>

- Jensen, K. L., Yenerall, J., Chen, X., & Yu, T. E. (2021). US consumers' online shopping behaviors and intentions during and after the COVID-19 pandemic. *Journal of Agricultural and Applied Economics*, 53(3), 416-434. <https://doi.org/10.1017/aae.2021.15>
- Khan, F., Ateeq, S., Ali, M., & Butt, N. (2023). Impact of COVID-19 on the drivers of cash-based online transactions and consumer behaviour: evidence from a Muslim market. *Journal of Islamic Marketing*, 14(3), 714-734. <https://doi.org/10.1108/JIMA-09-2020-0265>
- Lazarević, J., & Marinković, V. (2021). Stil života potrošača u Srbiji pre i tokom pandemije virusa Covid 19. *Marketing*, 52(1), 3-11. <https://doi.org/10.5937/markt2101003L>
- Li, Y., Park, S. J., Li, H., & Choi, S. (2024). Contact or Contactless Payment: Impact of COVID-19 Pandemic on Consumer Decision Making in Money Domain. *SAGE Open*, 14(1), 21582440241239422. <https://doi.org/10.1177/21582440241239422>
- Marinković, V., Lazarević, J., & Marić, D. (2023). Consumer ethnocentrism under the circumstances of the COVID 19 virus pandemic. *Strategic Management-International Journal of Strategic Management and Decision Support Systems in Strategic Management*, 28(3), 46-60. <https://doi.org/10.5937/StraMan2200031M>
- Mason, A. N., Narcum, J., & Mason, K. (2021a). Social media marketing gains importance after Covid-19. *Cogent Business & Management*, 8(1). <https://doi.org/10.1080/23311975.2020.1870797>
- Mason, A. N., Brown, M., Mason, K., & Narcum, J. (2021b). Pandemic effects on social media marketing behaviors in India. *Cogent Business & Management*, 8(1). <https://doi.org/10.1080/23311975.2021.1943243>
- Mortimer, G., Andrade, M. L. O., & Fazal-e-Hasan, S. M. (2024). From traditional to transformed: Examining the pre-and post-COVID consumers' shopping mall experiences. *Journal of Retailing and Consumer Services*, 76, 103583. <https://doi.org/10.1016/j.jretconser.2023.103583>
- Nunnally, J. C. (1978). *Introduction to psychological measurement*. New York: McGraw-Hill Inc.
- Seo, J. I. (2024). Online Grocery Shopping Intention after the COVID-19 Pandemic. *International Journal of Business and Management*, 19(6). <https://doi.org/10.5539/ijbm.v19n6p1>
- Sharma, S., Devi, K., Naidu, S., Greig, T., Singh, G., & Slack, N. (2023). From brick and mortar to click and order: consumers' online food delivery service perceptions post-pandemic. *British Food Journal*, 125(11), 4143-4162. <https://doi.org/10.1108/BFJ-04-2023-0351>
- Sheth, J. (2020). Impact of Covid-19 on consumer behavior: Will the old habits return or die?. *Journal of Business Research*, 117, 280-283. <https://doi.org/10.1016/j.jbusres.2020.05.059>
- Shishah, W., & Alhelaly, S. (2021). User experience of utilising contactless payment technology in Saudi Arabia during the COVID-19 pandemic. *Journal of Decision Systems*, 30(2-3), 282-299. <https://doi.org/10.1080/12460125.2021.1890315>
- Sorrentino, A., Leone, D., & Caporuscio, A. (2022). Changes in the post-covid-19 consumers' behaviors and lifestyle in Italy. A disaster management perspective. *Italian Journal of Marketing*, 2022(1), 87-106. <https://doi.org/10.1007/s43039-021-00043-8>
- Szumski, O. (2022). Comparative analyses of digital payment methods from the pre and post COVID-19 perspective. *Procedia Computer Science*, 207, 4660-4669. <https://doi.org/10.1016/j.procs.2022.09.530>

- Tinonetsana, F., & Msosa, S. K. (2023). Shifts in consumer behavioural trends during and post the COVID-19 pandemic: An analysis using the theory of reasoned action. *Business Excellence & Management*, 13(4), 47-60. <https://doi.org/10.24818/beman/2023.13.4-0>
- Wisniewski, T., Polasik, M., Kotkowski, R., & Moro, A. (2024). Switching from cash to cashless payments during the COVID-19 pandemic and beyond. *International Journal of Central Banking*, 20(3), 303-371.
- Zielke, S., Komor, M., & Schlößer, A. (2023). Coping strategies and intended change of shopping habits after the Corona pandemic—Insights from two countries in Western and Eastern Europe. *Journal of Retailing and Consumer Services*, 72, 103255. <https://doi.org/10.1016/j.jretconser.2023.103255>

IMPLEMENTATION OF CSR IN SMES – EVIDENCE FROM SERBIA

Damnjanović Milena*

University of Kragujevac, Faculty of Technical Sciences Čačak, milena.damnjanovic@ftn.kg.ac.rs,
ORCID number 0000-0001-7689-1207

Abstract: Discussion and research in the field of corporate social responsibility (CSR) are mostly focused on large, multinational companies (MNCs) because they are considered to have advanced more in implementing CSR compared to small and medium-sized enterprises (SMEs). However, large MNCs heavily depend on other companies (suppliers, intermediaries, vendors) in their business operations, many of which are SMEs. Since SMEs represent the majority of companies in both developed and developing countries, they have a substantial impact on local communities and the environment. The structure and characteristics of SMEs in developing countries are significantly different from those in developed countries, making it necessary to dedicate special attention to the specific traits and potential contributions of CSR implementation in SMEs. In response to these challenges, it is important to investigate the level of CSR implementation in SMEs. This paper aims to demonstrate the assessed level of CSR in SMEs compared to large companies in the context of a developing country, the Republic of Serbia. The results showed that there are statistically significant differences between SMEs and large companies in the assessment of CSR and external CSR, while there is not a statistically significant difference in the assessment of internal CSR. These findings can be used to develop support programs for SMEs to facilitate CSR implementation.

Keywords: dimension of CSR, internal CSR, external CSR, SMEs

JEL Classification: M14, L26

* Corresponding author

1. INTRODUCTION

Discussion and research in the field of corporate social responsibility (CSR) are mainly focused on large, multinational companies (MNCs) (Berniak-Wozny et al., 2023). The reason might be the fact that large companies have a key role in economic development, but also the name of the concept itself suggest that CSR is a practice of large companies. It is generally considered that large companies have made significantly more progress in implementing CSR compared to small and medium enterprises (SMEs) (Baumann-Pauly et al., 2013). However, large companies in carrying out their business operations heavily rely on other companies (suppliers, intermediaries, vendors), many of which are SMEs. Theoretical foundations of CSR, based on the experiences of large companies, do not explain completely the way and effects of CSR implementation in the context of SMEs (Bhattacharyya & Kumar, 2022). At the beginning of the XXI century, a growing interest in research in the field of CSR implementation in SMEs has been noticed in developed countries (Amaeshi et al., 2016). In developing countries these studies are rare (Bhattacharyya & Kumar, 2022; Amaeshi et al., 2016; Aya Pastrana & Srirameshb, 2014), but with growth in developing countries, CSR implementation in SMEs is becoming an important topic (Jamali et al., 2017).

SMEs represent more than 90% of all companies worldwide and 99.8% in the EU (McEvoy, 2023). They account for over 50% of employment in both developing and developed countries (Bhattacharyya & Kumar, 2022). Given that SMEs constitute the majority of companies globally, they have a substantial impact on local communities and the environment. SMEs have a larger environmental impact per unit compared to large companies, significantly contributing to pollution, carbon emissions, and commercial waste (Berniak-Wozny et al., 2023). In Europe, they are responsible for 60-70% of all industrial waste (Berniak-Wozny et al., 2023). These data highlight the need for a deeper analysis of CSR in the context of SMEs.

In Serbia SMEs make up 99.5% of the total number of companies, they employ 56.8% of the workforce and contribute 54.4% to the creation of value-added (Statistical Office of the Republic of Serbia, 2023). Previous research in Serbia has shown that SMEs do not sufficiently apply the concept of CSR in their business operations (Damnjanović & Rendulić-Davidović, 2019). This paper deals with the assessment of CSR in large companies and SMEs in Serbia. This paper aims to reveal the differences in the employees' assessment of implemented CSR activities in SMEs compared to large companies in the context of a developing country, Serbia.

The paper was organized in the following way. Firstly, a literature review and hypothesis development were given. In the next section applied methodology and methods were explained. The results and their short discussion were presented in the fourth section. The conclusions were given in the final section.

2. LITERATURE REVIEW

2.1. CSR in large companies vs CSR in SMEs

In the beginning, CSR initiatives were developed by large companies, which have the financial and human resources to implement appropriate procedures in their business operations. Large companies possess the power and resources which create a responsibility for their use and development. Moreover, it is in the best interest of companies to behave

ethically and responsibly, as unethical behavior can negative impact stock prices and a company's reputation among stakeholders (Jenkins, 2006). Due to the high visibility of large companies on the capital, labor and product markets, reputation concerns influence how much is justified to spend on CSR (Fitjar, 2011). Many MNCs have developed solutions for global issues such as corporate policies on human rights, employee rights and climate change. To organize their CSR activities, large companies utilize codes of conduct, certifications, and reporting guidelines (Dias et al., 2018). Successful execution of CSR projects in large companies results from well-defined goals, measures and procedures used to monitor these activities (D'Amato & Falivena, 2019). It is generally believed that the scale of CSR activities is larger in big companies than in small ones. However, when it comes to producing CSR reports, large companies consume much less resources compared to SMEs (Fitjar, 2011).

SMEs respond to issues addressed by social responsibility in a specific way. The entrepreneurs are personally affected by the problems in the environment in which they operate, and along with their families and employees, they share successes and concerns. In this context, the development and implementation of CSR strategies are mostly affected by personal attitudes, values and preferences of the owner or managers of the company (Coppa & Sriramesh, 2013; Fitjar, 2011), as in small companies, ownership and control functions are often combined in a single person (Jenkins, 2006). As a result, SMEs usually do not have a person in charge only of CSR management, nor a separate department for that purpose. In terms of stakeholders, SMEs typically focus most of their attention on employees, the local community, the environment, and customers (Dias et al., 2018; Amaeshi et al., 2016; Coppa & Sriramesh, 2013; Vo, 2011). Employees are often the ones who encourage the implementation of CSR in SMEs, actively participate in those activities, and feel and measure the effects of its application. Research has shown that 92% of SME employees are proud to work for their company, while 93% believe that their work contributes to the company's success (Berniak-Wozny et al., 2023). In SMEs, managers often personally know all their employees, so employee well-being is particularly emphasized. Investing in employees boosts their morale. The community is a very important stakeholder for SMEs, so investment in community development and environment preservation are highly important areas of SMEs in terms of CSR. Constant interaction with the community enables SMEs to meet community needs in the best possible way (Turyakira, 2017). Some CSR initiatives include volunteering, charitable donations and waste reduction programs. SMEs expect these investments in the local community to improve their reputation, attract and retain talented workforce, foster good relationships with suppliers, and enhance access to funding sources (investors and banks). The long-term survival of SMEs depends on loyal customers. Recently, they have become more demanding regarding companies' socially responsible behavior (Dias et al., 2018). Human capital and close relationships with the community are crucial for SMEs if they want to survive in the market and improve their business (Coppa & Sriramesh, 2013). Besides that, SMEs sometimes begin to implement CSR because they are part of a supply chain, where it is expected that all participants fulfil certain demands to satisfy client interests and maintain business relationships (Amaeshi et al., 2016).

SMEs have certain advantages in implementing CSR compared to large companies. SMEs are flexible and can quickly adapt to changes, so in some situations, they can implement CSR activities better than large companies (Sarfraz et al., 2018). Through the implementation of CSR, SMEs can gain access to innovations, ensure long-term survival and adapt to new business circumstances (Sarfraz et al., 2018). Moreover, CSR can facilitate access to funding sources, because of the growing significance of socially responsible investing (Bhattacharyya

& Kumar, 2022). Motivated and happy employees, improved market position, cost reduction, energy savings, increased customer loyalty, strong ties with the community and suppliers, access to innovations, enhanced reputation, improved business performance are just some of many advantages SMEs can achieve through CSR implementation (Arsić et al., 2020; Turyakira, 2017). Reporting on CSR is not a legal obligation for SMEs, allowing them to use simple and effective means of internal and external communication.

On the other hand, there are some obstacles to CSR implementation in SMEs (Vo, 2011; Fitjar, 2011). The necessary information for CSR implementation may not be available on time due to insufficient time and knowledge. Entrepreneurs may be internally oriented, with a strong need for self-actualization, which can lead to neglecting the needs of other stakeholders. Informal organization and a focus on owners can push CSR implementation down the priority list. These activities are informal and may occur only periodically, due to a lack of financial resources, time or personnel. There are significant challenges in changing the organizational culture to incorporate principles of CSR, measuring and quantifying the benefits of CSR implementation and the absence of institutional support. Additionally, SMEs have fewer CSR instruments available, less formal CSR strategies, fewer resources for investing in CSR activities and rarely report about CSR activities (Vo, 2011).

2.2. Experience from developing countries

The structure and characteristics of SMEs in developing countries differ from those generally accepted in developed countries, requiring additional attention to the specific characteristics and contributions of CSR implementation in SMEs. Most SMEs do not accept that implementation of CSR can lead to increased efficiency (Dey et al., 2018). Due to the vast number of SMEs in developing countries, and globally, their impact on the community and the environment is significant. Many SMEs operate in sectors characterized by the generation of large amounts of waste. Environmental NGOs primarily focus their activities on large companies, so SMEs often neglect their responsibility toward the environment. They are not required to implement specific social and environmental standards that are prerequisites for entering the global market. Some of the most egregious human rights violations, such as child labor, forced labor, sexual abuse, and human trafficking, have been recorded in SMEs in developing countries (Jamali et al., 2017). This often occurs due to a lack of regulations, proper oversight, and law enforcement. To enhance CSR implementation in SMEs in developing countries, it is necessary to provide institutional support for the implementation of formal CSR activities so that both SMEs and the broader community can benefit.

Authorities, international organizations and business associations play a particularly important role in the adoption and implementation of CSR in SMEs in developing countries (Aya Pastrana & Srirameshb, 2014). Authorities can promote the need to adopt the new concept and ensure its implementation by introducing specific regulations. International organizations have the resources (knowledge, funds) and influence that can be used to encourage authorities to support CSR implementation. Business associations have up-to-date information on market needs and trends, and they can leverage their developed networks to raise awareness of the benefits of socially responsible business practices. Various international organizations (UN Global Compact, UN Industrial Development Organization, Inter-American Development Bank, World Bank) have already formulated different guidelines and instructions to help SMEs implement CSR in their business (Lund-Thomsen et al., 2013).

2.3. The case of Serbia

With the beginning of the economic transition, the concept of CSR started being applied in Serbia, primarily in companies with foreign capital, where CSR most commonly appeared in the form of philanthropy. By establishing their branches in Serbia, MNCs influenced the promotion of the CSR concept, which was already an integral part of their parent companies' operations. However, many companies in Serbia still lack sufficient knowledge about the benefits of CSR, as they view it as an activity requiring investment that does not bring profit (Stojanović et al., 2021). The process of joining the EU has impacted the recognition and promotion of CSR. Greater application of environmental protection practices (such as water management, global warming, and climate change) is necessary due to the opening of Chapter 27 'Environment and Climate Change' in the process of EU accession negotiations. Increased interest in this area may also be a result of the cooperation between the UN Development Programme, the Government of the Republic of Serbia, and international donors, which has provided financial and technical assistance for the development of green entrepreneurship in around 30 domestic companies, to create new jobs and retain qualified personnel (Madžar & Brkljač, 2023). The establishment of the Responsible Business Forum in 2008 and the adoption of the Strategy for the Development and Promotion of Socially Responsible Business in the Republic of Serbia for the period from 2010 to 2015 increased awareness of the benefits of CSR implementation. In 2016, the national Responsible Business Index was developed, representing the first national platform that enables the assessment of CSR in Serbia. It is the only methodology that allows an objective comparison of company performance in the context of CSR (Arsić et al., 2020). This index provides insight into the level of development of CSR practices in Serbia and simultaneously enables companies to identify their strengths and weaknesses to improve their business based on sustainability principles.

Recent research on large companies in Serbia has shown that the most important CSR activities are focused on environmental protection and consumers (Mijatović et al., 2021). The majority of large companies in Serbia strategically apply the concept of CSR, actively taking responsibility and contributing to the community. However, this practice is primarily seen in large companies with foreign ownership, which are part of MNCs. Recently, companies have begun developing their own CSR practices focused on environmental protection, sponsoring local communities, and fostering the professional development of young people, among other initiatives (Marić et al., 2021). In 2016, the top 100 companies in Serbia based on revenue identified the most significant CSR areas as environmental protection, support for education, health, sports, and volunteering (Mijatović et al., 2021). Nevertheless, a lack of financial resources and the uncertainty associated with long-term planning have been identified as the most significant causes of insufficient commitment to CSR in Serbian companies (Krstić et al., 2018). Additionally, research on SMEs in Serbia identified the lack of government support, low employee motivation, and insufficient information about social responsibility as major obstacles to the effective implementation of CSR (Arsić et al., 2020).

Internal CSR and business ethics have received little attention in Serbia. Although there is a lack of implementation of ethical codes and frequent examples of unethical behavior by managers toward employees are noticed, the position of employees is improving. Since 2013, there has been a significant increase in investment in employee education and professional development, as well as improvements in health and safety standards that go beyond legal requirements (Damnjanović, 2019).

Several measures have been recommended to encourage CSR practices in Serbia (Ivanović-Đukić, 2011). A national body responsible for promoting and developing CSR through specific programs and measures could provide substantial support for Serbian companies. Organizing conferences, forums, and events to enhance CSR practices would offer companies additional information on current development trends and tools for implementing such programs. Institutional support should be improved by proposing and adopting laws that introduce mandatory international and national CSR standards, with close monitoring of CSR-related laws implementation. Tax breaks, along with financial and non-financial rewards, could be offered as incentives for socially responsible companies. Public companies could be restructured to operate based on CSR principles. Schools and universities could enrich their curricula by introducing CSR courses.

Some of these elements have been noticed in recent years in Serbia, such as the organization of the annual CSR&ESG Forum (organized by Smart Kolektiv and the Forum for Responsible Business), the establishment of awards like ‘Champions of Sustainability’ and ‘Most Inclusive Employer’ (organized by Smart Kolektiv and the Forum for Responsible Business), the publication of the annual edition ‘Leaders of Social Responsibility’ (Business Info Group), the publication *CSR in Serbia – Status Analysis and Examples of Good Practice* (Smart Kolektiv, USAID, Forum for Responsible Business, Institute for Sustainable Communities), and the inclusion of CSR courses as elective or mandatory courses at universities.

2.4. Hypothesis development

In general, large companies advanced more in implementing CSR than SMEs (Baumann-Pauly et al., 2013). Even though the research on CSR in SMEs has been growing in recent years, it has been noted that the literature does not offer a coherent theory on the topic. There is no generally accepted model for researching the relationship between SMEs and CSR, so these studies are fragmented and underdeveloped (Dias et al., 2018). In particular, there is limited research on the implementation of internal and external CSR in SMEs.

A large study covering 51 countries and approximately 2500 companies (both large and SMEs) demonstrated that SMEs can gain more benefits from the implementation of CSR compared to large companies, particularly in terms of reducing financing costs, retaining and attracting quality workers, and increasing innovation (Gangi et al., 2018). Ahsan and Khalid (2024) showed that the positive effects of external CSR on employee performance can be enhanced when both external and internal CSR activities are implemented simultaneously.

Some previous research showed that internal CSR has higher importance for SMEs than external CSR (Dias et al., 2018). Aras-Beger and Taskin (2021) concluded that employees and improving working conditions are equally relevant for both SMEs and large companies. D’Amato and Falivena (2019) found that there are significant differences in CSR implementation between large companies and SMEs, while assessing 252 companies in Western Europe countries. In contrast to these results, Dias, Rodrigues, Craig, and Neves (2018) found in their study in Portugal that there is no statistically significant difference in the assessment of CSR, internal and external CSR between large companies and SMEs. They argue that the only differences lie in the ranking of external stakeholders, with SMEs prioritizing the local community and consumers, while large companies are more dedicated to the environment and society as a whole. Their conclusion is consistent with the findings of

Sung, Lim and Lee (2021), who showed that the CSR activities of large companies are more focused on national programs, while the CSR activities of SMEs are directed towards local programs. Based on previous research findings, the following hypotheses were formulated:
Hypothesis H1: There is a statistically significant difference in the employees' assessment of internal CSR between SMEs and large companies.

Hypothesis H2: There is a statistically significant difference in the employees' assessment of external CSR between SMEs and large companies.

3. METHODOLOGY

The data were collected using a questionnaire that had two sections. The first section included questions about respondents' gender, age, education, work experience, position in the company, company size. The second section was a CSR scale, which was created based on the work of several authors (Zlatanović et al., 2024; Hur et al., 2019; El Akremi et al., 2018; Stojanović-Aleksić et al., 2016; Pérez & Rodríguez del Bosque, 2012; Turker, 2009). It had 24 items, with eight dedicated to employees, eight to customers and eight to the local community and the environment. The items referring to employees were used to assess internal CSR, while those referring to customers, the local community and the environment were used to assess external CSR. All items were rated on a five-point Likert-type scale, ranging from 'strongly agree' to 'strongly disagree'. The data were analyzed using the SPSS program. Cronbach's alpha coefficient was calculated to test the reliability of variables. Descriptive analysis and independent samples t-tests were conducted to test the hypothesis.

The sample comprised 136 respondents, 67 were employed in SMEs, while 69 were employed in large companies. In SMEs, 58.2% respondents were male, compared to 49.3% in large companies. Most respondents were aged 31 to 40 in both SMEs (58.2%) and large companies (53.6%). Non-managerial staff comprised 23.9% of respondents in SMEs, while in large companies, non-managerial staff made up 26.1%. Most respondents had 6 to 15 years of work experience, with 58.2% in SMEs, 49.2% in large companies.

4. RESULTS AND DISCUSSION

All the scales demonstrated high internal consistency and reliability, as the Cronbach's alpha coefficient for all scales exceeded the minimum value of 0.70 (DeVellis, 2003). The Cronbach's alpha coefficient for the internal CSR was 0.84 and for external CSR, it was 0.92. Descriptive statistics were calculated separately for SMEs and large companies, with the results presented in Table 1. For the SME subsample, the descriptive analysis showed the highest mean value for the assessment of internal CSR. In the subsample of large companies, the highest mean value was for the assessment of external CSR. The greatest homogeneity in respondents' attitudes was observed for the assessment of internal CSR in SMEs. In large companies, the highest level of homogeneity was found for both the assessment external CSR.

Table 1. *The results of descriptive analysis*

Company size		N	Min	Max	Mean	Std. Dev.	Var.
SMEs	Internal CSR	67	2.00	5.00	4.00	0.66	0.44
	External CSR	67	1.31	5.00	3.71	0.71	0.51
Large company	Internal CSR	69	1.75	5.00	4.07	0.73	0.53
	External CSR	69	2.44	5.00	4.13	0.64	0.41

To determine whether the difference in means is significant and to test hypothesis, an independent samples t-test was conducted. Levene's test for equality of variances confirmed the assumption of equal variances ($p > 0.05$). The results of this analysis are given in Table 2.

Table 2. Comparison of employees' assessments of CSR between employees in SMEs and employees in large companies – results of independent samples t-tests

t-test for Equality of Means								
Variable	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference		Eta square
						Lower	Upper	
Internal CSR	-0.56	134	0.58	-0.07	0.12	-0.30	0.17	/
External CSR	-3.57	134	0.00	-0.41	0.12	-0.64	-0.18	0.09

The results indicate a statistically significant, moderate difference was found in the assessment of external CSR between employees in SMEs and those in large companies, thereby supporting hypothesis H2. In contrast, it was determined that there is no statistically significant difference in the assessment of internal CSR between employees in SMEs and those in large companies, meaning that hypothesis H1 was not supported.

These findings indicate that internal CSR is equally relevant for both types of companies, which is consistent with similar studies (Aras-Beger & Taskin, 2021; Dias et al., 2018). Additionally, these research findings align with several studies that found no statistically significant difference in the assessment of internal CSR between large companies and SMEs (Sung et al., 2021; Dias et al., 2018). However, research findings suggest a statistically significant difference in the assessment of external CSR between large companies and SMEs, which contrasts with several studies (Sung et al., 2021; Dias et al., 2018). Research conducted in Spain showed that the intensity of CSR activities increases with the size of the company (Sanchez-Infante Hernandez et al., 2020).

5. CONCLUSIONS AND RECOMMENDATIONS

SMEs differ from large companies in many ways, including the amount of available resources, strategies, motives, the importance of managerial values, the level of involvement, and the prioritization of stakeholders (Coppa & Sriramesh, 2013). These factors influence the creation of different perceptions and practices of CSR in SMEs compared to large companies. Since SMEs' differ significantly from large companies, it is necessary to develop tailored tools, guidelines, and standards specifically for SMEs, as such CSR support already exists for large companies.

The findings of this research showed a statistically significant difference in CSR between SMEs and large companies. These results indicate that SMEs in the Republic of Serbia lag in the implementation of CSR compared to large companies, and that support is needed for SMEs to improve their business through the application of CSR practices. Additionally, SMEs could enhance their application of CSR by joining the Forum for Responsible Business (Damnjanović & Rendulić-Davidović, 2019), as it provides support for SMEs in several areas. Nevertheless, continued promotion of CSR is necessary for society to fully benefit from its implementation.

The findings of this research add significant insights into the field of CSR implementation in SMEs in a developing country. Studying this issue in a national context contributes to the domestic professional literature and opens up new research questions. The practical contribution of this research lies in highlighting the current level of CSR in SMEs and underscoring the need for further development. The results of this research could be used to create various support programs for SMEs to facilitate CSR implementation and provide them an opportunity to benefit from its advantages.

The limitation of this study refers to the sample size and used method for data collection. A larger sample size could allow for more general conclusions. Since the attitudes of employees were investigated, a questionnaire was an appropriate method for data collection. However, as it was distributed via email, it was not possible to provide additional explanations regarding the items used in the questionnaire. Nevertheless, this is the most common method for collecting data in this type of research. Future research could include interviews with employees to obtain more detailed information.

REFERENCES

- Ahsan, M.J. & Khalid, M.H. (2024). Linking corporate social responsibility to organizational commitment: the role of employee job satisfaction, *Journal of Global Responsibility*, Vol. ahead-of-print No. ahead-of-print. doi:10.1108/JGR-01-2023-0012
- Amaeshi, K., Adegbite, E., Ogbechie, C., Idemudia, U., Kan, K.A.S., Issa, M., & Anakwue, O.I.J. (2015). Corporate Social Responsibility in SMEs: A Shift from Philanthropy to Institutional Works?. *Journal of Business Ethics*, 138(2), 385–400. doi:10.1007/s10551-015-2633-1
- Aras-Beger, G. & Taskin, F.D. (2021). Corporate social responsibility (CSR) in Multinational Companies (MNCs), Small-to-Medium Enterprises (SMEs) and Small Businesses. In Crowther, D., & Seifi, S. (eds.) *The Palgrave Handbook of Corporate Social Responsibility* (791-815). doi:10.1007/978-3-030-42465-7
- Arsić, S., Vasković, S., Milošević, I., Stojanović, A., Mihajlović, I. (2020). Employees' attitude towards CSR in SMEs in Eastern Serbia. In Szikora, P. (ed) *MEB — 17th International Conference on Management, Enterprise, Benchmarking Proceedings* (5-14), Óbuda University, Keleti Faculty of Business and Management, Budapest, Hungary. ISBN 978-963-449-127-9
- Aya Pastrana, N., & Sriramesh, K. (2014). Corporate Social Responsibility: Perceptions and practices among SMEs in Colombia. *Public Relations Review*, 40(1), 14–24. doi:10.1016/j.pubrev.2013.10.002
- Baumann-Pauly, D., Wickert, C., Spence, L.J., Scherer, A.G. (2013). Organizing Corporate Social Responsibility in Small and Large firms - size matters. *Journal of Business Ethics*. 115(4), 693–705. doi:10.1007/s10551-013-1827-7
- Berniak-Wozny, J., Kwasek, A., Gasinski, H., Maciaszczyk, M. & Kocot, M. (2023). Business Case for Corporate Social Responsibility in Small and Medium Enterprises —Employees' Perspective. *Sustainability*, 15, 1660. doi:10.3390/su15021660
- Bhattacharyya, A. & Kumar, A. (2022). Corporate Social Responsibility and SME Value Creation, *Australasian Accounting, Business and Finance Journal*, 16(6), 45-69. doi:10.14453/aabfj.v16i6.04
- Coppa, M., & Sriramesh, K. (2013). Corporate social responsibility among SMEs in Italy. *Public Relations Review*, 39(1), 30–39. doi:10.1016/j.pubrev.2012.09.009

- Damnjanović, M. & Rendulić Davidović, G. (2019). Primena koncepta korporativne društvene odgovornosti u malim i srednjim preduzećima u Srbiji. U A. Veljović (ur.). *Zbornik radova ITOP19* (355-362). Čačak: Fakultet tehničkih nauka
- Damnjanović, M. (2019). Investing in Employees in Serbian Companies - Internal Dimension of CSR. In Milković, M., Seljan, S., Pejić Bach, M., Peković, S., Perovic, Đ., (eds.). *Proceedings of the ENTRENOVA - ENTERprise REsearch INNOVATION Conference*, 5(1), 441-448. IRENET, Zagreb, Croatia.
- D'Amato, A., & Falivena, C. (2019). Corporate social responsibility and firm value: Do firm size and age matter? Empirical evidence from European listed companies. *Corporate Social Responsibility and Environmental Management*. 1–16. doi:10.1002/csr.1855
- DeVellis, R.F. (2003) *Scale development: Theory and applications* (2nd edn). Thousand Oaks, California: Sage
- Dey, P.K., Petridis, N., Petridis, K., Malesios, C., Nixon, J.D., & Ghosh, S.K. (2018). Environmental Management and Corporate Social Responsibility Practices of Small and Medium-sized Enterprises. *Journal of Cleaner Production*, 195, 687-702. doi:10.1016/j.jclepro.2018.05.201
- Dias, A., Rodrigues, L.L., Craig, R., & Neves, M.E. (2018). Corporate social responsibility disclosure in small and medium-sized entities and large companies. *Social Responsibility Journal*. 15(2), 137-154. doi:10.1108/srj-05-2017-0090
- El Akremi, A., Gond, J.-P., Swaen, V., De Roeck, K., & Igalens, J. (2018). How Do Employees Perceive Corporate Responsibility? Development and Validation of a Multidimensional Corporate Stakeholder Responsibility Scale. *Journal of Management*, 44(2), 619–657. doi:10.1177/0149206315569311
- Fitjar, R.D. (2011). Little big firms? Corporate social responsibility in small businesses that do not compete against big ones. *Business Ethics: A European Review*, 20(1), 30–44. doi:10.1111/j.1467-8608.2010.01610.x
- Hur, W.-M., Moon, T.-W., & Choi, W.-H. (2019). When are internal and external corporate social responsibility initiatives amplified? Employee engagement in corporate social responsibility initiatives on prosocial and proactive behaviors. *Corporate Social Responsibility and Environmental Management*, 1-10. doi:10.1002/csr.1725
- Gangi, F., Meles, A., Monferrà, S., & Mustilli, M. (2018). Does corporate social responsibility help the survivorship of SMEs and large firms?. *Global Finance Journal*. 43(C). doi:10.1016/j.gfj.2018.01.006
- Ivanović-Đukić, M. (2011). Promovisanje društveno odgovornog poslovanja preduzeća u Srbiji, *Sociologija*, 53(1), 21-42. doi:10.2298/SOC1101021I
- Jamali, D., Lund-Thomsen, P., & Jeppesen, S. (2017). SMEs and CSR in Developing Countries. *Business & Society*, 56(1), 11–22. doi:10.1177/0007650315571258
- Jenkins, H. (2006). Small Business Champions for Corporate Social Responsibility. *Journal of Business Ethics*, 67(3), 241–256. doi:10.1007/s10551-006-9182-6
- Krstić, N., Trbovich, A., & Drašković, B. (2018). Evaluation the Strategic Approach to CSR in Serbia. *Teme*, g. XLII, 2, 503-521. doi:10.22190/TEME1802503K
- Lund-Thomsen, P., Jamali, D., & Vives, A. (2013). *CSR in SMEs: An Analysis of Donor-financed Management Tools*. Copenhagen Business School Centre for Corporate Social Responsibility, CBS Working Paper Series [wp]. Working Paper No. 3, 1-20. ISBN 978-87-92114-31-0
- Madžar, L. & Brkljač, M. (2023). Implementation of green marketing in corporate social responsibility on the example of companies from Serbia. In Jovanović, L., Ermakov, V. & Ostroumov, S. (eds.) *Technogenesis, green economy and sustainable development - Second International Thematic Monograph: The role of green*

- economy transition in green growth and environmental protection (pp. 87-113), Ecologica, Belgrade, Serbia
- Marić, S., Berber, N., Slavić, A., & Aleksić, M. (2021). The Mediating Role of Employee Commitment in the Relationship Between Corporate Social Responsibility and Firm Performance in Serbia. *Sage Open*, 11(3). doi:10.1177/21582440211037668
- Mijatović, I., Horvat, A. & Tošić, B. (2021). Current Practices of Corporate Social Responsibility in Serbia. In Idowu S. & Schmidpeter, R. (eds). *Current Global Practices of Corporate Social Responsibility - In the Era of Sustainable Development Goals*, (327-350) Springer, UK. doi:10.1007/978-3-030-68386-3_15
- McEvoy, O. (2023). *Number of SMEs in the European Union 2008-2023, by size*. Retrieved February 19, 2024, from <https://www.statista.com/statistics/878412/number-of-smes-in-europe-by-size>
- Pérez, A., & Rodríguez del Bosque, I. (2012). Measuring CSR Image: Three Studies to Develop and to Validate a Reliable Measurement Tool. *Journal of Business Ethics*, 118(2), 265–286. doi:10.1007/s10551-012-1588-8
- Sánchez-Infante Hernández, J.P., Yañez-Araque, B. & Moreno-García J. (2020). Moderating effect of firm size on the influence of corporate social responsibility in the economic performance of micro-, small- and medium-sized enterprises, *Technological Forecasting and Social Change, Technological Forecasting & Social Change*, 151, 119774. doi:10.1016/j.techfore.2019.119774
- Sarfraz, M., Qun, W., Abdullah, M., & Alvi, A. (2018). Employees' Perception of Corporate Social Responsibility Impact on Employee Outcomes: Mediating Role of Organizational Justice for Small and Medium Enterprises (SMEs). *Sustainability*, 10(7), 2429. doi:10.3390/su10072429
- Statistical Office of Republic of Serbia (2023). Working paper – *Enterprises in the Republic of Serbia, by size, 2022*. No.124. Statistical Office of the Republic of Serbia, Belgrade
- Stojanović Aleksić, V., Erić Nielsen, J., & Bošković, A. (2016). Social responsibility in the banking sector: Experience from Serbia. *Bankarstvo*, 45(2), 34-55. doi:10.5937/bankarstvo1602034S
- Stojanović, A., Sofranova, N., Arsić, S., Milošević, I., & Mihajlović, I. (2021). The Effects of CSR Activities on Business According to Employee Perception. *European Review*, 30(5), 1–22. doi:10.1017/S1062798721000156
- Sung, Y.H., Lim, R.E. & Lee, W.-N. (2021) Does company size matter in corporate social responsibility? An examination of the impact of company size and cause proximity fit on consumer response, *International Journal of Advertising*, 1-25. doi:10.1080/02650487.2020.1850997
- Turker, D. (2009). How Corporate Social Responsibility Influences Organizational Commitment. *Journal of Business Ethics*, 89(2), 189–204. doi:10.1007/s10551-008-9993-8
- Turyakira, P.K. (2017). Small and medium-sized enterprises (SMEs) engagement in corporate social responsibility (CSR) in developing countries: Literature review. *African Journal of Business Management*, 11(18), 464–469. doi:10.5897/ajbm2017.8312
- Zlatanović, D., Savović, S. & Nikolić, J. (2024). Corporate social responsibility, innovativeness and organisational performance in public sector: implications for international public management, *European Journal of International Management*, in press. doi:10.1504/EJIM.2023.10062628
- Vo, L.C. (2011). Corporate social responsibility and SMEs: a literature review and agenda for future research. *Problems and Perspectives in Management*, 9(4), 89-97

ACKNOWLEDGEMENT

This study was supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia, and these results are parts of the Grant No. 451-03-66/2024-03/200132 with University of Kragujevac – Faculty of Technical Sciences Čačak.

THE IMPACT OF SOCIAL MEDIA CONSUMER ENGAGEMENT AND GREENWASHING ON GREEN PRODUCT PURCHASE BEHAVIOR

Jovana Filipović*

University of Kragujevac, Faculty of Economics, jovanagolo@kg.ac.rs,
ORCID number 0000-0001-8066-164X

Abstract: Social media platforms provide companies with the opportunity to engage directly with consumers, address their environmental concerns, and foster trust through transparency. Interactive features, such as polls, Q&A sessions, and user-generated content, further enhance this engagement, thereby increasing the appeal of green products. Conversely, greenwashing constitutes a deceptive marketing strategy in which a company or organization falsely claims to be environmentally friendly or exaggerates its sustainability efforts. Given the pivotal role of social media in modern marketing and business practices, alongside the growing emphasis on sustainability as a business imperative, this paper aims to examine the impact of social media consumer engagement (comprising cognitive, emotional, and behavioral components) and greenwashing on consumer behavior regarding the purchase of green products. To achieve this aim, relevant hypotheses were formulated, and empirical research was conducted utilizing the survey method. A total of 317 questionnaires were collected, and statistical analysis was performed using confirmatory factor analysis (CFA) and structural equation modeling (SEM) through IBM SPSS and AMOS to test the hypotheses. The research findings indicate that social media consumer engagement and greenwashing significantly influence consumers' attitudes and intentions towards purchasing green products. Given that sustainability and green marketing practices are more prevalent in developed countries, this issue warrants further investigation in developing contexts, such as Serbia. The primary contribution of this research lies in its potential to offer guidelines for companies in these regions, particularly in understanding consumer behavior regarding green products.

Keywords: Consumer engagement, Greenwashing, Green marketing, Social media, Sustainability

JEL Classification: M31

* Corresponding author

1. INTRODUCTION

Social media platforms are instrumental in shaping consumer engagement with green products, functioning as both a vital communication channel and an interactive medium that bridges the gap between brands and environmentally conscious consumers. Consumer engagement, characterized by the cognitive, behavioral, and emotional connections that consumers establish with brands, is particularly significant in the context of green products. This engagement not only influences purchasing decisions but also encourages sustainable behaviors (Piligrimiene et al., 2020). The interactive nature of social media enables consumers to express their opinions and participate in discussions, thereby co-creating value with brands committed to sustainability (Gupta & Syed, 2021). Consequently, the strategic utilization of social media platforms can strengthen consumer commitment to green products, foster brand loyalty, and contribute to long-term environmental benefits.

Green marketing refers to the strategic promotion of products, services, or practices that prioritize environmental sustainability and support sustainable development. This approach involves designing, advertising, and delivering offerings that reduce environmental impact, such as incorporating renewable energy, minimizing carbon footprints, or employing recyclable materials in packaging. By embedding sustainable practices into their operations, organizations address the increasing consumer demand for eco-friendly options while actively contributing to global environmental sustainability. Green marketing aligns with the principles of sustainability by emphasizing the long-term environmental, social, and economic benefits of responsible consumption, ensuring that current needs are met without depleting resources for future generations. Companies adopting this approach often establish deeper connections with eco-conscious consumers, enhance brand equity, and contribute positively to society while maintaining a competitive edge in the marketplace.

Greenwashing, defined as the practice of disseminating misleading information regarding a company's environmental initiatives or the ecological benefits of its products, has become increasingly prevalent in the digital age, particularly on social media platforms. As brands seek to capitalize on the rising consumer interest in sustainability, social media functions as a powerful vehicle for marketing narratives. However, the lack of robust oversight mechanisms to verify environmental claims significantly heightens the risk of greenwashing. Empirical research underscores that greenwashing undermines consumer trust and can lead to substantial reputational harm when discrepancies or deceptive practices are exposed (Schmuck et al., 2018).

Consumer engagement on social media—manifested through comments, reviews, and the sharing of brand content—serves as a double-edged sword. While positive interactions can enhance a brand's credibility and foster consumer loyalty, negative responses arising from perceived greenwashing can swiftly escalate into widespread public criticism, damaging brand equity (de Jong et al., 2018). This underscores the critical importance of authenticity in brand communications, as well as the value of leveraging third-party certifications to substantiate environmental claims.

As social media continues to evolve as a central platform for sustainability discourse, brands must navigate the delicate balance between promoting environmental initiatives and ensuring transparency. Maintaining this equilibrium is essential for fostering meaningful and enduring

consumer engagement while safeguarding brand reputation in an increasingly discerning marketplace.

This paper seeks to integrate the construct of consumer engagement into the context of sustainable consumption, with the objective of identifying the factors that influence sustainable consumption behavior. This topic holds particular significance in the contemporary business environment, especially in developing economies such as Serbia, where sustainability practices are less entrenched compared to developed countries.

The study is structured as follows: the initial section provides a comprehensive literature review, culminating in the formulation of research hypotheses. This is followed by a detailed explanation of the research methodology, succeeded by the presentation of empirical findings. The core contribution of the paper lies in the analysis and discussion of the results, which are examined in depth alongside concluding observations. Finally, the study acknowledges its limitations and outlines potential directions for future research, offering a foundation for further scholarly inquiry into sustainable consumption.

2. LITERATURE REVIEW

The concept of consumer engagement has been extensively examined across various disciplines. Recent research converges on defining consumer engagement as a "psychologically based willingness to invest in focal interactions with specific engagement objects" (Hollebeek et al., 2016, p. 2). It is also regarded as an indicator of a firm's dedication to its customers, its capacity to foster trust, and the critical role of customer loyalty in sustaining relationships (Nadeem et al., 2021).

Consumer engagement is conceptualized through three dimensions: cognitive, affective, and behavioral (Hollebeek, 2011a, 2011b; Dessart et al., 2015; Calder et al., 2009). The cognitive dimension, referred to as "cognitive processing," is defined as "a consumer's level of brand-related thought processing and elaboration during a particular consumer/brand interaction." The affective dimension, termed "affection," captures "a consumer's degree of positive brand-related affect in a specific consumer/brand interaction." Lastly, the behavioral dimension, labeled "activation," encompasses "a consumer's level of energy, effort, and time invested in a brand during a given consumer/brand interaction" (Hollebeek et al., 2014, p. 154). These dimensions collectively provide a comprehensive framework for understanding how consumers interact with brands and the psychological and behavioral mechanisms underpinning these interactions.

The concept of consumer engagement has been explored across various disciplines, including marketing, information systems, service management, and social psychology. Within this broad framework, social media engagement represents a context-specific manifestation of consumer engagement (Brodie et al., 2013). Social media platforms are defined as "a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0 and allow the creation and exchange of User Generated Content" (Kaplan & Haenlein, 2010, p. 61). These platforms encompass social networking sites such as Facebook and Instagram, as well as other mediums like YouTube, X (formerly Twitter), LinkedIn, and blogs.

A defining characteristic of social media in the context of consumer engagement is its capacity to facilitate direct consumer-brand interactions. This interactive environment enables

brands to connect with consumers in dynamic and meaningful ways, fostering deeper levels of engagement that are critical for building long-term relationships and enhancing brand loyalty.

Consumer engagement on social media has garnered significant scholarly attention in recent years as a predictor of consumers' purchase intentions for various products and services. Pilgrimiene et al. (2020) identify two primary groups of factors influencing consumer engagement in sustainable consumption: internal and external. The internal factors include environmental attitude, perceived responsibility, and perceived behavioral efficiency, while the external factors encompass conditions for sustainable consumption, social environment, and promotion of sustainable consumption. These factors are found to exert a direct positive influence on consumer engagement with sustainable consumption, which, in turn, positively affects the intention to purchase green products. Grounded in these theoretical foundations and prior empirical findings, the following hypotheses are proposed:

H1: Cognitive consumer engagement on social media has a positive and statistically significant effect on attitudes towards green products.

H2: Affective consumer engagement on social media has a positive and statistically significant effect on attitudes towards green products.

H3: Behavioural engagement on social media has a positive and statistically significant effect on attitudes towards green products.

The concept of greenwashing can be analyzed within the broader framework of environmental psychology, which examines the dynamic interactions between individuals and their environment (Adil et al., 2024). Greenwashing is defined as the deliberate act by firms to withhold, distort, or falsify information regarding their environmental commitments, product attributes, or operational processes (Akturan, 2018; Zhang et al., 2018). These practices are frequently driven by motives to appease environmentally conscious consumers or to enhance profitability (Hameed et al., 2021). While potentially effective in the short term, such strategies pose significant risks, including erosion of consumer trust, reputational damage, and regulatory scrutiny, thereby underscoring the critical need for transparency and authenticity in corporate environmental communications.

In the context of social media, the phenomenon of greenwashing has been extensively investigated in prior research. Ahmad and Zhang (2020) identified that consumer social responsibility, green trust, and green perceived value exert significant positive effects on green purchase intention, whereas greenwashing negatively influences such intentions. Similarly, Parguel et al. (2011) explored the impact of greenwashing on consumer behavior, highlighting the psychological mechanisms through which deceptive environmental claims affect consumer perceptions and decision-making processes. Their findings underscore the critical need to comprehend consumer responses to misleading sustainability messaging.

More recently, Adil et al. (2024) provided empirical evidence demonstrating that greenwashing directly diminishes consumers' purchase intentions while simultaneously fostering green skepticism. These insights reinforce the detrimental consequences of greenwashing on consumer trust and behavior. Building upon these findings, the following hypothesis is proposed:

H4: Greenwashing on social media has a negative and statistically significant effect on attitudes towards green products.

The purchase decision-making process is grounded in the notion that attitudes precede the intention to purchase specific products, as outlined by the Theory of Reasoned Action (TRA) (Ajzen & Fishbein, 1980) and the Theory of Planned Behavior (TPB) (Ajzen, 1991). These theoretical models posit that behavioral intentions serve as precursors to actual behavior, making them reliable predictors of human actions. This framework has been extensively applied in prior studies to predict consumer behavior in various contexts, including social media marketing (Kim & Ko, 2012) and the purchase of green products (Pop et al., 2020; Sun & Wang, 2020). By integrating attitudes, intentions, and behavior, these models provide a robust foundation for understanding the mechanisms that drive consumer decisions. In consideration of these theoretical insights, the following hypothesis has been formulated:

H5: Green products attitudes have a positive and statistically significant effect on the intention to purchase these products.

3. METHODOLOGY

The questionnaire was developed based on a comprehensive review of relevant literature and designed to address the specific requirements of research on green products. Items measuring consumer engagement on social media were adapted from the studies of Khan et al. (2022) and Hollebeek et al. (2014), while the greenwashing scale was derived from Singh et al. (2022). Constructs related to attitudes toward green products were informed by the works of Gupta and Syed (2021) and Kim and Hyun (2011), and the purchase intention scale was adapted from Kim and Ko (2012). To ensure contextual relevance, all questionnaire items, were modified to reflect the context of green products offered by companies operating within the Republic of Serbia.

The questionnaire began with an introduction explaining the purpose of the research, after which participants were asked to indicate whether they had prior experience purchasing green products. Additionally, respondents were asked about their use of social media as a source of information about companies and their green product offerings. Only responses from individuals who confirmed both their prior green products purchase experience and their engagement with social media were included in the analysis.

The survey was conducted between November 2023 and January 2024. Data were collected in person within Kragujevac and other major cities in Central Serbia, yielding a final sample of 327 valid responses.

4. RESULTS AND DISCUSSION

The analysis commenced with the construction of the research model, followed by an evaluation of its validity. Table 1 presents the validity indicators associated with the research model. Consistent with the recommendations of Bagozzi and Yi (1988), the χ^2/df ratio was required to be less than 3. Furthermore, the Goodness of Fit Index (GFI), Incremental Fit Index (IFI), Tucker-Lewis Index (TLI), and Comparative Fit Index (CFI) were expected to exceed the threshold of 0.9, as outlined by Byrne (1998). The Root Mean Square Error of

Approximation (RMSEA) value was also evaluated, with an acceptable range being below 0.08, as per the guidelines of Hair et al. (2006).

The observed values for all indicators met the prescribed thresholds, confirming that the validity criteria were satisfactorily achieved for the model under consideration. This ensures the robustness and reliability of the research model for subsequent analysis.

Table 1. *Model validity analysis*

Indicators of model validity	Research model – Local green products	Recommended value
χ^2/df	1.814	<3
GFI	0.908	>0.9
IFI	0.916	>0.9
TLI	0.924	>0.9
CFI	0.926	>0.9
RMSEA	0.058	<0.08

Source: Authors` research

The results of the confirmatory factor analysis are detailed in Table 2. Consistent with the guidelines proposed by Fornell and Larcker (1981), the Average Variance Extracted (AVE) for all constructs exceeded the recommended threshold of 0.50, thereby establishing the convergent validity of the constructs. Furthermore, the Composite Reliability (CR) values for all variables surpassed the benchmark of 0.70, aligning with Fornell and Larcker's criteria for internal consistency. Similarly, the reliability of the constructs was assessed using Cronbach's alpha, with Nunnally (1978) recommending a minimum acceptable value of 0.70. The analysis confirmed that all variables achieved Cronbach's alpha coefficients above this threshold, indicating robust reliability across the constructs. These findings collectively affirm the validity and reliability of the measurement model.

Table 2. *Confirmatory factor analysis (CFA)*

Variables	AVE, CR, α
Consumer engagement on social media	
Cognitive consumer engagement	AVE=0.651 CR=0.848 α =0.814
Using social media of my preferred green products makes me think about them often and buying them.	0.841
Using social media of my preferred green products influences my interest and desire to learn more about them.	0.798
Time flies for me when I use social media of my preferred green products, because I always want to know more about them.	0.781
Affective consumer engagement	AVE=0.657 CR=0.806 α =0.800
I feel positive when I use social media of my preferred green products.	0.832
Using social media of my preferred green products makes me happy.	0.785
I feel good when I use social media of my preferred green products.	0.814
Behavioural consumer engagement	AVE=0.714 CR=0.882 α =0.784

I spend a lot of time on social media researching my preferred green products.	0.865
When I want to search for green products on the Internet, I often use social media to do so.	0.824
In general, I feel motivated to use social media to search and buy green products.	0.846
Greenwashing on social media	AVE=0.639 CR=0.841 α =0.724
The green products I encounter often make exaggerated environmental claims on their social media.	0.791
I believe that many green products use misleading environment-friendly marketing on social media.	0.814
I am sceptical about the sincerity of environmental claims made by green products on their social media.	0.792
Attitudes towards green products	AVE=0.666 CR=0.857 α =0.772
I am willing to make a special effort to buy preferred green products.	0.746
I prefer green products over other products, if they are of similar quality.	0.824
I prefer green products over other products, even when their price is slightly higher.	0.874
Intention to buy a green product	AVE=0.642 CR=0.782 α =0.751
I would like to buy a preferred green product.	0.799
I would like to recommend my preferred green product to others.	0.803

Source: Authors' research

The results of the hypothesis testing are summarized in Table 3. The analysis reveals that all dimensions of consumer engagement exert a statistically significant influence on attitudes toward green products, thereby **confirming hypotheses H1, H2, and H3**. Among these dimensions, affective consumer engagement demonstrates the strongest effect on attitudes toward green products ($\beta = 0.324$, $p < 0.001$), followed by cognitive engagement ($\beta = 0.254$, $p < 0.001$) and behavioral engagement ($\beta = 0.212$, $p < 0.001$). In contrast, greenwashing is found to have a significant negative impact on attitudes toward local green products ($\beta = -0.211$, $p < 0.001$), **providing support for hypothesis H4**. These findings highlight the pivotal role of consumer engagement in fostering positive attitudes toward green products, while simultaneously emphasizing the detrimental effects of greenwashing on consumer perceptions.

Table 3. SEM analysis

	Hypotheses	SE.	Hypothesis testing result
H1:	Cognitive consumer engagement on social media → Attitudes toward green products	0.254***	Supported
H2:	Affective consumer engagement on social media → Attitudes toward green products	0.324***	Supported

H3:	Behavioral consumer engagement on social media → Attitudes toward green products	0.212***	Supported
H4:	Greenwashing on social media → Attitudes toward green products	-0.211***	Supported
H5:	Attitudes towards green products → Intention to buy a green product	0.847***	Supported

Source: Authors` research

The analysis demonstrates that attitudes toward green products exert a strong and statistically significant influence on consumers' intention to purchase green products ($\beta = 0.847$, $p < 0.001$). This finding **provides robust support for Hypothesis H5**, aligning with the principles of the Theory of Reasoned Action (TRA). The result underscores the theoretical assertion that attitudes serve as a critical determinant of behavioral intentions, further validating the applicability of TRA in the context of green product consumption.

5. CONCLUSIONS AND RECOMMENDATIONS

This study sought to examine the impact of various dimensions of social media consumer engagement (cognitive, affective, and behavioral) and greenwashing on consumer attitudes toward green products. Grounded in the Theory of Reasoned Action (TRA), the research further explored the influence of consumer attitudes on purchase intentions within the context of sustainable product consumption.

The findings reveal that all dimensions of consumer engagement exert a positive and statistically significant influence on consumer attitudes toward green products, aligning with previous research (Piligrimiene et al., 2020). Conversely, greenwashing was found to have a negative and statistically significant impact on consumer attitudes, corroborating earlier studies (Ahmad & Zhang, 2020; Adil et al., 2024; Oppong-Tawiah & Webster, 2023). Additionally, consumer attitudes were shown to have a strong and positive effect on purchase intentions, confirming that attitudes serve as a reliable predictor of actual consumer behavior. Based on these findings, all proposed research hypotheses were supported.

The intersection of sustainability and social media represents a crucial domain for promoting environmental awareness and driving collective action. Social media platforms provide powerful tools for disseminating information about sustainable practices, enabling organizations, influencers, and individuals to participate in global dialogues on environmental issues. By leveraging the interactive and visual capabilities of platforms such as Instagram, Twitter, and LinkedIn, stakeholders can amplify messages related to climate change, resource conservation, and sustainable consumption. These platforms also facilitate real-time engagement, allowing businesses to highlight their corporate social responsibility (CSR) initiatives and providing consumers with the means to hold them accountable. This dynamic fosters a culture of transparency and collaboration, encouraging the adoption of sustainable behaviors. However, challenges such as misinformation and greenwashing emphasize the need for critical evaluation and credible communication within digital environments. Social media's ability to connect diverse audiences positions it as a pivotal medium for advancing sustainability agendas and mobilizing collective efforts toward a more sustainable future.

The study is not without limitations. First, the research was geographically confined to the region of Kragujevac and Central Serbia. Future studies could expand the geographic scope to

include broader regions or multiple countries to investigate potential differences in consumer behavior toward sustainability and green marketing. Second, the selection of variables analyzed within the research model presents another limitation. Future research could incorporate additional variables, such as social media marketing activities or green knowledge, to explore their direct or moderating effects on consumer attitudes and behavior. These avenues could provide deeper insights into the multifaceted dynamics of sustainable consumption and social media engagement.

REFERENCES

- Adil, M., Parthiban, E. S., Mahmoud, H. A., Wu, J.-Z., Sadiq, M., & Suhail, F. (2024). Consumers' Reaction to Greenwashing in the Saudi Arabian Skincare Market: A Moderated Mediation Approach. *Sustainability*, 16(4), 1652. <https://doi.org/10.3390/su16041652>
- Ahmad, W., & Zhang, Q. (2020). Green purchase intention: Effects of electronic service quality and customer green psychology. *Journal of Cleaner Production*, 267, 122053. <https://doi.org/10.1016/j.jclepro.2020.122053>
- Akturan, U. (2018). How does greenwashing affect green branding equity and purchase intention? An empirical research. *Marketing Intelligence & Planning*, 36(7), 809–824. <https://doi.org/10.1108/mip-12-2017-0339>
- Bagozzi, R.P., & Yi, Y. (1988). On the evaluation of structural equation model. *Journal of the Academy of Marketing Science*, 16(1), 74–94. <https://doi.org/10.1007/bf02723327>
- Brodie, R. J., Ilic, A., Juric, B., & Hollebeek, L. (2013). Consumer engagement in a virtual brand community: An exploratory analysis. *Journal of Business Research*, 66(1), 105–114. doi:10.1016/j.jbusres.2011.07.029
- Byrne, B. M. (1998). *Structural Equation Modeling with LISREL, PRELIS, and SIMPLIS: Basic Concepts, Applications, and Programming*. Hillsdale, NJ: Lawrence Erlbaum.
- Calder, B. J., Malthouse, E. C., & Schaedel, U. (2009). An experimental study of the relationship between online engagement and advertising effectiveness. *Journal of Interactive Marketing*, 23(4), 321–331. doi:10.1016/j.intmar.2009.07.002
- de Jong, M. D. T., Huluba, G., & Beldad, A. D. (2019). Different Shades of Greenwashing: Consumers' Reactions to Environmental Lies, Half-Lies, and Organizations Taking Credit for Following Legal Obligations. *Journal of Business and Technical Communication*, 34(1), 38–76. <https://doi.org/10.1177/1050651919874105>
- Dessart, L., Veloutsou, C., & Morgan-Thomas, A. (2015). Consumer engagement in online brand communities: A social media perspective. *Journal of Product & Brand Management*, 24(1), 28–42. doi:10.1108/jpbm-06-2014-0635
- Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, 18(1), 39–50. <https://doi.org/10.2307/3151312>
- Gupta, M., & Syed, A. A. (2021). Impact of online social media activities on marketing of green products. *International Journal of Organizational Analysis*, 30(3), 679–698. <https://doi.org/10.1108/ijoa-02-2020-2037>
- Hair, J.F., Black, B., Babin, B., Anderson, R. E., & Tatham, R. L. (2006). *Multivariate Data Analysis*. 6th ed., Upper Saddle River, NJ: Prentice Hall.
- Hameed, I., Hyder, Z., Imran, M., & Shafiq, K. (2021). Greenwash and green purchase behavior: an environmentally sustainable perspective. *Environment, Development and Sustainability*, 23(9), 13113–13134. <https://doi.org/10.1007/s10668-020-01202-1>

- Hollebeek, L. (2011b). Exploring customer brand engagement: Definition and themes. *Journal of Strategic Marketing*, 19(7), 555–573. doi:10.1080/0965254x.2011.599493
- Hollebeek, L. D. (2011a). Demystifying customer brand engagement: Exploring the loyalty nexus. *Journal of Marketing Management*, 27(7–8), 785–807. doi:10.1080/0267257x.2010.500132
- Hollebeek, L. D., Conduit, J., & Brodie, R. J. (2016). Strategic drivers, anticipated and unanticipated outcomes of customer engagement. *Journal of Marketing Management*, 32(5–6), 393–398. doi:10.1080/0267257x.2016.1144360
- Hollebeek, L., Glynn, M., & Brodie, R. (2014). Consumer brand engagement in social media: Conceptualization, scale development and validation. *Journal of Interactive Marketing*, 28(2), 149–165. <https://doi.org/10.1016/j.intmar.2013.12.002>
- Kaplan, A. M., & Haenlein, M. (2010). Users of the world, unite! The challenges and opportunities of social media. *Business Horizons*, 53(1), 59–68. doi:10.1016/j.bushor.2009.09.003
- Khan, I., Hollebeek, L. D., Fatma, M., Islam, J. U., Rather, R. A., Shahid, S., & Sigurdsson, V. (2022). Mobile app vs. desktop browser platforms: the relationships among customer engagement, experience, relationship quality and loyalty intention. *Journal of Marketing Management*, 39(3–4), 275–297. <https://doi.org/10.1080/0267257x.2022.2106290>
- Kim, A. J., & Ko, E. (2012). Do social media marketing activities enhance customer equity? An empirical study of luxury fashion brand. *Journal of Business Research*, 65(10), 1480–1486. <https://doi.org/10.1016/j.jbusres.2011.10.014>
- Kim, J.-H., & Hyun, Y. J. (2011). A model to investigate the influence of marketing-mix efforts and corporate image on brand equity in the IT software sector. *Industrial Marketing Management*, 40(3), 424–438. <https://doi.org/10.1016/j.indmarman.2010.06.024>
- Nadeem, W., Tan, T. M., Tajvidi, M., & Hajli, N. (2021). How do experiences enhance brand relationship performance and value co-creation in social commerce? The role of consumer engagement and self brand-connection. *Technological Forecasting and Social Change*, 171, 120952. <https://doi.org/10.1016/j.techfore.2021.120952>
- Nunnally, J.C. (1978). *Introduction to Psychological Measurement*, New York, NY: McGraw-Hill.
- Oppong-Tawiah, D., & Webster, J. (2023). Corporate Sustainability Communication as ‘Fake News’: Firms’ Greenwashing on Twitter. *Sustainability*, 15(8), 6683. <https://doi.org/10.3390/su15086683>
- Parguel, B., Benoît-Moreau, F., & Larceneux, F. (2011). How Sustainability Ratings Might Deter ‘Greenwashing’: A Closer Look at Ethical Corporate Communication. *Journal of Business Ethics*, 102(1), 15–28. <https://doi.org/10.1007/s10551-011-0901-2>
- Piligrimiene, Ž., Žukauskaitė, A., Korzilius, H., Banytė, J., & Dovalienė, A. (2020). Internal and External Determinants of Consumer Engagement in Sustainable Consumption. *Sustainability*, 12(4), 1349. <https://doi.org/10.3390/su12041349>
- Pop, R.-A., Săplăcan, Z., & Alt, M.-A. (2020). Social Media Goes Green—The Impact of Social Media on Green Cosmetics Purchase Motivation and Intention. *Information*, 11(9), 447. <https://doi.org/10.3390/info11090447>
- Schmuck, D., Matthes, J., & Naderer, B. (2018). Misleading Consumers with Green Advertising? An Affect–Reason–Involvement Account of Greenwashing Effects in Environmental Advertising. *Journal of Advertising*, 47(2), 127–145. <https://doi.org/10.1080/00913367.2018.1452652>

- Singh, N., Gupta, K., & Kapur, B. (2022). Greenwashed word of mouth (GWWOM): a vibrant influence on customer green behaviour. *Journal of Global Responsibility*, 13(4), 472–487. <https://doi.org/10.1108/jgr-11-2021-0094>
- Sun, Y., & Wang, S. (2020). Understanding consumers' intentions to purchase green products in the social media marketing context. *Asia Pacific Journal of Marketing and Logistics*, 32(4), 860–878. <https://doi.org/10.1108/apjml-03-2019-0178>
- Zhang, L., Li, D., Cao, C., & Huang, S. (2018). The influence of greenwashing perception on green purchasing intentions: The mediating role of green word-of-mouth and moderating role of green concern. *Journal of Cleaner Production*, 187, 740–750. <https://doi.org/10.1016/j.jclepro.2018.03.201>

EXPLORING MOBILE TECHNOLOGY ADOPTION IN THE REPUBLIC OF SERBIA: IDENTIFYING CONSUMER SEGMENTS

Julija Vidosavljević*

University of Kragujevac, Faculty of Economics, jvidosavljevic19@gmail.com,
ORCID number 0009-0007-2154-6212

Abstract: *Mobile commerce is rapidly becoming a major driver of global commerce, with the potential to surpass traditional purchasing methods. As technology adoption expands, various models have emerged to explain user acceptance. While models like TAM offer foundational insights into user acceptance, they often lack the depth to address the complexity of modern consumer behavior. The UTAUT2 model expands on this by integrating factors such as hedonic motivation, price value, and habit, providing a more comprehensive framework for understanding mobile commerce adoption. Segmentation plays a critical role in this dynamic industry, helping businesses tailor strategies to diverse consumer needs. Considering the above mentioned, the aim of the paper is to identify distinct consumer segments regarding the acceptance and usage of mobile technologies, with UTAUT2 determinants serving as the foundation for segment classification. The sample consists of 210 respondents. The research was conducted in the territory of Central Serbia, from April to May 2023. Descriptive statistical analysis and cluster analysis were applied in the paper. The findings highlight the importance of customizing mobile commerce platforms for specific consumer groups. For lower-income users, strategies should focus on affordability, including discounts, flexible payment options, and easy-to-use interfaces. Educational campaigns addressing barriers like security concerns and limited technical knowledge, along with regular feedback, can further enhance offerings. This approach enables businesses to optimize platforms, ensuring they meet the needs of diverse consumer groups and improve overall user satisfaction.*

Keywords: *m-commerce, UTAUT2, consumer segments*

JEL Classification: *M31, L81*

* Corresponding author

1. INTRODUCTION

With the expansion of the internet and mobile technologies, it can be said that the business world has changed significantly over the past two decades. Lamberton and Stephen (2016, p. 152.) highlight that digital transformation in marketing is reflected “in the ways companies and consumers embrace new technologies and how technology facilitates new forms of market behavior, interactions, and experiences.” Technological advancements provide new opportunities and can create new ways for suppliers to engage consumers in co-creating innovative products and services (Payne et al., 2008). Similar to the introduction of e-commerce (Huang et al., 2015), m-commerce is significantly impacting how companies and consumers interact with each other (Omar et al., 2021). The widespread adoption of mobile devices has expanded their use, so today they are not only used for communication but also for numerous other activities, such as mobile commerce (m-commerce) (Marić & Vidosavljević, 2024).

Penetration of mobile devices in Serbia is notably high. According to the Statistical Office of the Republic of Serbia (2022), mobile device penetration reaches 123.9%, indicating there are 123 mobile devices per 100 residents. With nearly 90% of the population using mobile phones to access social networks, Serbia stands above the global average in terms of mobile device ownership. Globally, almost 7 billion people own smartphones, suggesting that around 80% of the world’s population has a smartphone, compared to Serbia’s higher rate.

The percentage of social media users in Serbia has been above 90% for years. The highest annual growth was recorded in the age group between 55 and 64 years. Most users have accounts on Facebook (89%) and Instagram (75%), while TikTok saw the highest annual growth in 2022, with a quarter of Serbia's population now having an account on the platform. Research conducted by Social Serbia (2024) shows that 51% of social media users in Serbia use it for information, 39% for searching companies and brands, while about 27% use it for online shopping.

Considering the above mentioned, the aim of the paper is to identify distinct consumer segments regarding the acceptance and usage of mobile technologies, with UTAUT2 determinants serving as the foundation for segment classification. The study seeks to better understand mobile commerce adoption patterns, allowing businesses to tailor their strategies to meet the unique needs of different consumer groups.

2. LITERATURE REVIEW

The acceptance or adoption of information technology has garnered significant attention over the past decade (Ma & Liu, 2005). Several models, mostly derived from psychology and sociology theories, have been developed to explain technology acceptance and use (Venkatesh et al., 2003). A Numerous theoretical models have been developed to explain end-users' acceptance behaviour, with the Technology Acceptance Model (TAM), introduced by Davis and colleagues (Davis, 1989; Davis et al. 1989) standing out as one of the most widely applied and empirically tested frameworks. Despite the enhancements, extensions as TAM2 and TAM 3 still explain only about 40% of the variability in information system usage. To address these limitations, Venkatesh et al. (2003) proposed the Unified Theory of Acceptance and Use of Technology (UTAUT), which has been further refined into UTAUT2 (Venkatesh et al., 2012). UTAUT2 introduced consumer-oriented factors such as hedonic motivation,

price value, and habit, making it more comprehensive for studying user behaviors. This enhanced framework serves as the basis for this study's segmentation approach, providing a structured method to classify users and better understand their acceptance and usage patterns of mobile technologies. By applying UTAUT2, the study aims to generate actionable insights into consumer behavior across varying segments.

Customer segmentation plays a vital role in the success of m-commerce, as emphasized by Bhatnagar and Ghose (2004). Similarly, the rise of m-commerce and models explaining consumer behavior became integral to online business strategies (Humbani & Wiese, 2019). By employing segmentation, marketers can achieve significant advantages, such as allocating resources more effectively, competing even with limited means, and tailoring products and services to align with the specific needs of target segments. The benefits gained from effective segmentation far surpass the investments needed for its implementation, as noted by Quinn (2009). The following papers in the domain of m-commerce explore customer segmentation by applying clustering techniques to identify distinct consumer groups based on various factors such as behavior, demographics, and preferences. Cui (2023) examined post-pandemic m-commerce behavior in China, segmenting consumers into general, purchase-focused, motivated, product-oriented, and evaluation groups. These groups were defined based on purchasing habits, motivations, and post-purchase actions. Similarly, Kargin et al. (2009) analyzed mobile service adoption preferences using conjoint and cluster analyses, identifying four segments. The study found that speed, cost, and content were critical factors influencing adoption. By clustering customers based on gender, age, income, and spending habits, e-businesses can tailor marketing and services, such as cost-effective products for low-income groups and luxury items for high-income segments Zhao (2022). These clusters are then employed to tailor promotional strategies efficiently, ensuring precise targeting of products and services. Similarly, Sarkar (2012) defines customer segments among 500 mobile users, using attributes such as like age, income, domicile, and family size. These studies, illustrate how segmentation can lead to more effective marketing strategies, personalized services, and improved customer engagement across different industries.

3. METHODOLOGY

The research was conducted in Central Serbia from May 5th to May 15th, 2023, with a sample of 210 participants segmented by gender, age, education level, employment status, and income. Data was gathered electronically, where respondents rated their agreement with statements on a five-point Likert scale (1 - strongly disagree to 5 - strongly agree). The questionnaire included 25 statements drawn from relevant studies, grouped into seven factors. To ensure representativeness, the sample's gender and employment distributions roughly mirrored the 2022 analysis of mobile commerce users by the Statistical Office of the Republic of Serbia. Of the respondents, 53.81% were female, and 46.19% male, with the majority aged 18 to 24 (35.71%) and most earning between 40,000 to 80,000 RSD monthly (36.67%). The highest level of education attained by most respondents was a university degree (44.76%). The sociodemographic analysis is presented in more detail in Table 1.

Table 1. Sociodemographics

Demographic characteristics	Number of participants	Percentage of participants
Gender		
Male	97	46.19%
Female	113	53,81%
Age		
From 18 to 24 years	75	35,71%
From 25 to 44 years	70	33.33%
Over 45 to 54 years	43	20,48%
55 and more	22	10,48%
Earnings		
Without earnings	51	24,29 %
Up to 40.000 RSD	30	24.76%
From 40.000 RSD to 80.00 RSD	77	36.67%
80.000 RSD and more	52	24,76%
Education		
High school	94	44.76%
College/University	40	50%
Master's studies	14	17.5%

Source: Author's research

Data analysis was performed using SPSS v20 statistical software. Initial analysis involved descriptive statistics (mean and standard deviation) to assess the favorability and homogeneity of respondents' attitudes towards the survey statements. In order to identify distinct consumer segments regarding the acceptance and usage of mobile technologies, the cluster analysis was conducted.

4. RESULTS AND DISCUSSION

According to the results of descriptive statistics shown in Table 2, it can be observed respondents most strongly agree with the statement: "Mobile commerce is easy to use", which has the highest mean value of 4.25. In contrast, the statement "I am one of the first to try mobile commerce" received the lowest level of agreement, with a mean value of 3.08. Respondents' attitudes are most homogeneous for the statement "Mobile commerce systems deliver on their promises", with the lowest standard deviation value of 0.94. Attitudes are most varied for the statements "Mobile commerce is useful to me in everyday life" and "Using mobile commerce helps me quickly complete transactions," both of which have the highest standard deviation of 1.24.

Table 2. Results of descriptive statistical analysis

Statements	Mean	SD
Mobile commerce is useful to me in everyday life.	3.87	1.24
Using mobile commerce helps me quickly complete transactions.	4.09	1.24
Using mobile commerce enhances my productivity.	3.81	1.22
It is easy to learn how to use mobile commerce.	4.24	1.04
Mobile commerce is easy to use.	4.25	1.05

The use of mobile commerce is clear and understandable.	4.15	1.04
Skills in using mobile commerce are easily acquired.	4.20	1.02
People who influence my behavior think I should continue to use mobile commerce.	3.63	1.15
My friends think I should continue to use mobile commerce.	3.76	1.08
Mass media influences me to use mobile commerce.	3.36	1.29
I have the resources necessary to use mobile commerce.	4.20	1.10
I have the knowledge necessary to use mobile commerce.	4.17	1.12
Using mobile commerce is compatible with other technologies I use.	4.12	1.04
I can rely on others' help when I have difficulty using mobile commerce.	4.02	1.01
I trust mobile commerce systems.	3.83	0.97
Mobile commerce systems provide services in my interest.	3.99	0.96
Mobile commerce systems deliver on their promises.	4.04	0.95
Information provided through mobile commerce systems is reliable.	3.86	1.05
I am one of the first to try mobile commerce.	3.08	1.38
I like to try new technologies.	3.82	1.23
I enjoy learning about new technologies.	3.89	1.20
Friends often ask me for advice on using new technologies.	3.53	1.30

Source: Author's research

To determine segments regarding the acceptance and use of mobile technologies, a cluster analysis was conducted. Based on the results, two segments were identified. The sizes of the segments are shown in Figure 1. Cluster 1 consists of 85 respondents, accounting for 40.5%, while Cluster 2 comprises 125 respondents, or 59.5%.

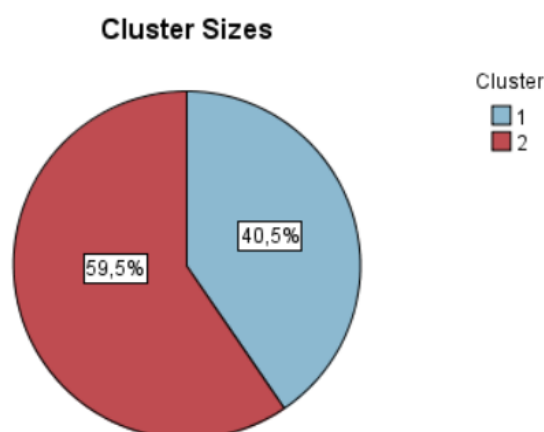


Figure 1. Cluster analysis

Source: Author's research

Table 3 presents the demographic characteristics that are dominant in the identified clusters. *Moderate Users* (Cluster 1) primarily consist of male respondents who have a high school education, and earn between 40,000 RSD and 80,000 RSD. While they use mobile technologies to some extent, their engagement with mobile commerce is less frequent, likely influenced by factors such as education level, income, or limited familiarity with mobile commerce platforms compared to the Engaged Users.

Table 3: Cluster characteristics

Clusters	Demographic characteristics		
	Gender	Education	Earnings
Moderate users	male	High school education	between 40,000 RSD and 80,000 RSD
Engaged users	female	College/University	above 80.000 RSD

Source: Author's research

In contrast, *Engaged Users* (Cluster 2) demonstrate higher levels of mobile commerce acceptance and usage. This segment is primarily composed of female respondents who possess university degree, and earn an income above 80,000 RSD. This group is more active in using mobile technologies, likely driven by higher education, professional status, and disposable income, making them more likely to engage with mobile commerce for convenience and efficiency.

5. CONCLUSIONS AND RECOMMENDATIONS

Mobile commerce is rapidly changing how people shop by offering convenience and personalized experiences. With the increasing use of mobile devices, m-commerce is becoming the preferred method for conducting electronic transactions. Understanding consumer behavior in adopting new technologies is essential for businesses. Among the evolving models in this field, the UTAUT2 model stands out as a widely used framework for analyzing why people embrace innovations such as mobile commerce. Unlike its predecessors, this model incorporates the most extensive set of variables and places a strong emphasis on consumer behavior. This makes it particularly effective for providing a comprehensive understanding of user attitudes and behavior in mobile commerce contexts. The importance of customer segmentation in mobile commerce is well-documented, with studies emphasizing its role in improving marketing strategies and product alignment with consumer needs. By using segmentation, businesses can efficiently allocate resources and tailor their offerings to target specific market segments, resulting in higher customer engagement and improved services.

Using Cluster analysis, two distinct consumer segments were identified regarding the acceptance and use of mobile technologies. The results revealed that Cluster 2 represents the Engaged Users who show higher levels of mobile commerce acceptance. This group, predominantly female, with a university education and higher income, is more active in using mobile technologies. Cluster 1 (Moderate Users), comprising is primarily composed of men with a lower level of education and lower income, showing lower levels of mobile commerce engagement.

The application of clustering techniques in m-commerce, as demonstrated by researchers (Bhatnagar & Ghose, 2004; Cui, 2023; Humbani & Wiese, 2019; Sarkar, 2012), highlights the effectiveness of segmentation in shaping more personalized marketing strategies. These studies underscore the significant benefits of segmentation in enhancing the customer experience, optimizing business outcomes, and driving growth in the mobile commerce industry.

Building on these insights, the approach to catering to different consumer segments, such as those identified in Cluster 1 (Moderate users), can further improve m-commerce accessibility.

To make mobile commerce more accessible for users in lower income ranges, platforms should focus on affordable options and flexibility. Price-sensitive products can be offered with regular discounts, sales, and cashback promotions, and create dedicated sections for affordable essentials to ensure value for money. Flexible payment plans can be implemented, such as installment options or “buy now, pay later” schemes, to make higher-priced items more accessible, while prominently featuring small-ticket items that won’t strain their budget. To further improve affordability, offer low-cost or free shipping on essential items and provide local pick-up points as an alternative to reduce delivery fees. In order to cater the needs of Cluster 1, mobile commerce platforms should focus on providing straightforward content that is easy to understand. This can mean avoiding overly complex product descriptions, and instead offering simple guides, Frequently Asked Questions (FAQs), or video tutorials to explain how products, services, or the app itself works. Additionally, clear and concise product information should be emphasized, with direct, no-frills descriptions that highlight key features and practical benefits, eliminating unnecessary complexity. The platform should also feature a user-friendly interface with an intuitive design, clear icons, and simple navigation, making it easy for users to find what they need without confusion. To appeal to male consumers, mobile commerce platforms should focus on practical, utility-driven product categories such as electronics, gadgets, tools, automotive accessories, sports equipment, and fashion items. These products should be complemented by features, like mobile-optimized search, product comparison tools, and easy access to technical specifications, catering to a more tech-aware audience. Additionally, platforms should highlight time-saving solutions such that fit into busy lifestyles. This combination of relevant products and functional features will enhance the overall user experience for this demographic.

Engaged Users, predominantly composed of female respondents with higher education and income, show a higher level of mobile commerce adoption. For this segment, marketing campaigns should focus on convenience and efficiency, highlighting premium services such as fast shipping, personalized product recommendations, and loyalty rewards. Providing exclusive offers or early access to new products can further engage this group, as they are likely more tech-savvy and accustomed to utilizing mobile technologies for shopping. Offering features like easy navigation, seamless payment options, and high-quality customer service will resonate with their preferences for a premium mobile commerce experience.

For both segments, educational campaigns should address common barriers, such as security concerns or lack of technical knowledge, and highlight the benefits of mobile commerce. Finally, gathering regular feedback from both segments will help businesses refine their offerings and remain responsive to consumer needs.

The conducted research has several limitations. The study was conducted with a relatively small sample size of 210 participants. Additionally, the study focused on a specific set of demographic and socio-economic variables, which may not account for all factors influencing mobile commerce behavior. Considering these limitations, future research can include more participants, and, potentially participants from other countries. To address the limitations mentioned, other psychological, cultural, or situational factors could be included.

REFERENCES

- Bhatnagar, A., & Ghose, S. (2004). A latent class segmentation analysis of e-shoppers. *Journal of Business Research*, 57(7), 758-767. [https://doi.org/10.1016/S0148-2963\(02\)00357-0](https://doi.org/10.1016/S0148-2963(02)00357-0)
- Chong, A.Y.L. (2013). Predicting m-commerce adoption determinants: A neural network approach. *Expert Systems with Applications*, 40(2), 523-530. <https://doi.org/10.1016/j.eswa.2012.07.068>
- Cui, Z. (2023). Clustering-Based Analysis of E-commerce Customers' Consumption Behavior in the Post-epidemic Period, In book: 4th International Conference on E-Commerce and Internet Technology (ECIT 2023), 30-35. https://doi.org/10.2991/978-94-6463-210-1_5
- Davis, F.D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *MIS Quarterly*, 13 (3), 319-340. <https://doi.org/10.2307/249008>
- Davis, F.D., Bagozzi, R.P., & Warshaw, P.R. (1989). User Acceptance of Computer Technology: A Comparison of Two Theoretical Models. *Management Science*, 35 (8), 982-1003. <https://doi.org/10.1287/mnsc.35.8.982>
- Huang, E. Y., Lin, S.-W., & Fan, Y.-C. (2015). M-S-QUAL: Mobile service quality measurement. *Electronic Commerce Research and Applications*, 14(2), 126-142. <https://doi.org/10.1016/j.elerap.2015.01>
- Humbani, M., & Wiese, M. (2019). An integrated framework for the adoption and continuance intention to use mobile payment apps. *International Journal of Bank Marketing*, 37(2), 646-664. <https://doi.org/10.1108/IJBM-03-2018-0072>
- Kargin, B., Basoglu, N., & Turgul, B. (2009). Exploring Mobile Service Adoption: Customer Preferences, 42st Hawaii International International Conference on Systems Science (HICSS-42 2009), Proceedings (CD-ROM and online), 5-8 January 2009, Waikoloa, Big Island, HI, USA, 1-8. <https://doi.org/10.1109/HICSS.2009.211>
- Lamberton, C., & Stephen, A. T. (2016). A Thematic Exploration of Digital, Social Media, and Mobile Marketing: Research Evolution from 2000 to 2015 and an Agenda for Future Inquiry. *Journal of Marketing*, 80(6), 146-172. <https://doi.org/10.1509/jm.15.0415>
- Ma, Q., & Liu, L. (2005). The Technology Acceptance Model: A Meta-Analysis of Empirical Findings. In M. Mahmood (Ed.), *Advanced Topics in End User Computing*, Volume 4 (pp. 112-128). IGI Global. <https://doi.org/10.4018/978-1-59140-474-3.ch006>
- Marić, D., & Vidosavljević, J. (2024). Understanding the determinants of continuous intention to use m-commerce: Application of the adapted UTAUT model. *Marketing*, 55(1), 5-16. <https://doi.org/10.5937/mkng2401005M>
- Nunnally, J. C. (1978). *Introduction to psychological measurement*, New York: McGraw-Hill
- Omar, S., Mohsen, K., Tsimonis, G., Oozeerally, A., & Hsu, J.-H. (2021). M-commerce: The nexus between mobile shopping service quality and loyalty. *Journal of Retailing and Consumer Services*, 60, 1-15. <https://doi.org/10.1016/j.jretconser.2021.102468>
- Payne, A.F., Storbacka, K., & Frow, P. (2008). Managing the co-creation of value. *Journal of the Academy Market Sciences*, 36, 83 - 96. <https://doi.org/10.1007/s11747-007-0070-0>
- Quinn, L. (2009). Market segmentation in managerial practice: a qualitative examination. *Journal of Marketing Management*, 25, (3-4), 253-272. <https://doi.org/10.1362/026725709X429746>

- Sarkar, D. (2012). A Noble Approach of Clustering the Users in M-Commerce for Providing Segmented Promotion of Goods & Services Using K-means Algorithm. *International Conference on Computer Technology and Science (ICCTS 2012) IPCSIT, IACSIT Press, Singapore*, 96-100. <https://doi.org/10.7763/IPCSIT.2012.V47.19>
- Social Serbia (2024). Istraživanje stanja društvenih mreža u Srbiji <https://pioniri.com/sr/socialserbia2024/> datum pristupa: 05.09.2024.
- Tak, P., & Panwar, S. (2017) Using UTAUT 2 model to predict mobile app based shopping: evidences from India. *Journal of Indian Business Research*, 9 (3), 248-264. <https://doi.org/10.1108/JIBR-11-2016-0132>
- Venkatesh, V., Morris, M., Gordon B. Davis, G., & Davis, F. (2003). User Acceptance of Information Technology: Toward a Unified View. *MIS Quarterly*, 27 (3), 425-478. <https://doi.org/10.2307/30036540>
- Venkatesh, V., Thong, J.Y.L., & Xu, X. (2012). Consumer Acceptance and Use of Information Technology: Extending the Unified Theory of Acceptance and Use of Technology. *MIS Quarterly*, 36(1), 157-178. <https://doi.org/10.2307/41410412>
- Zhao, B. (2022). Research on Using Market Segmentation to do Recommendation in E-commerce. *BT - Proceedings of the 2022 7th International Conference on Financial Innovation and Economic Development (ICFIED 2022)*, 3017-3022. <https://doi.org/10.2991/aebmr.k.220307.492>

GLOBALIZATION AND REGIONALIZATION

INTERNATIONAL TRANSFER OF DEFENSE TECHNOLOGIES

Ganna Duginets*

State University of Trade and Economics, e-mail: g.duginets@knote.edu.ua
ORCID number 0000-0003-3708-3666

Kostiantyn Nizheiko

State University of Trade and Economics, e-mail: k.nizheyko@knote.edu.ua
ORCID number 0000-0002-2925-1140

Abstract: *Export of various defense products and technologies is an important aspect of international technology transfer in the twenty-first century. The formation of international consortia, which build up licensed production of foreign military equipment in developing countries on the basis of these technologies, is an important characteristic of the current environment. Studying the theoretical foundations and practical aspects of international technology transfer, as well as its specific features and trends in the military-industrial sector, are of particular scientific and practical interest, as a result. The related issue of improving the mechanisms for coordinating the activities of states in the procurement and production of military equipment has led to strengthening and increasing the sustainability of international flows of military goods and services. The first part of this paper considers the existing forms and mechanisms of international transfer of military equipment production technologies, as well as foreign experience in managing military production. For Ukraine, domestic production of military equipment is important not only for the ongoing fight against the aggressor state, but also for stimulating economic growth and strengthening the international image of Ukraine. Therefore, the second part of the paper will discuss international technology transfer as one of the vectors of innovative development of the Ukrainian economy. Based on the results of the study, the authors propose measures aimed at improving the efficiency of Ukrainian companies' inclusion in international structures for the production and distribution of weapons and military equipment*

Keywords: *technologies, transfer, weapon, defense, development.*

JEL Classification: *F10, F52, O52*

* Corresponding author

1. INTRODUCTION

International technology transfer in the production of weapons and military equipment allows countries to modernize their defense systems, introduce the latest technologies and improve production efficiency. This process is also an important mechanism for innovative development, increasing competitiveness in the global market and modernizing Industrial Sectors based on the transfer of knowledge, technologies, innovative solutions and experience from one country to another. Such cooperation helps states develop defense capabilities, adapt foreign technologies to their own needs, and integrate into global arms markets. It should be noted that each of the forms of international technology transfer has its own unique features, which differ in the mechanism of implementation, the level of participation of partner countries and the impact on the economy and defense capability of states. And their thorough analysis allows us to understand how countries exchange military technologies, what factors contribute to effective cooperation and how this affects global security and the arms market, taking into account the peculiarities of the existing external environment.

2. LITERATURE REVIEW

The international transfer of defense technologies refers to the cross-border exchange of military-related knowledge, systems, and capabilities between nations, corporations, or organizations. This phenomenon has significant implications for global security, economic development, and geopolitical dynamics. So, research on the international transfer of defense technologies covers a wide range of topics, including economic, political, technical, and legal aspects of this process. For example, a group of authors study the legal aspects of international transfer of defense technologies, such as how intellectual property rights are transferred in these processes (Bellais & Guichard, 2006), or how to address the highly regulated nature of the defense sector (Mendoza, 2007). Another group of scholars analyzes how the international transfer of defense technologies affects the innovative development of partners, as well as how these processes contribute to strengthening international security in regions or in the world as a whole (Aripuro et al, 2024, Tian, Nan, et al 2024). There is also a significant number of publications in which the authors consider specific examples of countries' participation in international transfer of defense technologies projects (Lundmark, 2016, Cheung et al, 2019, Farkas, 2023, Valkanov, 2024). These studies are aimed at identifying the benefits and risks in each specific case, since in addition to significant economic benefits, it is necessary to constantly find a consensus on different national interests, technical coordination of standards, and possible competition in the future on the global arms market.

It should be noted that with the beginning of the full-scale Russian invasion of Ukraine, the vector of consideration of this issue in Ukrainian science is shifting towards the issue of military assistance, the consequences of this war and ways to resolve this confrontation. Thus, in the national literature, there are only a few references to military partnership as one of the main factors of scientific and technical development of the military-industrial complex. Thus, preliminary studies of the existing developments in the world science have made it possible to draw certain conclusions. Thus, it is relevant to define the process of international transfer of military technologies as one that contributes to strengthening military relations between states, preserving and maintaining defense production potential by stimulating research and development work on the creation of new and modernization of existing models of weapons and military equipment.

3. METHODOLOGY

The study uses a complex of complementary methods of scientific identification of economic processes and phenomena: the system-structural, comparative and statistical analysis, and the informational, process and institutional approaches. The information base of the research is formed by statistical and analytical materials and informational and analytical collections, bulletins and reviews, made public by such sources as the Organization for Economic Cooperation and Development, World Bank Group, European Bureau of Statistics, Ukrainian and foreign research centers, factual information provided by state authorities, a wide range of domestic and foreign literary sources, and results of own research.

4. RESULTS AND DISCUSSION

International transfer of military technology plays an important role for all countries, regardless of their size and military power. This kind of cooperation helps countries reduce defense spending and improve their security, while achieving greater impact in performing defense tasks. It should also be noted that most countries of the world have limited resources for conducting research, so the exchange of technologies is attractive for participants because:

- joint defense projects and programs can reduce costs. This is especially important for small countries, which may find it difficult to spend heavily on military infrastructure. By combining the resources and expertise of several countries, it is possible to create more efficient and modern military technologies.
- joint defense efforts lead to the development of more advanced military systems and strategies. This increases the overall level of efficiency and provides countries with more confident means of defense.
- the international transfer of military technologies contributes to the creation of collective defense alliances and treaties that strengthen collective security. This contributes to stability and promotes compliance with international norms and regulations.
- joint international defense projects may also include humanitarian aspects such as peacekeeping operations and humanitarian assistance in conflict zones. This contributes to the protection of civilians and the reduction of humanitarian crises.
- international transfer of military technologies improves diplomatic relations between countries, helping to resolve conflicts and reduce tensions in international relations.

It should be noted that in world practice there are several main mechanisms for the transfer of weapons and military equipment:

- *direct export* to another country (for example, to the United States, which remains the largest arms exporter by the end of 2023). Both state and private enterprises are engaged in the supply of weapons and military equipment, and this happens through contracts. In this case, the state has influence on private enterprises and may impose certain restrictions) (Public News, 2024, SURL, 2024);
- *offset agreements* (a type of compensation agreement in which the importer not only receives weapons or military equipment, but also sets additional conditions for the exporter) (Rheinmetall, 2024, CIAO, 2024);
- *transfer of weapons through international programs* (for example, Lend-Lease, which provides for payment for assistance received after the end of a military conflict or under other conditions, or special programs of specific countries that finance the purchase of weapons for another country) (DSCA, 2024);

- assistance within alliances (in accordance with Article 5 of the North Atlantic Treaty, NATO countries undertake to assist any member country of the alliance in the event of an attack on it, since this will be considered an attack on the entire alliance) (NATO, 2024).

Each of the above methods contains restrictions created in order to control the turnover of military technologies, the effectiveness of their use, as well as to prevent their use for criminal purposes. The legal framework in this area contains three main modes of control (CONSULTANT.NET.UA, 2024):

- **The Wassenaar Arrangement.** The agreement is intended to coordinate the efforts of its participants to control the export of conventional weapons and dual-use goods and technologies to countries with unstable political regimes and regions where conflicts continue. Thus, states parties are required to monitor goods in the lists of dual-use goods and technologies, which are regularly reviewed in accordance with new technological developments. (MFA, 2024);
- **Treaty on the non-proliferation of nuclear weapons (NPT).** According to it, all signatories undertake to contribute to the cessation of the nuclear arms race (ZAKON RADA, 2024);
- **Missile Technology Control Regime (MTCR).** Informal association established in addition to the NPT for the non-proliferation of certain types of missile equipment and dual-use goods (MTCR, 2024).

Preliminary analysis of the above-mentioned documents provided an opportunity to conclude that they cover all important aspects of control, but there are certain shortcomings in the mechanisms for punishing violators of agreements, since now the only existing opportunity to influence them is to impose sanctions or break off diplomatic relations, but often the parties to agreements can act indecisively if the situation concerns influential countries. An example is the Wassenaar Arrangement, which is not effectively used in the context of the Russian-Ukrainian war.

The effectiveness of international cooperation on the transfer of military technologies is the result of many factors of influence, some of which are more structural in nature, such as Strategic Culture and historical experience, while others may be of a temporary nature, such as unexpected cuts in defense budgets or personal relationships between key political leaders. The most well-known examples of international transfer of military technologies in the twenty-first century are shown in Table 1.

Table 1. *Successful examples of international transfer of military technology*

№	Partner states	Technology	Content of the agreement
1	Turkey and Italy	Production of the SAMP/T air defense system	Turkey has signed an agreement with Italy and France through the Eurosam consortium for the joint production and development of SAMP/T air defense systems. The project involved the transfer of key technologies, including the production of missiles and radars, which allowed Turkey to improve the level of its defense technologies.

2	India and Russia	Joint production of BrahMos missiles	India and Russia are working together to create BrahMos supersonic cruise missiles through the BrahMos Aerospace joint venture. Russia has provided critical technologies for missile development, and India has integrated them into its industry, which has made it possible to localize production. The cooperation included technology transfer, scientific and technical exchange, and co-production.
3	PRC and Pakistan	Production of JF-17 Thunder fighters	China has transferred technology to Pakistan for the production of JF-17 Thunder fighters. The cooperation began with the development and later transfer of production technology, which allowed Pakistan to partially localize the production of these aircraft at its PAC (Pakistan Aeronautical Complex) enterprise.
4	USA and Japan	Joint production of F-35 fighter jets	Japan has gained access to fifth-generation F-35 fighter production technologies through cooperation with the United States. Licensed production allowed Japanese companies, in particular Mitsubishi Heavy Industries, to participate in the assembly of fighter jets in Japan.
5	Poland and South Korea	Technology transfer for the production of K2 tanks	Poland signed an agreement with South Korea to purchase K2 Black Panther tanks, which included the transfer of technology for their local production. This allowed Poland to organize the production of tanks at its own enterprises and gain access to advanced military technologies.
6	Qatar and France	NH90 helicopters	Qatar signed a contract with France for the supply of NH90 military helicopters, which provided for a significant part of offset obligations. As part of the agreement, French companies transferred technologies to Qatar to create maintenance and repair facilities at the local level.
7	Ukraine and Turkey	Cooperation in the production of Bayraktar drones	Ukraine has signed an agreement with Turkey to establish a joint venture for the production and modernization of Bayraktar TB2 unmanned aerial vehicles on Ukrainian territory.
8	Brazil and Sweden	Production of Gripen fighter jets	Brazil has signed an agreement with Sweden to acquire Saab Gripen fighter jets with technology transfer. The Swedish company Saab has transferred technology and knowledge for the production of part of the fighter jets in Brazil. This contributed to the development of Brazil's aviation industry, allowing it to gain access to the latest technologies in the field of aircraft construction.
9	Germany and South Korea	Production of type 214 submarines	Germany has transferred technology to South Korea for the production of Type 214 submarines. This agreement allowed Korean companies to build submarines based on German technology, including the use of an air-independent power plant (AIP). Localization of production and adaptation of technology helped South Korea develop its own naval forces.

10	Poland and the USA	Patriot air defense system technologies	Poland received the Patriot air defense system from the United States, which included the transfer of certain technologies and the creation of opportunities for local production of individual components. As part of the agreement, technologies were transferred to modernize the Polish defense industry and increase production capacity.
11	United Arab Emirates and South Korea	APC K2	The UAE has signed an agreement with South Korea for the supply of K2 combat vehicles, which provided for the transfer of technology to create production lines at local enterprises. This allowed the UAE to gain access to advanced armored vehicle technologies and create opportunities for further independent production and modernization of military equipment.
12	Egypt and France	Production of Gowind frigates	Egypt has signed an agreement with France to build Gowind-class frigates with a partial technology transfer. One of the ships was built at a French shipyard, but the remaining frigates were decided to be built at an Egyptian shipyard in Alexandria, which allowed localization of production and access to modern shipbuilding technologies.
13	Italy and Brazil	AgustaWestland helicopters	Italian company AgustaWestland has transferred technology to Brazil for the production of military helicopters as part of a joint production agreement. This allowed Brazil to increase its aviation capacity and develop its own production of helicopters for military needs.
14	Saudi Arabia and the United Kingdom	Typhoon aircraft manufacturing	As part of the agreement between Saudi Arabia and the United Kingdom, Saudi Arabia received Eurofighter Typhoon fighter jets. In addition to aircraft deliveries, the agreement included technology transfer components for the development of the local aircraft industry, in particular the construction of production facilities for aircraft maintenance in Saudi Arabia.

Source: compiled by authors based on open sources

Analyzing the data shown in the table, you can determine certain criteria for the success of international cooperation. First, the number of partners should be limited, meaning that effective defense cooperation usually takes place in a bilateral format or in small sub-regional formations. Second, the more standardized concepts, technologies, and equipment are, the easier and more extensive collaboration can be. Third, there must be realism, clarity and seriousness of intentions, which is an important criterion for success. Too many projects failed because they only served a political or symbolic purpose. Countries should have the same intentions, be open and clear about cooperation goals, and define realistic goals.

As for Ukraine, international cooperation has always been an important area of development of the country's military-industrial complex. Until February 24, 2022, Ukraine actively attracted international partners to joint projects, participation in research programs and exchange of experience. This made it possible to use advanced world technologies and practices that contributed to improving the quality and efficiency of Ukrainian defense products. In addition, participation in international exhibitions and forums contributed to

increasing the awareness of the Ukrainian military-industrial complex on the world stage and expanding sales markets. But after February 24, 2022, the volume of military technical assistance to Ukraine from its partners increased significantly. NATO, the European Union and other allies of Ukraine provide it with weapons, ammunition, equipment and other resources necessary to protect it from Russian aggression. If before the full-scale invasion, Javelin anti-tank missiles and Stinger man-portable air defense systems were transferred to Ukraine with difficulty, then after that they transferred the latest air defense system (ADS), radar surveillance (RS), armored vehicles, artillery and began training Ukrainian pilots on F-16 aircraft.

The war in Ukraine has led to an increase in interest in domestic military technologies and the ability to test existing weapons in real combat conditions. Many countries, including the United States, the European Union, the United Kingdom and Canada, provide Ukraine with military assistance, including technologies and equipment to test their effectiveness. Also, Ukraine is increasingly starting to implement joint projects in the field of Defense Industries. Some partners, even despite the war, are starting to build their facilities on the territory of Ukraine. Thus, in July 2023, the construction of a plant for the production of Bayraktar attack unmanned aerial vehicles began in Ukraine, which is one of the examples of international transfer of military technologies given in Table 1. Production is an important step in the development of the Ukrainian defense industry. It will allow Ukraine to produce high-quality attack drones that will be used to protect Ukraine from Russian aggression (FORBES.UA, 2024). Another important strategic partner for Ukraine is Rheinmetall from Germany. This defense company is a key supplier of military equipment and ammunition for the Armed Forces of Ukraine. Thanks to its diverse supplies and services, Rheinmetall has become one of Ukraine's most important supporters in countering Russian aggression. Currently, the company provides the Armed Forces of Ukraine with a variety of equipment, including Leopard 1 and Leopard 2 tanks, Marder infantry fighting vehicles, Skynex air defense systems, modular mobile hospital, MAN HX 88 trucks, automated surveillance and protection systems for Surveil SPIRE drones. Rheinmetall is also one of the main suppliers of a large number of medium and large caliber ammunition for the Armed Forces of Ukraine, including 20-mm ammunition for Marder infantry fighting vehicles, 40-mm and 105-mm ammunition for Leopard 1 and Leopard 2 tanks, respectively. In September 2023, the first batch of 35-mm ammunition for the Gepard anti-aircraft artillery system was delivered. The company is also a key supplier of 155-mm artillery ammunition for the Armed Forces of Ukraine, and plans to continue these deliveries (Rheinmetall, 2024).

In May 2023, Rheinmetall and the Ukrainian state-owned company Ukroboronprom signed a strategic partnership agreement, creating a joint venture for the repair and production of Tanks. This company plans to engage in maintenance and repair of ambulances, as well as start production of armored vehicles, including Fuchs transport vehicles, Lynx infantry fighting vehicles and Panther main battle tanks. Rheinmetall is also considering opening a tank repair center and factory in Ukraine. According to the CEO of Rheinmetall, Armin Papperger, the construction of such a plant can cost 200 million euros, and its capacity will allow producing up to 400 tanks annually. (ESPRESO, 2024). Rheinmetall has received an order to supply the Armed Forces of Ukraine with several hundred thousand shells in 2025 for 100 million dollars. An interesting fact is that due to a significant shortage of artillery shells, all the company's shells were purchased by the Bundeswehr by 2029 (Rheinmetall, 2024).

Another example of international transfer in the defense industry is the activity of the German company Quantum-Systems, which produces the Vector drone. In the spring of 2023, this

company opened a service, support, training and logistics center (SSTLC) in Ukraine. The main task of the center is to train operators of these drones and repair drones. At the same time, the company started creating a separate research and development (R&D) center in Ukraine. These foreign research and development centers are extremely useful for Ukrainian scientific and technological progress. This gives Ukraine an innovative potential, promotes the development of knowledge and skills of our engineers, and strengthens strategic partnerships. The company plans to start production of spare parts for Vector reconnaissance drones by the end of 2024, and in 2025 it is planned to organize a full assembly of these drones in Ukraine (Quantum System, 2024).

Military training of Ukrainians abroad is also an important part of cooperation between Ukraine and its partners for several reasons. First, it helps to increase the combat capability of the Ukrainian Armed Forces and increase efficiency in the use of Western weapons. Secondly, the exercise helps strengthen ties between the Ukrainian and Western military personnel. This helps to increase the level of trust and mutual understanding between them, which is an important condition for successful cooperation. The leading countries in the training of the Ukrainian military are USA, Great Britain, most EU countries, Canada, Norway, Australia, Kosovo, North Macedonia, Georgia, Moldova and Albania (MILITARNYI, 2024).

In the current conditions, new mechanisms for the international transfer of military technologies are also being developed. Thus, the Ukrainian government has created various fundraising platforms and forums, such as UNITED24, DFNC2 and others, which unite all states for a single common goal – the victory of Ukraine and the creation of a powerful arsenal of Europe. In the context of the continuous evolution of the defense industry, Ukraine will become a leader and example for other states, conducting training and sharing experience that will bring it closer to international standards and promote its accession to NATO. The Ukrainian experience also became the basis for the formation of a new global trend of military-tech, which, of course, will continue to exist even after the victory of Ukraine in the war. This trend underscores the critical importance of military innovation, which in turn will attract much-needed foreign investment to Ukraine and promote desired international cooperation.

As already noted, the international transfer of military technologies allows us to solve one of the main problems of the development of the military-industrial complex, namely the effective use of limited resources allocated for the needs of defense capability. The war in Ukraine led to an increase in defense spending which led to an increase in 6633% of arms imports for the period 2019-2023, which is almost 4.9% in the world (SIPRI, 2024). Accordingly, any decision related to the rational use of economic resources of the state is not just important, but necessary to ensure the effective functioning of the state. As a way out, this is a reduction in dependence on arms supplies from partner countries through increased participation of private investors in the development of the defense industry of Ukraine and the creation of joint production facilities with NATO partners. We believe that the following measures can be used to improve the investment climate in the field of military technology transfer:

1. State guarantees and compensations: providing a flexible system of guarantees that takes into account the level of investment and innovation in the industry, which allows you to regulate risks; expanding compensation for credit interest for the entire period of production establishment and not limited to the term.

2. Benefits and subsidies: clarification of the period of application of tax benefits and subsidies to support defense industry enterprises for a certain time; consideration of the provision of tax subsidies depending on the degree of investment in the production of modern weapons.

3. Insurance against military and political risks: exploring the possibilities of expanding the insurance system to all forms of foreign investment in the defense industry sector; introducing a transparent risk assessment system to attract additional investors.

4. Creation of international research centers: Ukraine should initiate the creation of joint research centers with partners to jointly solve important tasks and develop new technologies. This will allow Ukrainian manufacturers to increase their expertise and innovation.

5. CONCLUSIONS AND RECOMMENDATIONS

International transfer of military technologies is accompanied by certain challenges and risks. Political instability, economic difficulties, technological barriers and security aspects can affect the effectiveness of this process. Changes in government, economic crises, and technical differences can make it difficult to implement new technologies. In addition, there are risks associated with the possibility of technology falling into the hands of unscrupulous entities, which creates a threat to national security.

Despite these challenges, international technology transfer remains an important component of the development of any state's defense industry. It enables partners to adapt innovative solutions to their needs, enhances their defense capabilities, and promotes integration into the global military technology market. Such cooperation is critical for strengthening the defense capability in the face of modern challenges, ensuring technological development and supporting national security.

The considered examples of international technology transfer in the context of the Russian-Ukrainian war emphasize the key role of International Partnership for the innovative development of the Ukrainian economy. This process allows us to preserve and develop critical technologies, form international alliances in this area, and create new opportunities for both economic growth and increased military power in the liberation of temporarily occupied territories by the aggressor state.

REFERENCES

- Ariputro, A. B., Syahtaria, M. I., Trismadi, T., Suwarno, P., Widodo, P., & Purwanto, D. A. (2024). Collaboration and Technology Transfer in the Defense Industry as Drivers of Innovation and Global Security Enhancement. *Physical Sciences, Life Science and Engineering*, 1(3), 12. <https://doi.org/10.47134/pslse.v1i3.247>
- Bellais, R., & Guichard, R. (2006). Defense innovation, technology transfers and public policy. *Defence and Peace Economics*, 17(3), 273–286. <https://doi.org/10.1080/10242690600645274>
- CIAO (2024) Countertrade and Offsets Policies and Practices in the Arms Trade. URL: <https://ciaotest.cc.columbia.edu/wps/wis01/> (November 01, 2024).

- CONSULTANT.NET.UA (2024) Procedure for the transfer of military technology and equipment. URL: <https://consultant.net.ua/en/consultant-article/7654> (November 12, 2024).
- Cheung, T. M., Lucyshyn, W., & Rigilano, J. (2019). The Role of Technology Transfers in China Defense Technological and Industrial Development and the Implications for the United States. Acquisition Research Program. <https://dair.nps.edu/bitstream/123456789/2756/1/UCSD-AM-19-028.pdf>
- DSCA (2024) Foreign Military Financing. (FMF) Defense Security Cooperation Agency. URL: <https://www.dscamilitary.com/foreign-military-financing-fmf>. (November 02, 2024).
- Farkas, T. (2023). The Challenges for the European Defense Industry. SISY 2023 - IEEE 21st International Symposium on Intelligent Systems and Informatics, Proceedings, 457–462. <https://doi.org/10.1109/SISY60376.2023.10417901>
- FORBES.UA (2024) Bayraktar expects to complete the construction of the plant in Ukraine in a year. It will produce 120 UAVs annually. URL: <https://forbes.ua/news/virobnik-bayraktar-rozrakhovue-zavershiti-budivnitstvo-zavodu-v-ukraini-za-rik-vin-viroblyatime-po-120-bpla-shchoroku-07022024-19033> (November 12, 2024).
- ESPRESO (2024) Martynovych Y. Why Rheinmetall is important for the development of the Ukrainian military-industrial complex. espreso. URL: <https://espresso.tv/koli-nimtsi-robotimut-tanki-v-ukraini-ta-chomu-kompaniya-rheinmetall-e-klyuchovoyu-dlya-rozvitku-ukrainskogo-vpk> (November 13, 2024)
- Lundmark, M. (2016). Absorbing New Military Capabilities: Defense Technology Acquisition and the Asia-Pacific. In: Bitzinger, R.A. (eds) Emerging Critical Technologies and Security in the Asia-Pacific. Palgrave Macmillan, London. https://doi.org/10.1057/9781137461285_4.
- Mendoza, M. A. (2007). International Technology Transfer Regulations: A comparative study between the Defense Industry and the Civil (Electronics) Industry in the US. https://www.researchgate.net/profile/Mario-Mendoza-10/publication/271705513_International_Technology_Transfer_Regulations_A_comparative_study_between_the_Defense_Industry_and_the_Civil_Electronics_Industry_in_the_US/links/54cffcc70cf298d656660bf6/International-Technology-Transfer-Regulations-A-comparative-study-between-the-Defense-Industry-and-the-Civil-Electronics-Industry-in-the-US.pdf
- MFA (2024) Wassenaar Arrangement. Permanent Mission of Ukraine to the International Organizations in Vienna. URL: <https://vienna.mfa.gov.ua/ustanovi-oon-u-vidni/vassenaarska-domovlenist>. (November 12, 2024).
- MILITARNYI (2024) 34 countries are involved in the training of the Armed Forces of Ukraine abroad URL: https://mil.in.ua/uk/news/do-pidgotovky-vijskovykh-zsu-zakordonom-zalucheni-34-krayiny/#google_vignette (November 12, 2024).
- MTCR (2024) Our Mission - MTCR. URL: <https://www.mtcr.info/en/partners/our-mission>. (November 12, 2024).
- NATO (2024) Collective defense and Article 5. NATO. URL: https://www.nato.int/cps/en/natohq/topics_110496.htm (November 12, 2024).
- Quantum System (2024) Third Vector order from Ukraine URL: <https://quantum-systems.com/blog/2023/05/23/third-vector-order-from-ukraine/> (November 13, 2024)
- Public News (2024) The United States freezes firearms exports for 90 days. URL: <https://suspilne.media/604255-ssa-zamorozuut-eksport-vognepalnoi-zbroi-na-90-dniv/>. (November 02, 2024).
- Rheinmetall (2024). URL: <https://www.rheinmetall.com/en> (accessed November 12, 2024)

- SIPRI (2024) Global military spending surges amid war, rising tensions and insecurity SIPRI
URL:<https://www.sipri.org/media/press-release/2024/global-military-spending-surges-amid-war-rising-tensions-and-insecurity> (November 12, 2024).
- SURL (2024) Arms sales: which countries are the largest exporters and importers. The word and the deed. URL: <http://surl.li/uvhanr>. (November 03, 2024).
- Tian, Nan, Da Silva, D. L., Liang, X., Scarazzato, Trends In World Military Expenditure, 2023. (2024). SIPRI Fact Sheet, “Stockholm International Peace Institute SIPRI Databases,” Retrieved from: <https://www.sipri.org/databases>
- Valkanov, P. N. (2024). Key elements of successfully transferring military technology by a foreign manufacturer into the upcoming modernization of the Indian defense sector. *Knowledge-International Journal*, 65(1), 145-151.
<https://www.ceeol.com/search/viewpdf?id=1315477>
- ZAKON RADA (2024) Treaty on the Non-Proliferation of Nuclear Weapons of July 1, 1968: Treaty of the Org. United Nations of July 1, 1968: as of November 16, 1994. 1994 p.
URL: <https://zakon.rada.gov.ua/laws/show/995098#Text> (November 12, 2024).

ALIGNMENT OF THE LEGAL FRAMEWORK FOR CONSUMER PROTECTION IN BIH WITH EU LAW

Alaudin Brkić*

University of Zenica-Faculty of Law, alaudin.brkic@unze.ba,
ORCD number 0009-0007-8047-0246

Amina Hasanović

University of Zenica-Faculty of Law, ahasanovic@unze.ba,
ORCD number 0009-0008-0739-6235

Alisa Imamović

University of Zenica-Faculty of Law, alisa.imamovic@unze.ba,
ORCD number 0009-0000-2442-1975

Abstract: *This paper analyzes possible approaches and directions for the subsequent alignment of the legal framework for consumer protection in Bosnia and Herzegovina with EU acquis after the adoption of the Consumer Protection Law of BiH in 2006, in which most of the implemented directives have undergone significant changes to date, with some even being repealed with the adoption of entirely new consumer directives aimed at modernizing the existing structures of EU secondary consumer law. The chronic inconsistency of consumer law in Bosnia and Herzegovina, compared to the EU's secondary consumer law, negatively affects the current level of protection for the rights and obligations of consumers and traders in consumer contracts within the single economic area of Bosnia and Herzegovina. In this context, the trade of goods with a digital element and digital services in the EU's single digital market requires completely different approaches to the affirmation and development of Bosnia and Herzegovina's digital market, with the aim of ensuring a high and unified level of consumer protection, as well as creating a legal and institutional infrastructure that will enable more effective implementation of consumer policies and the use of entirely new legal instruments in resolving consumer disputes." The objectives of this study are focused on analyzing the current legal framework for consumer protection in BiH, which needs to be amended and aligned with EU secondary consumer law through the implementation of newly adopted consumer directives. These directives introduce entirely new legal concepts, methods of contract formation, types of consumer contracts, and ways to protect consumer rights, which also implies presenting appropriate proposals for legislative interventions and improving the existing legal framework for consumer protection in the BiH market, and its further alignment with the EU acquis in fulfilling the obligations arising from the Stabilization and Association Agreement between BiH and the EU.*

Keywords: *consumer rights, consumer contractual relationships, EU secondary consumer law, implementation of consumer directives, alternative methods of resolving consumer disputes.*

JEL Classification: *K12, D18, P11*

* Corresponding author

1. INTRODUCTION

Consumer law is a specific branch of law that governs relationships in which one party is always the consumer and the other is the trader (*ratione personae*). The Consumer Protection Law of Bosnia and Herzegovina (2006) defines a consumer as any individual who purchases, acquires, or uses products or services for personal needs and for the needs of their household. The consumer is considered the less informed party in comparison to traders. Dabović Anastasovska (2023) state the fact that law has recognized the need to provide special legal protection for individuals in their relations with traders, and to impose greater obligations on traders when offering or selling goods and services to natural persons as consumers.

With the development of consumer law, new categories of individuals have been identified: consumers who, due to physical or mental impairments, age, or inattention, are particularly vulnerable to certain business practices or specific products, and who are entitled to even greater protection. These are the so-called "vulnerable" categories of consumers, for whom traders and marketing professionals must exercise a higher degree of caution.

The realization of consumer rights in the modern era is particularly influenced by digital transformation, which radically changes the lives of consumers, offering them more opportunities and a greater choice of goods and services. At the same time, it can make it more difficult for consumers to make informed decisions and protect their interests. The collection and processing of basic data combined with the analysis of consumer behavior and cognitive biases, using artificial intelligence and algorithms, can be used to encourage consumers to make decisions that may be contrary to their best interests. This limits the effectiveness of existing rules designed to protect consumers.

Digitization and the virtual world impose the introduction of new rules for consumer protection. An essential characteristic of consumer law is its dynamism, meaning that it changes over time. Legislators frequently amend laws to protect consumers in new market conditions. Another important fact is the need to protect consumers at a global level, because consumer transactions do not occur solely at the national level, but often involve foreign elements. This is also important for encouraging market competition because when consumer law is harmonized and traders' obligations are clear, it encourages traders to offer products and services beyond the borders of the country where they are based.

What is happening to consumers globally today? First, the reduction of trade barriers and new technologies have made it easier to purchase goods from abroad, allowing consumers in the globalized economy to increase their engagement in cross-border transactions. On one hand, this has benefited consumers who now have more choice of products and services that they can easily compare online. On the other hand, due to varying sales practices and legal barriers in different countries, this has created challenges in enforcing cross-border consumer rights, in addition to the inevitable limitations on information when purchasing goods or services from distant sellers. In this context, national law can only offer limited solutions, requiring the development of international consumer protection provisions.

Some of the recent major global scandals related to consumer law that have affected consumers in many different jurisdictions (e.g., Ferrero and Nutella) have highlighted the growing importance of international consumer protection law, emphasizing the need for responses to consumer rights issues at a global level. The internationalization of consumer

transactions also requires an appropriate "international" regulatory response to consumer law. In this sense, legal theory asserts that the primary goal of international consumer law must be to maintain a minimum level of consumer protection, below which no jurisdiction should fall. Technological development and its potential benefits to society should never be used as an excuse to reduce the level of consumer protection, and this is even more true when it comes to the enforcement of consumer law rules emphasizes Dobović Anastaskovska (2023).

In an increasingly globalized world with deeply internationalized markets, law remains one of the least globalized elements of society. However, law is also becoming more internationalized, crossing the boundaries of national jurisdictions. This is the case with consumer law, where there is a noticeable trend towards the development of supranational rules or, at least, internationally recognized principles of consumer law.

1. EUROPEAN CONSUMER LAW

The fundamental rights of consumers in the European Union were first defined in 1975 in the Council Resolution on the previous program of the European Economic Community for consumer protection and information policy. Today, these rights are secured in both primary and secondary sources of European Union law: the Charter of Fundamental Rights of the European Union, the Treaties of the European Union, regulations, and directives.

The Treaty on the Functioning of the European Union (TFEU) stipulates that consumer protection is one of the areas shared between the Union and the member states according to Article 4. Furthermore, Article 12 of the TFEU obliges the Union and the member states to take consumer protection requirements into account when determining and implementing other Union policies and activities. The European Commission, in its proposals for consumer protection, is required to base them on a high level of protection, taking into account every new development based on scientific facts. As stated in Article 114, in addition to the European Commission, the European Parliament and the Council of the European Union, within their respective competences, must aim to achieve the same goal.

Article 169 of the TFEU represents the legal basis for consumer protection in the European Union:

"1. In order to promote the interests of consumers and ensure a high level of consumer protection, the Union contributes to the protection of consumers' health, safety, and economic interests, as well as to promoting their right to be informed, educated, and organized in order to protect their interests.

2. The Union contributes to achieving the objectives in paragraph 1: (a) by measures adopted based on Article 114 in the context of achieving the internal market; (b) by measures that support, complement, and supervise the policies pursued by the member states.

3. The European Parliament and the Council, acting in accordance with the ordinary legislative procedure and after consulting the Economic and Social Committee, adopt the measures referred to in paragraph 2, point (b).

4. Measures adopted under paragraph 3 do not prevent any member state from maintaining or introducing stricter protective measures. These measures must be in accordance with the Treaties. The Commission shall be notified of these measures."

2.1. EUROPEAN UNION CONSUMER PROTECTION POLICY

The EU's consumer protection policy has significantly evolved since its inception. Since 2020, a new consumer protection agenda has been in place, titled "*Strengthening Consumer Resilience for Sustainable Recovery*", which represents an updated vision for EU consumer policy from 2020 to 2025. One of the agenda's goals is to adequately respond to the effects of the COVID-19 pandemic in this area.

The agenda covers five priority areas:

Green Transition: Addressing new challenges in consumer rights and creating opportunities for empowerment in this area, ensuring that sustainable products and lifestyles are accessible to everyone, regardless of geographic location or income.

Digital Transformation: Creating a safer digital space for consumers where their rights are protected and ensuring a level playing field to enable innovation and the provision of new and better services to all EU citizens.

Effective Enforcement and Redress: Mitigating the impact of COVID-19 on consumer rights and preventing misleading environmental claims and unfair commercial practices in the digital space. While consumer rights enforcement is primarily the responsibility of national authorities, the EU plays an important coordinating and supporting role, as evidenced by the Consumer Protection Cooperation Regulation (2017).

Addressing Specific Consumer Needs: Considering the needs of consumers who, in certain situations, may be vulnerable and require additional protection measures. This can be driven by social circumstances or specific characteristics of individuals or groups of consumers.

Consumer Protection in a Global Context: Ensuring import safety and protecting EU consumers from unfair practices by operators outside the EU through market surveillance and closer cooperation with relevant authorities in EU partner countries.

EU institutions systematically monitor consumer policy using the Consumer Scoreboard (2019), which tracks national conditions for consumers across three areas: knowledge and trust, compliance and enforcement, and complaints and dispute resolution. It also examines progress in integrating the EU retail market based on the level of cross-border transactions between businesses and consumers, as well as the development of e-commerce.

Consumer policy is also monitored through the Consumer Markets Scoreboard (2018), targeting consumers who have recently made purchases in order to track the following parameters: the degree of application of consumer protection regulations, comparability of offers, market choice availability, consumer satisfaction, and damages caused by issues consumers face, across over 40 consumer markets.

Additionally, in April 2021, the Single Market Programme (2021) was launched to achieve its full potential and ensure recovery from the COVID-19 pandemic. This program is accompanied by the relevant budget for the period 2021–2027, representing an integrated package to support and strengthen the management of the single market, including financial services.

It is also important to highlight specific sectoral measures being undertaken in the field of consumer protection in the EU, such as the involvement of consumer interest groups. The European Consumer Consultative Group (ECCG) serves as the main forum for the Commission to consult with national and European consumer organizations. Established by Commission Decision 2009/705/EC, the ECCG can advise and inform the Commission on any issues relating to consumer interests at the EU level. Furthermore, in 2017, the European Parliament and Council adopted Regulation (EU) 2017/826 establishing a Union programme to support specific activities aimed at increasing the involvement of consumers and other end-users of financial services in the development of EU policies in the area of financial services for the period 2017–2020.

3. IMPLEMENTATION OF THE NEW CONSUMER LAW OF THE EUROPEAN UNION INTO THE CONSUMER LEGISLATION OF BOSNIA AND HERZEGOVINA

The legal *acquis*, which includes: the founding treaties, legislation based on the founding treaties, the case law of the Court of Justice of the European Union, international treaties of the European Union and other entities, and agreements between member states in the Union's area of activity, must be implemented by the Republic of Croatia as an EU member state. In contrast, Bosnia and Herzegovina, the Republic of North Macedonia, and the Republic of Serbia are obliged to adopt and implement it into their national laws following the signing of the Stabilization and Association Agreement between the European Communities and their member states and these countries.

Since the signing of the Stabilization and Association Agreement, legislators in these countries have adopted national general consumer protection laws, and some elements of consumer law *acquis* have been implemented into national laws governing obligations or specific sectoral laws (such as consumer credit, food safety, etc.). Following the adoption of new EU consumer protection regulations, national consumer protection laws in the countries of our region have been amended. In some of these new national laws, the mentioned updates of EU consumer law have been implemented, while in others, despite the adoption of new laws, implementation has been lacking. In some countries, implementation is planned through strategic documents for the development of consumer law, which foresee amendments to existing laws.

The main dilemma legislators face when dealing with the new consumer legal framework is whether all these novelties should be implemented into national laws in the following ways: in a horizontal general consumer protection law, as part of the laws governing contractual relations (when it comes to changes in consumer contracts), or by adopting special laws for particular issues. Arguments against implementing consumer protection in laws that regulate contractual relations include the fast-paced nature of changes in consumer law and its supervision, while arguments in favor suggest that this approach allows for better organization of consumer rights and obligations related to sales contracts in one place, such as warranties and seller liability for material and legal defects in goods sold.

According to Dabović Anastasovska (2023) a further dilemma is whether it is possible to implement multiple consumer directives (which are now directives of maximum harmonization) into a single consumer law. It is becoming clear that this is not feasible, and

the better and more appropriate option is to implement these directives into separate laws. This procedure was followed by the enforcement body in the Republic of Croatia.

The legal framework for consumer protection in Bosnia and Herzegovina is contained in the **Consumer Protection Act**, adopted in 2006 at the state level. Consumer protection authorities are regulated in Chapter XVII:

- a) Ministry of Foreign Trade and Economic Relations of BiH,
- b) Ombudsman for Consumer Protection in BiH,
- c) Consumer Protection Council of BiH,
- d) Competition Council of BiH,
- e) Relevant authorities of the entities and Brčko District of BiH,
- f) Office for Competition and Consumer Protection in the Federation of BiH and Republika Srpska,
- g) Consumer associations,
- h) Educational institutions and media,
- i) Inspection and other bodies in accordance with the law.

The country's consumer protection policy consists of measures aimed at protecting the health, safety, and economic interests of consumers, ensuring compensation for consumers, and providing consumer information. The **Consumer Protection Act** applies in the Federation of BiH and Brčko District of BiH, while Republika Srpska applies a separate **Consumer Protection Act**. The **Consumer Protection Council of BiH** serves as an expert and advisory body to the Council of Ministers. The main tasks of this Council include proposing the **State Annual Consumer Protection Program**, monitoring its implementation, establishing the basis for consumer protection policy, and directing activities financed from the state budget. It also sets goals and tasks related to educating, informing, and raising awareness about consumer protection. There are 16 consumer protection organizations in the country—seven in the Federation of BiH, eight in Republika Srpska, and one in Brčko District of BiH. Consumers have the right to judicial and out-of-court protection, as well as alternative dispute resolution.

The **European Commission**, in its **2024 Report on Bosnia and Herzegovina**, states that Bosnia and Herzegovina is in the early stages of preparation regarding consumer protection and public health. No progress has been made in this area during the reporting period. The 2023 recommendations have not been implemented and remain in force. In the coming year, Bosnia and Herzegovina should particularly focus on aligning its **Consumer Protection Act** at the state level with the EU acquis. A comprehensive review of this law should be undertaken as soon as possible to align it with the latest EU acquis in this area, to quickly address issues related to rapidly changing digital markets and to prevent uneven consumer protection across entities due to fragmented legislation throughout the country.

To assist Bosnia and Herzegovina in implementing the recommendations in this area, the EU approved and funded the project "Support to MoFTER in Aligning BiH Consumer Protection Law with the EU Acquis," which was implemented from May 20, 2019, to January 20, 2020. As a result of this project, a Draft New Consumer Protection Law for BiH was prepared, which transposed the new EU "consumer" directives where appropriate, improved certain material and misdemeanor provisions, and addressed shortcomings identified during the previous application of the law. The Federal Ministry of Trade points out that the Draft Law was prepared at the end of 2019, but the competent Ministry of Foreign Trade and

Economic Relations of BiH has not yet sent this draft to the Council of Ministers of BiH for review and parliamentary procedure.

3.1. PROCEDURE BEFORE THE OMBUDSMAN FOR CONSUMER PROTECTION IN BOSNIA AND HERZEGOVINA

According to the 2023 Annual Report of the Ombudsman Institution for Consumer Protection in Bosnia and Herzegovina, throughout the year, in line with the competences defined by Articles 101 to 105 of the Law, as well as the administrative capacities of the Ombudsman for Consumer Protection, both proactive and reactive investigations were conducted in the field of consumer protection in cooperation with the relevant market inspections. The highest percentage of received complaints concerned commercial services, followed by services of general economic interest. Among the services of general economic interest, the highest percentage of complaints related to heating services, followed by complaints in the telecommunications sector, the electricity sector, and water supply services. In a certain number of complaints, it was established that the institution had no jurisdiction, and appropriate instructions were provided to the parties involved.

Complaint procedures are available to consumers. A standard complaint form is available on the website, and complaints are accepted electronically or via mail. In addition to written consultations and support, consumers are provided with necessary instructions, legal advice, and information related to consumer relations, handling complaints (grievances), as well as providing explanations or opinions concerning specific individual cases or normative legal acts.

These activities also have a collective significance, as they preventively protect all consumers and promote good business practices in accordance with consumer regulations. The field of consumer protection is heterogeneous, and the Ombudsman Institution is, in principle, competent for all consumer-related matters in accordance with the law. In this context, actions are taken based on complaints in individual cases unless legal proceedings have been initiated for the same issues or if actual lack of jurisdiction is determined. Handling complaints involves more complex legal procedures, such as market investigations, familiarity with the technical specifications related to the disputed service or product, and local community regulations, which are often not in agreement with consumer protection laws. All of this requires significant time and intellectual effort, as well as additional inspection oversight and cooperation with other institutions.

Collective consumer protection refers to actions whose economic consequences affect a larger number of citizens (consumers). This involves recommendations, instructions, and opinions issued by the Ombudsman aimed at improving and overcoming detected violations of consumer rights. In this way, consumers are effectively empowered in resolving consumer disputes with merchants and other service providers. Given the significant number of complaints in the commercial sector and the limitation of consumer rights to choose in cases of product defects and related issues, as well as disputes regarding warranty claims on devices, special recommendations were issued to merchants. In this regard, meetings were held with cantonal market inspections, certain municipal inspections, and the Federal Ministry of Trade, all aimed at improving the existing state of affairs in light of the legislative framework from 2006.

By September 2023, the Ombudsman Institution had received 906 submissions for action. Of these, one-third of the requests concerned the retail sector, one-third the telecommunications sector, and one-third other services of general economic importance. Requests related to the banking and tourism sectors were also received. The Decision of the Ombudsman Institution for Consumer Protection in Bosnia and Herzegovina states that information gathered by the institution from inspection offices indicates that about 70% of consumer complaints were successfully resolved, meaning consumers were able to exercise their rights. The latest data shows that consumers are increasingly approaching the institution with specific complaints compared to previous years. The 2022 Annual Report indicated that the total number of complaints received throughout the year was approximately 700, while by the end of September 2023, the number had already exceeded 900. Particularly encouraging is the fact that 70% of complaints were successfully resolved, and agreements were reached between consumers and merchants, resulting in the realization of consumer rights. By the end of 2023, the total number of complaints (inquiries, information, advice), and decisions made, amounted to 1,394. The Ombudsman Institution for Consumer Protection in Bosnia and Herzegovina and its role in dispute resolution is a unique feature of our legislation, as many legal systems do not have such a mechanism.

4. CONCLUSION AND RECOMMENDATIONS

The legal framework of consumer law in the European Union is characterized by its dynamic nature, with the fact that it changes and adapts quickly to new business conditions and the impact of new technologies. The latest EU consumer protection regulations are most consistently implemented in the Republic of Croatia, perhaps because it is an EU member state. With the adoption of the new Consumer Protection Act, Croatia has established a comprehensive and current legal framework in the field of consumer protection, taking over the European legal *acquis* in this area.

As for Bosnia and Herzegovina, the lack of harmonization of legal regulations within the unified economic space of BiH negatively affects both the rights and obligations of consumers and traders in the Federation of Bosnia and Herzegovina. A modern market requires a high and uniform level of consumer protection, which includes creating an institutional structure that serves as a foundation for the implementation of an effective policy in this area, as well as market oversight as effective instruments for resolving consumer disputes. The Consumer Protection Ombudsman highlights almost identical indicators of consumer rights violations in every annual report, and in practice, there are insufficient positive developments. Therefore, the reports of this institution need to be taken much more seriously, its recommendations should be concretized, and normative responsibility for non-compliance should be legally established. Bosnia and Herzegovina has yet to implement this new consumer framework into its national laws. In addition to the consistent application of the new European legal framework for consumer protection, Bosnia and Herzegovina lacks systematic and strategic planning and implementation of measures that would enable better awareness among consumers and traders regarding their rights and obligations under the existing laws. Furthermore, there is a need to find ways for continuous consumer education from an early age about consumer rights and effective ways to protect those rights.

REFERENCES

- Consumer Protection Law of Bosnia and Herzegovina, Official Gazette of BiH, No. 25/2006 and 88/2015.
- Council Resolution on a preliminary programme of the European Economic Community for a consumer protection and information policy (1975). OJ C 92. Retrieved 15 December 2024 from: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=oj:JOC_1975_092_R_0001_01
- Dabović Anastasovska, J. (2023). *Implementation of Innovations in European Union Consumer Law into the Consumer Laws of the Countries in the Region. Proceedings of the Conference on Current Issues of Civil and Commercial Legislation and Legal Practice*, 20, 8. <https://pf.sum.ba/wp-content/uploads/2023/06/1-clanak.pdf>
- Decision of the Ombudsman Institution for Consumer Protection in Bosnia and Herzegovina, Number 05-26-4-1010-1/23, dated September 28, 2023.
- European Commission (2009). *Commission Decision of 14 September 2009 setting up a European Consumer Consultative Group*, 2009/705/EC, OJ L 244.
- European Parliament and Council (2017). *Regulation (EU) 2017/826 on establishing a Union programme to support specific activities enhancing the involvement of consumers and other financial services end users in Union policy-making in the area of financial services for the period of 2017-2020* (2017). OJ L 129. Retrieved 20 December 2024 from: <https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A32017R0826>
- European Parliament and Council (2017). *Regulation (EU) 2017/2394 on cooperation between national authorities responsible for the enforcement of consumer protection laws and repealing Regulation (EC) No 2006/2004 (Text with EEA relevance)* OJ L 345. Retrieved 20 December 2024 from: EUR-Lex - 32017R2394 - EN - EUR-Lex (europa.eu)
- European Commission (2018). *Consumer Markets Scoreboard: making markets work for consumers - 2018 edition*. Retrieved 20 December 2024 from: Consumer Markets Scoreboard: making markets work for consumers - 2018 edition (europa.eu)
- European Commission (2019). *Consumer Conditions Scoreboard, Consumers in the Single Market*. Retrieved 20 December 2024 from: <https://op.europa.eu/fi/publication-detail/-/publication/8c4649b6-1258-11ea-8c1f-01aa75ed71a1/language-en> (accessed December 5 2024).
- European Commission (2020). *Communication from the Commission to the European Parliament and the Council, New Consumer Agenda Strengthening consumer resilience for sustainable recovery*, COM/2020/696 final, EUR-Lex - 52020DC0696 - EN - EUR-Lex (europa.eu)
- European Parliament and Council (2021). *Regulation (EU) 2021/690 establishing a programme for the internal market, competitiveness of enterprises, including small and medium-sized enterprises, the area of plants, animals, food and feed, and European statistics (Single Market Programme) and repealing Regulations (EU) No 99/2013, (EU) No 1287/2013, (EU) No 254/2014 and (EU) No 652/2014* (2021). PE/18/2021/INIT, OJ L 153. Retrieved 15 December 2024 from: <https://eur-lex.europa.eu/eli/reg/2021/690/oj/eng>
- European Commission (2024), *Bosnia and Herzegovina Report*. Retrieved 26 November 2024 from: https://www.eeas.europa.eu/delegations/bosnia-and-herzegovina/bosnia-and-herzegovina-report-2024_en?s=219
- Government of the Federation of Bosnia and Herzegovina, *The Urgent Need for the Adoption of a New Consumer Protection Law in Bosnia and Herzegovina*. Retrieved 20

December 2024 from: <https://fbihvlada.gov.ba/bs/neophodno-donosenje-novog-zakona-o-zastiti-potrosaca-u-bih>

Ombudsman Institution for Consumer Protection in Bosnia and Herzegovina (2024). *Annual Report of the Ombudsman*. Retrieved 21 December 2024 from: <http://www.ozp.gov.ba/upload/planiranje/Izvješće%20o%20radu%20IOZZPuBIH%20za%202023.%20godinu.pdf>

ACKNOWLEDGMENT

This paper was created as a result of research conducted under an approved scientific research project with the same title by the Federal Ministry of Education and Science in 2023.

THE MOTORWAYS AVAILABILITY IMPLICATIONS FOR EMPLOYMENT AND EARNINGS AT MUNICIPAL LEVEL IN SERBIA

Marko Miljković*

University of Belgrade, Faculty of Transport and Traffic Engineering, m.miljkovic@sf.bg.ac.rs,
ORCID number 0000-0001-6232-6442

Jelica Petrović-Vujačić

University of Belgrade, Faculty of Transport and Traffic Engineering, j.petrovic@sf.bg.ac.rs,
ORCID number 0000-0003-1897-8990

Abstract: *Investments in transport infrastructure in Serbia have been characterized by an upward trend over the past few decades. The latest data indicate that these investments have reached the level of 2.3% of GDP and that they relate mainly to road infrastructure, i.e. motorways. Theoretical and empirical literature recognizes numerous economic and social benefits of motorways development, such as positive impact on economic growth, economic development and level of employment, decrease of regional disparities and income inequality, reduction of transport costs and increase of productivity, decrease of external costs of transport etc. The aim of this paper is to examine whether the motorways availability in Serbia has created any implications for employment and earnings. The analysis is carried out at the level of local administrative units. Data on employment and wages are collected for 143 municipalities in Serbia. The municipalities are classified into two groups according to distance from the nearest motorway. Using the non-parametric Wilcoxon rank-sum test, which is appropriate given that the data do not follow a normal distribution, we concluded that statistically significant differences exist between the employment rates and earnings in the identified groups of municipalities. These differences are particularly pronounced in the Serbia-North region, which encompasses Belgrade and Vojvodina, while the differences in the Serbia-South region are considerably smaller.*

Keywords: *Motorways, Employment, Earnings, Municipalities.*

JEL Classification: *O18, R40, H54*

* Corresponding author

1. INTRODUCTION

Over the past few decades, economic literature has identified numerous positive effects of investments in transport infrastructure, with the impact on economic growth being the most extensively researched and analysed. Many authors highlight the economic significance of motorway construction. Aschauer (1990) was one of the first to recognize the importance of motorways for the U.S. economy, noting that they increase the marginal product of private capital. This, in turn, encourages private sector investment and fosters growth in production and per capita income.

Similarly, Cook & Munnell (1990), using the U.S. economy as a case study, found that increases in public capital, including motorways, positively affect production growth. Consequently, local and regional governments in the U.S. are advised that investing in road infrastructure can influence the growth rates of their regions.

However, Boarnet (1995) cautioned that while the development of road infrastructure and motorways yields positive economic effects in municipalities where the network is established, it can also have negative repercussions on production in neighbouring municipalities due to shifts in company locations.

Regarding findings from Europe, Moreno et al. (1997) discovered a positive impact of infrastructure on labour productivity by examining 17 NUTS-2 regions in Spain, where the infrastructure indicator used was partially related to motorways. Additionally, Stephan (2001) investigated the influence of road infrastructure on production in regions of France and West Germany, identifying a significant effect.

Schade et al. (2015) evaluated the impact of investments in trans-European transport corridors within the core network on employment and gross domestic product (GDP) growth in the European countries traversed by these corridors. They estimated that these investments would lead to an increase of approximately €6 trillion in GDP across European countries during the period from 2015 to 2030, while the total increase in employment is projected to be around 17.5 million job-years. Notably, the most significant direct, indirect, and induced effects were observed from investments in the Scandinavian-Mediterranean corridor, followed by the Rhine-Alpine, Rhine-Danube, and North Sea-Baltic corridors.

Miljković et al. (2018) found significant disparities in economic performance among 157 European regions, highlighting that regions traversed by road and rail corridors of the core network perform better economically than those that are not. Specifically, regions within the TEN-T network achieve higher gross added value, higher gross added value per capita, and greater labour productivity, although the differences in employment rates are less pronounced. Similarly, Miljković & Petrović-Vujačić (2018a) examined 138 regions in the Central and Southeast European (CSEE) countries and concluded that there are notable differences in gross added value and labour productivity; however, no significant differences in employment rates were identified.

Moreover, proximity to these corridors impacts the attraction and location of foreign direct investments (FDI). An analysis of 106 foreign direct investments in Serbia between 2006 and 2012 revealed that the average distance of investment locations from Corridor X is only 25 kilometres. When the distances are weighted by the value of the investments, the average

distance drops to about 20 kilometres, indicating that larger investments tend to be located closer to the corridor (Miljković & Petrović-Vujačić, 2018b).

Empirical evidence demonstrates positive economic effects of infrastructure investments beyond Europe. Zou et al. (2008) identified beneficial impacts of road infrastructure investments on economic growth and the reduction of regional income inequality across a sample of 28 Chinese provinces. Similarly, Almeida & Guimaraes (2014) found that the development of road infrastructure in Brazilian municipalities positively influenced per capita income and facilitated economic convergence. Beyond their contributions to economic growth, employment, and income levels, investments in road infrastructure also help reduce transport costs, enhance productivity, mitigate externalities associated with transport, and yield numerous additional benefits.

This paper aims to investigate the correlation between the availability of motorways and higher earnings, as well as increased employment rates, using municipalities in Serbia as a case study. The second chapter of the paper presents statistical data on the amount and structure of transport infrastructure investments in Serbia. In the third chapter, the research methodology is explained, along with a presentation of the data that will be used for empirical analysis. Finally, the fourth chapter outlines the results of testing the established hypotheses.

2. TRANSPORT INFRASTRUCTURE INVESTMENT IN SERBIA

Total investment spending on transport infrastructure from 2001 to 2022 reached EUR 10.36 billion. Figure 1 illustrates the distribution of these investments by type of infrastructure. A significant majority, accounting for 81.6% of the total, was allocated to road infrastructure, with nearly half of that amount dedicated to motorways. Investments in railway infrastructure comprised 12% of the total, while inland waterways accounted for 6%, and air infrastructure represented a mere 0.5%.

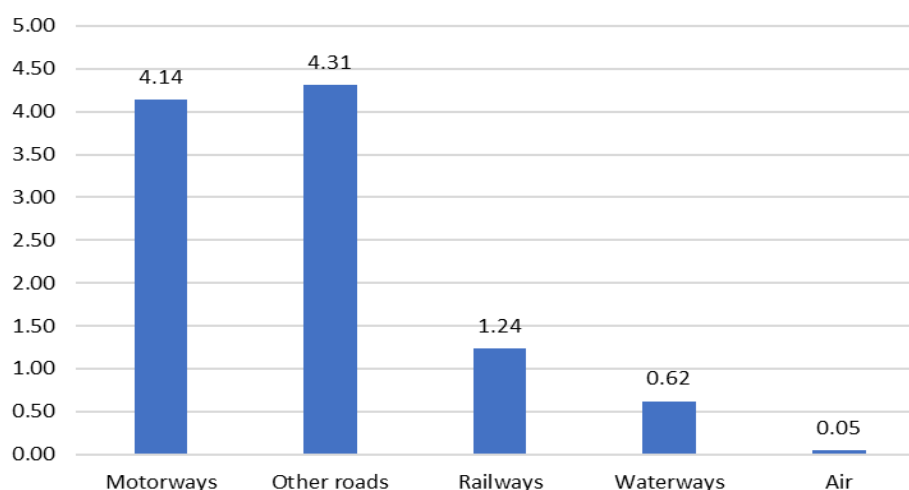


Figure 1: Value of Investment Spending by Type of Transport Infrastructure from 2001 to 2022 (EUR billion)

Source: Authors' calculation based on: OECD. (2024). ITF Transport Statistics - Transport infrastructure investment and maintenance. [Access Date: 4th November 2024] <https://doi.org/10.1787/trsprt-data-en>

Investments in transport infrastructure in Serbia have shown a significant upward trend over the past few decades, particularly in recent years, as illustrated in Figure 2. In 2022, total

infrastructure investment reached EUR 1.4 billion, with investments in motorways alone totalling EUR 0.82 billion.

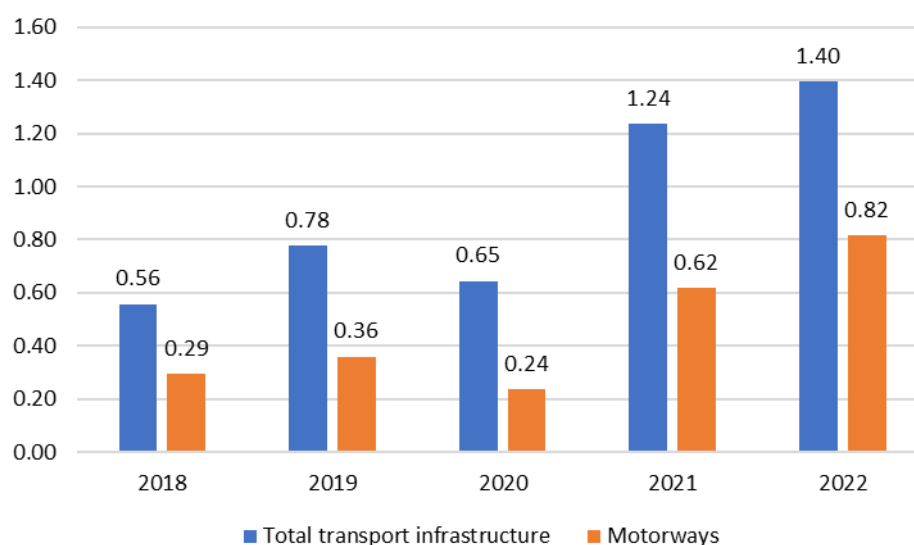


Figure 2: Value of Annual Investment Spending by Type of Transport Infrastructure from 2018 to 2022 (EUR billion)

Source: OECD. (2024). ITF Transport Statistics - Transport infrastructure investment and maintenance. [Access Date: 4th November 2024] <https://doi.org/10.1787/trsprt-data-en>

The total length of constructed motorways in Serbia is 977.3 km. Additionally, the construction of 117 km related to the A2 (Belgrade – Požega) and A5 (Pojate – Preljina, connecting A1 with A2) motorways is still planned, as presented in Table 1.

Table 1. Overview of Serbian motorways

Motorway	Description	Length (km)	
		Constructed	Under construction
A1	State border with Hungary – Belgrade – state border with North Macedonia	613.2	-
A2	Belgrade - Požega	140.1	19.7
A3	State border with Croatia - Belgrade	95.4	-
A4	Niš – state border with Bulgaria	105.4	-
A5	Pojate – Preljina	23.2	97.3
Total length of motorways		977.3	117.0

Source: PE Roads of Serbia. (2024). Department for Motorways. [Access Date: 5th November 2024] <https://www.putevi-srbije.rs/index.php/en/organisation/sector-for-the-maintenance-of-public-roads-of-i-and-ii-category/department-for-highway-preservation-and-maintenance>

Recent data reveals that total transport infrastructure investments in Serbia have reached 2.3% of GDP, a figure that is notably high in comparison to other countries in the region. Following Serbia, North Macedonia and Hungary have significant investments at approximately 1.7% of GDP, while the investments in other regional countries are comparatively lower, as shown in Figure 3.

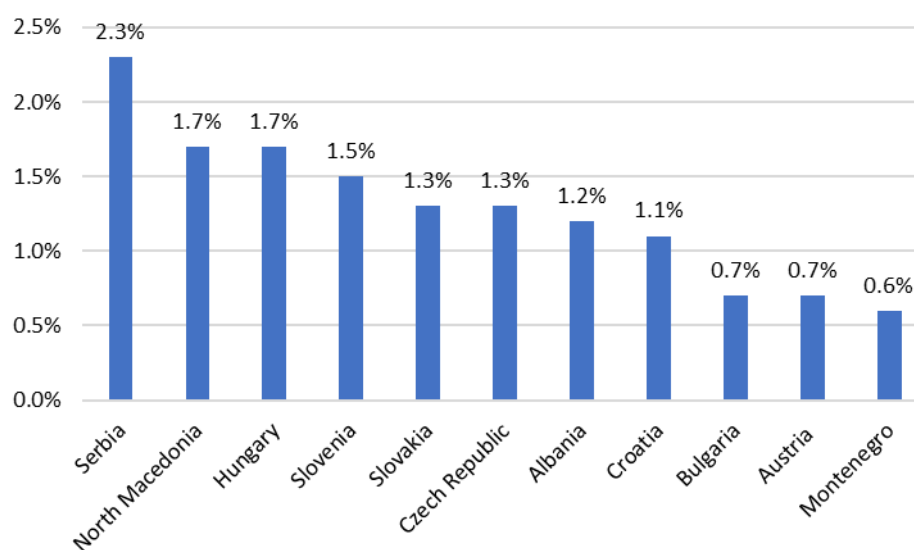


Figure 3: Share of Total Transport Infrastructure Investment as a Percentage of GDP by Country in the Region (2022)

Source: Authors' calculation based on: OECD. (2024). ITF Transport Statistics - Transport infrastructure investment and maintenance. [Access Date: 4th November 2024] <https://doi.org/10.1787/trsprt-data-en>

3. METHODOLOGY AND DATA

Based on the findings from the empirical literature, the following hypotheses are taken as a starting point:

- Municipalities with better motorways availability exhibit a higher employment rate compared to other municipalities with less access.
- In municipalities with better motorways availability, average earnings tend to be higher than in those with limited access.

To test the aforementioned hypotheses, all municipalities in Serbia were categorized into two groups based on motorway availability. The first group comprises 66 municipalities located no farther than 25 kilometres from the nearest motorway, while the second group includes 77 municipalities situated more than 25 kilometres away. Major cities such as Belgrade, Niš, and Novi Sad are treated as single units of local self-government.

To further examine the hypotheses regarding the relationship between motorways availability and employment rates as well as average earnings, a comprehensive dataset was compiled. The data sources and methodologies utilized are outlined as follows:

- Data on average net earnings for 2022 were sourced from the publication "Municipalities and Regions of the Republic of Serbia" (2023) by the Statistical Office of the Republic of Serbia. Earnings stated in dinars were converted to euros using the average annual exchange rate of 1 EUR = 117.4642 RSD for 2022.
- Information regarding the number of employed individuals and the working-age population (ages 15 to 64) was obtained from the same publication. The employment rate was calculated as the ratio of employed persons to the total working-age population.

- The distance of each municipality from the nearest motorway was determined using the map of constructed state roads of order IA, which is accessible through the Public Enterprise Roads of Serbia's website.

Descriptive statistics analysing the data by the selected groups are compiled in the following table, which include metrics such as mean earnings, mean employment rates, standard deviations, minimum and maximum values, and sample sizes for each group.

Table 2. *Descriptive statistics for the entire sample*

Variable	Distance from the nearest motorway	Obs.	Mean	Std. Dev.	Min	Max
Employment rate (%)	≤ 25 km	66	51.39	5.26	35.39	62.90
	> 25 km	77	48.03	6.60	21.54	61.84
Average monthly net earnings (EUR)	≤ 25 km	66	528.85	64.67	443	807
	> 25 km	77	509.83	50.35	423	739

Source: Authors' calculation using Stata software

The following normality tests are conducted: the joint skewness and kurtosis test for normality, the Shapiro-Wilk test, and the Shapiro-Francia test. Based on the values of the test statistics and the corresponding p-values presented in Table 3, it can be concluded that the null hypothesis of normal data distribution should be rejected.

Table 3: *Results of Normality Tests*

Variable	Test statistic	P-value
Joint skewness and kurtosis test for normality		
Employment rate (%)	adj. $\chi^2(2)=22.84$	Prob> $\chi^2 = 0.0000$
Average monthly net earnings (EUR)	adj. $\chi^2(2)=54.89$	Prob> $\chi^2 = 0.0000$
Shapiro-Wilk test for normal data		
Employment rate (%)	Z=3.597	Prob>Z = 0.0002
Average monthly net earnings (EUR)	Z=6.410	Prob>Z = 0.0000
Shapiro-Francia test for normal data		
Employment rate (%)	Z=3.594	Prob>Z = 0.0002
Average monthly net earnings (EUR)	Z=5.988	Prob>Z = 0.0000

Source: Authors' calculation using Stata software

Consequently, to test the hypotheses regarding differences between the two groups in the sample, the two-sample Wilcoxon rank-sum test will be applied.

4. RESULTS AND DISCUSSION

The employment rate, as well as the average monthly net earnings, is higher in municipalities located closer to the motorway, as evidenced by Figure 4. The results of the nonparametric two-sample Wilcoxon rank-sum test, presented in Table 4, indicate that the null hypothesis regarding the equality of employment rates between the two groups of municipalities can be rejected at the 1% significance level. Additionally, the null hypothesis concerning the equality of average monthly net earnings between the two groups can be rejected at the 5% significance level.

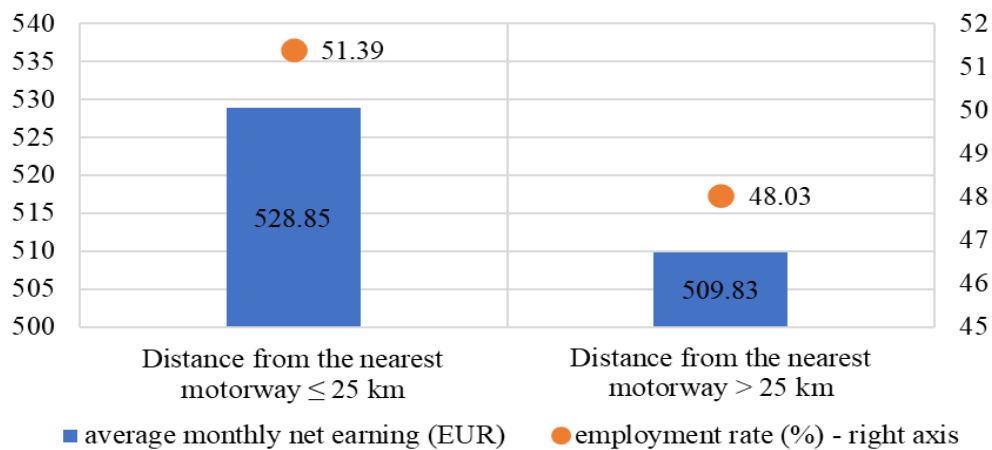


Figure 4: *Employment rate and average monthly net earnings of Serbian municipalities by distance from the nearest motorway (2022)*

Source: Authors' calculation based on data from: Statistical Office of the Republic of Serbia. (2023). Municipalities and Regions of the Republic of Serbia.

Table 4: *Results of the Two-Sample Wilcoxon Rank-Sum Test (entire Serbia)*

Hypothesis	Test statistic	P-value
H ₀ : Employment rates are the same in both groups of municipalities.	Z=-3.001	Prob>Z = 0.0027
H ₀ : Average monthly net earnings are the same in both groups of municipalities.	Z=-2.043	Prob>Z = 0.0410

Source: Authors' calculation using Stata software

Figure 5 illustrates the differences in employment rates and average monthly net earnings between two groups of municipalities, focusing specifically on each NUTS-1 statistical region of Serbia. The regions include Serbia-North, which encompasses Vojvodina and Belgrade, and Serbia-South, which includes Šumadija, Western Serbia, and Southern and Eastern Serbia.

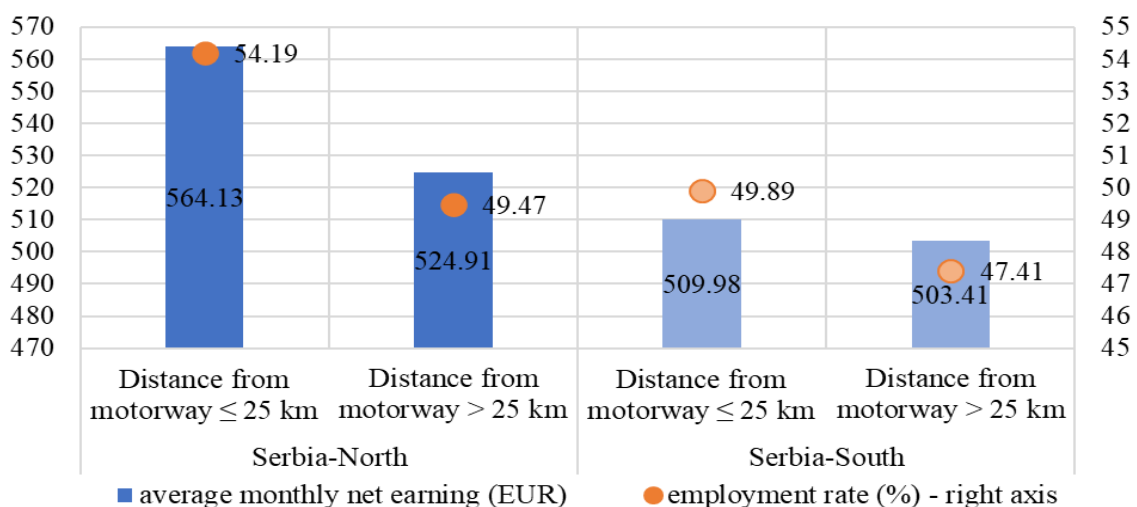


Figure 5: *Employment rate and average monthly net earnings of Serbian municipalities by distance from the nearest motorway and by NUTS-1 statistical regions of Serbia (2022)*

Source: Authors' calculation based on data from: Statistical Office of the Republic of Serbia. (2023). Municipalities and Regions of the Republic of Serbia.

In the Serbia-North region, the results of the two-sample Wilcoxon Rank-Sum test show that the null hypothesis regarding the equality of employment rates between the two groups of municipalities can be rejected at the 1% significance level. Similarly, the hypothesis regarding the equality of average monthly net earnings can be rejected at the 5% significance level, consistent with findings for the entire country of Serbia.

Table 5: Results of the Two-Sample Wilcoxon Rank-Sum Test (by statistical NUTS-1 regions)

Hypothesis	Test statistic	P-value
SERBIA-NORTH		
H ₀ : Employment rates are the same in both groups of municipalities.	Z=-2.713	Prob>Z = 0.0067
H ₀ : Average monthly net earnings are the same in both groups of municipalities.	Z=-2.132	Prob>Z = 0.0330
SERBIA-SOUTH		
H ₀ : Employment rates are the same in both groups of municipalities.	Z=-1.743	Prob>Z = 0.0814
H ₀ : Average monthly net earnings are the same in both groups of municipalities.	Z=-1.398	Prob>Z = 0.1620

Source: Authors' calculation using Stata software

Conversely, while municipalities in the Serbia-South region exhibit an average employment rate that is two percentage points higher than those located farther from the motorway (see Figure 5), the results of the Wilcoxon rank-sum test indicate that the null hypothesis regarding the equality of earnings between the two groups can only be rejected at a significance level of 10%. Additionally, it is not possible to determine the statistical significance of the differences in earnings between municipalities closer to the motorway and those farther away in the Serbia-South region.

5. CONCLUSIONS

Considering the obtained results, we can conclude that municipalities in Serbia with better motorway access demonstrate a higher employment rate compared to those with limited access. Additionally, average earnings tend to be higher in municipalities with better motorway availability. These differences are particularly pronounced in the Serbia-North region, which includes Belgrade and Vojvodina, where the road network has been well developed for an extended period.

In contrast, within the Serbia-South region, where significant investments have been made recently and more are expected in the coming period, the differences in earnings between municipalities near the motorway and those farther away are not statistically significant. Furthermore, the differences in employment rates are only significant at the 10% level. This observation suggests that recent investments have not yet produced significant effects on local employment and earnings in this region of Serbia.

To draw conclusions about the mutual influence of the aforementioned variables, an important step following identification of differences in earnings and employment, a more sophisticated econometric analysis is necessary. However, conducting such an analysis at the local level is challenging due to a lack of comparable data across many municipalities.

REFERENCES

- Almeida, E., & Guimaraes, P. (2014). *Economic Growth and Infrastructure in Brazil: A Spatial Multilevel Approach*. ERSA Conference Papers, European Regional Science Association.
- Aschauer, D. A. (1990). Highway Capacity and Economic Growth. *Economic Perspectives*, 14(Sep), 14-24.
- Boarnet, M. G. (1995). *Transportation Infrastructure, Economic Productivity and Geographic Scale: Aggregate Growth Versus Spatial Redistribution*. University of California Transportation Center Working Paper No. 255.
- Cook, L. M., & Munnell, A. H. 1990. How does public infrastructure affect regional economic performance? *New England Economic Review*, issue Sep, 11-33.
- Miljković, M., Jovanović Gavrilović, B., Petrović-Vujačić, J. (2018). „The transEuropean transport corridors: contribution to economic performances of European regions“, *Industrija* 46(2), 173-187. <https://doi.org/10.5937/industrija46-18043>
- Miljković, M., & Petrović-Vujačić, J. (2018a). „Road infrastructure and its implications for regional economic activity and productivity in the CSEE countries“, *Proceedings of the fourth International Conference on Traffic and Transport Engineering*, 985-991, 27-28 September 2018, Belgrade, City Net Scientific -Research Center Ltd. Belgrade.
- Miljković, M., & Petrović-Vujačić, J. (2018b). „Uticaj izgradnje pan-evropskog Koridora X na regionalni razvoj Srbije“, *Međunarodni simpozijum „Strateški razvoj saobraćaja Jugoistočne Evrope“*, 99-105, maj 2018, Budva, Fakultet za saobraćaj, komunikacije i logistiku, Univerzitet Adriatik.
- Moreno, R., Artis, M., Lopez-Bazo, E., Surinach, J. (1997). *Evidence of the Complex Link between Infrastructure and Regional Growth*. Working Papers in Economics 19, University of Barcelona.
- OECD. (2024). *ITF Transport Statistics - Transport infrastructure investment and maintenance*. [Access Date: 4th November 2024] <https://doi.org/10.1787/trsprt-data-en>
- PE Roads of Serbia. (2024). Department for Motorways. [Access Date: 5th November 2024] <https://www.putevi-srbije.rs/index.php/en/organisation/sector-for-the-maintenance-of-public-roads-of-i-and-ii-category/department-for-highway-preservation-and-maintenance>
- Statistical Office of the Republic of Serbia. (2023). Municipalities and Regions of the Republic of Serbia.
- Schade, W., Krail, M., Hartwig, J., Walther, C., Sutter, D., Killer, M., Maibach, M., Gomez-Sanchez, J., Hitscherich, K. (2015). *Cost of non-Completion of the TEN-T*. Fraunhofer Institut für System und Innovationsforschung.
- Stephan, A. (2001). *Regional Infrastructure Policy and Its Impact on Productivity: A Comparison of Germany and France*. CIG Working Papers FS IV 00-02, Wissenschaftszentrum Berlin (WZB), Research Unit: Competition and Innovation (CIG).
- Zou, W., Zhang, F., Zhuang, Z., Song, H. (2008). Transport Infrastructure, Growth and Poverty Alleviation: Empirical Analysis of China. *Annals of Economics and Finance*, 9(2), 345-371.

NAVIGATING ENTREPRENEURSHIP AND INNOVATION: THE IMPORTANCE OF INSTITUTIONAL QUALITY IN CEE

Ljubivoje Radonjić

State University of Novi Pazar, ljrandonjic@np.ac.rs,
ORCID number 0000-0001-8098-3833

Damjan Jolović

State University of Novi Pazar, djolovic@np.ac.rs,
ORCID number 0009-0002-1176-253X

Nevena Veselinović*

Institute for Information Technologies Kragujevac, nveselinovic@uni.kg.ac.rs,
ORCID number 0000-0001-8283-265X

Abstract: *The research examines the impact of institutional quality on entrepreneurship and patenting activity in Central and Eastern European (CEE) countries, utilizing the Economic Freedom indicators from the Fraser Institute. We hypothesize that higher institutional quality, characterized by limited government intervention, an effective legal system and property rights, capital market and trade institutions, and regulatory framework positively influence entrepreneurial endeavors and patenting outcomes. Strong institutions facilitate access to resources, reduce bureaucratic barriers, and foster an environment conducive to innovative behavior. Employing a panel regression, the paper examines the relationship between various institutions and entrepreneurial and innovation performance in the CEE countries. The results reveal a significant positive correlation between higher levels of economic freedom and increased rates of entrepreneurship and the production of patents. However, the impact of institutional quality is greater in determining entrepreneurship than innovation activities. The findings underscore the importance of institutions in shaping economic development in the CEE region and highlight the need for policy reforms to enhance institutional frameworks to support entrepreneurship better and stimulate patenting activity. Overall, the research contributes to understanding how institutional quality affects economic outcomes, emphasizing the vital role of economic freedom as a driver of innovation and entrepreneurship.*

Keywords: *Innovation, Entrepreneurship, Institutional Quality, CEE*

JEL Classification: *E02, O30, O43,*

* Corresponding author

1. INTRODUCTION

The relationship between institutions, entrepreneurship, and innovation is a topic of growing interest in the field of economic development (Harraf et al., 2020). Institutions, defined as the formal and informal rules that govern economic and social interactions, play a crucial role in shaping the incentives and opportunities for entrepreneurial and innovative activities (Harraf et al., 2020). The transition from centrally planned to market-oriented economies in Central and Eastern Europe (CEE) has brought institutional quality to the forefront of economic discourse. As these countries strive to achieve sustainable economic growth, the role of institutions in shaping entrepreneurial and innovation outcomes has gained increasing scholarly and policy attention. Institutions - encompassing legal frameworks, property rights, regulatory environments, and financial market systems - serve as the foundation for economic activity. They establish the rules and incentives that guide the behavior of entrepreneurs and innovators. This study investigates how these institutional dimensions, as measured by the Economic Freedom indicators from the Fraser Institute, influence entrepreneurship and patenting activity in the CEE countries.

Institutional quality is critical in reducing uncertainty and providing the necessary support structures for economic agents to thrive. Robust institutions facilitate access to resources, streamline administrative processes, and safeguard the returns on investments in innovation. Prior studies highlight the significant impact of judicial independence, property rights, and business regulations in fostering environments conducive to entrepreneurial growth and technological advancement (Jurlin & Čučković, 2010; Lubacha-Sember & Godlewska, 2018). However, the link between institutional quality and innovation remains complex, particularly as reflected in patenting activity. While entrepreneurship often responds quickly to improvements in governance and regulatory frameworks, innovation tends to depend on long-term investments and specialized financial mechanisms (Krammer, 2017; Tebaldi & Elmslie, 2008).

This research aims to contribute to the ongoing discourse by analysing the relationship between institutional quality and economic performance in 11 CEE countries over the period 2009 to 2020. By examining key institutional dimensions such as judicial independence, property rights, credit market regulations, and business regulations, the study seeks to provide a deeper understanding of how institutional quality supports entrepreneurship and innovation. In doing so, it offers valuable insights for policymakers seeking to strengthen institutional frameworks and foster sustainable economic development in the region.

The structure of the paper is as follows. After the introduction, the relevant empirical literature on the research topic is reviewed. The next section provides a detailed explanation of the data and methodology employed. This is followed by a presentation of the test results and discussion. Finally, the paper concludes by summarizing the main results and recommendations.

2. LITERATURE REVIEW

The intricate relationship between institutional quality and economic outcomes, particularly in the realms of entrepreneurship and innovation, has been a focal point in scholarly research. In the context of CEE, this relationship is particularly salient due to the region's transition from centrally planned to market economies. The exploration of institutional quality and its impact

on patent activity—a key indicator of innovation—has yielded valuable insights. Tebaldi (2005) laid the groundwork by highlighting the complexity of establishing a direct empirical link between institutions and economic growth, emphasizing that institutional arrangements can significantly stimulate innovation. His work underscores the challenges faced by countries with institutional constraints, which often lag in patent production and broader economic performance. Building on this, Tebaldi and Elmslie (2008) demonstrated through econometric analysis that institutions, particularly those ensuring corruption control and property rights protection, play a pivotal role in fostering technical innovation and enhancing patent output.

Werle (2011) takes this discussion further by examining how institutional frameworks facilitate incremental learning processes within firms. His analysis highlights the importance of collaborative interactions between firms, universities, and public research organizations, emphasizing that sectoral specialization driven by institutional quality can enhance technological advancement. Dolfsma and Leydesdorff (2011) add a methodological dimension by using patent data to map innovation systems, revealing how institutional frameworks shape patent networks and facilitate cross-country comparisons. Ugur (2012) critiques the normative assumptions of the national innovation systems (NIS) approach, arguing for more rigorous hypothesis testing to better understand the interplay between institutional factors and market structures. His work stresses the multifaceted nature of innovation incentives, calling for a deeper examination of institutional dynamics.

The role of governance in scientific and technological progress is further explored by Poege et al. (2019), who highlight the importance of scientific quality governance through metrics like citation counts. They argue that such governance structures are crucial for building robust innovation capabilities. Taalbi (2022) introduces a nuanced perspective on the role of intellectual property rights (IPR), suggesting that while strengthened IPR influences patenting behavior, significant innovation often occurs outside these legal frameworks. This complexity is further underscored by AlMalki and Durugbo (2023), who explore biases in institutional innovation and advocate for a multi-level management model to better navigate these complexities.

Parallel to the discourse on innovation, the relationship between institutional quality and entrepreneurship has also garnered significant attention. Bhat and Khan (2014) highlight how institutional environments shape entrepreneurial behavior, arguing that well-structured institutions channel entrepreneurial efforts toward productive activities. Their study emphasizes the importance of private property protection, taxation, and labor market regulations in fostering entrepreneurship. Li (2018) expands on this by examining the mediating role of governance quality, revealing that variations in national institutions influence the levels of entrepreneurial activity. His findings highlight the need for effective governance mechanisms to leverage institutional strengths for entrepreneurial growth.

Chowdhury et al. (2019) refine the discussion by distinguishing between necessity-driven and growth-oriented entrepreneurship, asserting that institutional quality plays a more substantial role in promoting the latter, which has a greater impact on innovation and economic development. Boudreaux et al. (2021) add to this by exploring the resilience of entrepreneurship following natural disasters, emphasizing that economic freedom can mitigate challenges faced by small firms in crises.

Collectively, these studies underscore the multifaceted impact of institutional quality on entrepreneurship and innovation. They reveal that robust institutions, characterized by effective governance, secure property rights, and streamlined regulatory frameworks, are essential for fostering a conducive environment for entrepreneurial and innovative activities.

3. METHODOLOGY

The study employs panel data covering the period from 2009 to 2020, focusing on eleven CEECs: Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, and Slovenia. The primary objective is to examine the relationship between institutional quality and its influence on entrepreneurial activity and patenting outcomes. To capture these aspects, two dependent variables are used. The first is the logarithmic value of the number of patent applications by residents (variable - *lpat*), which measures innovation output and is sourced from the World Development Indicators. The second is the logarithmic value of the number of enterprise births (variable - *lent*), which reflects new entrepreneurial activity and is obtained from Eurostat database. The study utilizes institutional quality indicators from the Fraser Institute's Economic Freedom dataset, specifically focusing on Judicial Independence, Protection of Property Rights, Credit Market Regulations, and Business Regulations. These indicators were chosen due to their direct relevance to the institutional environment that supports entrepreneurship and innovation. Judicial Independence (variable - *JI*) ensures that courts operate without external influence, offering a reliable mechanism for enforcing contracts and resolving disputes. This fosters a legal environment that encourages both entrepreneurs and innovators by safeguarding their investments and intellectual property. Similarly, the Protection of Property Rights (variable - *PRP*) provides security over tangible and intangible assets, reducing uncertainty and incentivizing investment in new ventures and innovative activities. Both indicators are essential for fostering confidence among entrepreneurs and innovators. Credit Market Regulations (variable - *CMR*) capture the accessibility and efficiency of financial markets, which are critical for funding entrepreneurial ventures and supporting innovation. Access to credit lowers financial barriers for startups and allows innovators to develop and commercialize their ideas. Lastly, Business Regulations (variable - *BR*) assess the administrative and procedural ease of starting and operating a business. Streamlined regulations reduce bureaucratic hurdles, enabling faster business formation and facilitating innovation by freeing up resources that can be redirected toward research and development.

The descriptive statistics in Table 1 highlight significant disparities in institutional quality and economic indicators across the CEECs. Innovation, measured by the log of patent applications (*lpat*), shows notable variation, with a mean of 5.74 and a range from 2.99 to 8.45. Entrepreneurial activity, captured by the log of enterprise births (*lent*), is more consistent but still varies, with a mean of 10.52. Institutional indicators such as Judicial Independence (*JI*) and Protection of Property Rights (*PPR*) exhibit moderate variability, reflecting differences in legal and property protections. Credit Market Regulations (*CMR*) are relatively high and consistent, while Business Regulations (*BR*) show wider variation, indicating diverse regulatory environments that may impact entrepreneurship and innovation differently across the region.

Aligned with the study's objective, two models are developed, where patents and entrepreneurship are expressed as linear functions of control variables, including Judicial

Independence, Protection of Property Rights, Credit Market Regulations, and Business Regulations:

$$lpat_{it} = \beta_0 + \beta_1 JI_{it} + \beta_2 PRP_{it} + \beta_3 CMR_{it} + \beta_4 BR_{it} + \varepsilon_{it} \quad (1)$$

$$lent_{it} = \alpha_0 + \alpha_1 JI_{it} + \alpha_2 PRP_{it} + \alpha_3 CMR_{it} + \alpha_4 BR_{it} + \omega_{it} \quad (2)$$

Where β_i and α_i represent the parameters to be estimated, and ε_{it} and ω_{it} denote the error terms.

Table 1. *Descriptive statistics*

Variable	Obs	Mean	Std. Dev.	Min	Max
lpat	132	5.736504	1.252203	2.995732	8.450198
lent	132	10.524690	0.994222	8.334951	12.507180
JI	132	6.302285	0.822902	4.741918	7.983740
PRP	132	6.461325	1.099230	4.361182	8.786045
CMR	132	9.019231	0.765734	6.115799	10.000000
BR	132	6.107198	1.004717	3.578563	8.635305

Source: Authors' calculations

To assess the presence of cross-sectional dependence in the panel dataset, the Pesaran Cross-Sectional Dependence (CD) was employed. This test is critical for panel data analysis as it evaluates whether the error terms across different cross-sectional units, in this case, the eleven CEECs, are correlated. Cross-sectional dependence is a common feature in regional or globally connected economies, where shocks or policy changes in one country may influence others. The test examines the null hypothesis of no cross-sectional dependence against the alternative that such dependence exists (De Hoyos & Sarafidis, 2006). Detecting cross-sectional dependence is essential, as its presence can lead to biased standard errors and invalid statistical inference if unaddressed. If significant cross-sectional dependence is detected, it signals the need for robust estimation techniques that can account for these interdependencies to ensure the reliability of the model's results. Further, the study employs the Cross-Sectional Augmented Im, Pesaran, and Shin (CIPS) test, developed by Pesaran (2007), to assess the stationarity of the data. As a second-generation unit root test, the CIPS test is specifically designed to account for cross-sectional dependence, ensuring more reliable and robust results under such conditions. In addition to testing for cross-sectional dependence, the analysis also examined the issues of heteroscedasticity and serial correlation. The Wald test for heteroscedasticity was used to assess whether the error variances are consistent across different sections. Heteroscedasticity can undermine the efficiency of estimators and lead to invalid statistical inferences within the standard regression framework. Additionally, the Wooldridge test was applied to detect first-order serial correlation in the panel data. The presence of serial correlation in the error terms violates key assumptions of the regression model, resulting in inefficient estimators and biased standard errors.

The first two equations will be established using Feasible Generalized Least Squares (FGLS). If the results of any of these tests suggest the presence of heteroscedasticity or serial correlation, the application of the Generalized Least Squares (GLS) method becomes necessary. GLS is a robust estimation technique designed to address issues of both heteroscedasticity and autocorrelation in error terms (Bai, Choi, & Liao, 2020). By transforming the model, GLS adjusts the error structure, ensuring that the transformed error terms are homoskedastic (having constant variance) and uncorrelated across observations. This transformation improves the efficiency of the estimators, making them more precise and

reliable compared to those obtained through ordinary least squares (OLS), which may be biased or inefficient under the presence of heteroscedasticity or serial correlation.

4. RESULTS AND DISCUSSION

The results in Table 2 reveal a significant level of interdependence among the CEECs, with the null hypothesis of cross-sectional independence being decisively rejected at the 1% significance level. This suggests that economic shocks in one CEE country are likely to propagate and affect others in the region. Additionally, the panel unit root tests show that the variables become stationary after first differencing, reinforcing the effectiveness of this transformation in accurately capturing the underlying economic dynamics within the countries under study.

Table 2. *Cross-Sectional Dependence and Unit Root Tests Results*

Variables	CD test	CIPS	
		level	first difference
lpat	7.675***	-1.686	-3.140***
lent	2.416**	-2.388*	-3.222***
JI	2.498***	-1.191	-3.050***
PPR	6.533***	-1.580	-2.411**
CMR	9.439***	-2.613***	-3.416***
BR	15.034***	-2.152	-3.675***

Notes: *, **, and ***denote significance at 10%, 5%, and 1%, respectively.

Source: Authors' calculations

Table 3 presents the results of several diagnostic tests, including the Pesaran CD test, the Wald test for heteroscedasticity, and the Wooldridge test for serial correlation. The Wald test provides strong evidence of group-wise heteroscedasticity in the data. Additionally, the Wooldridge test confirms the presence of autocorrelation in the error terms over time, while the Pesaran CD test reveals significant cross-sectional dependence. These findings suggest that the error terms are interrelated across sections, which may lead to unreliable standard errors for the estimated coefficients.

Table 3. *Diagnostic test results*

Test	Statistics	p-value	Indication
Pesaran CD	3.065	0.0022	Presence of cross-sectional dependence
Wald test	299.52	0.0000	Presence of group heteroscedasticity
Wooldridge test	F(1, 10) = 17.395	0.0019	Presence of autocorrelation

Source: Authors' calculations

Considering the results of the diagnostic tests, the model was estimated using the FGLS method, and the findings are presented in Table 4. The high Wald chi-squared values confirm the strong overall explanatory power of the models.

The results provide compelling evidence on the relationship between institutional quality and both innovation, measured by the number of patent applications (lpat), and entrepreneurial activity (lent) in the CEECs. Judicial Independence (JI) and Protection of Property Rights (PRP) emerge as the most significant predictors, with positive and highly significant coefficients for both dependent variables. The coefficient for Judicial Independence is 0.52 for lpat and 0.47 for lent, indicating that a one-unit increase in judicial independence is

associated with a 0.52% increase in patent applications and a 0.47% increase in entrepreneurial activity, respectively. Similarly, the coefficient for Protection of Property Rights is 0.55 for *lpat* and 0.49 for *lent*, suggesting that improvements in property rights protection lead to a 0.55% increase in patenting and a 0.49% increase in enterprise births. This underscores the critical role of strong legal frameworks and property rights in fostering environments conducive to innovation and entrepreneurship, aligning with findings by Nyström (2008) and Aidis et al. (2012), who similarly emphasize the importance of institutional quality in transition economies. Business Regulations show positive and significant coefficients for both dependent variables (0.33 for *lpat* and 0.38 for *lent*). This implies that a one-unit reduction in regulatory burden leads to a 0.33% increase in patenting and a 0.38% rise in new business formations. These findings align with Aidis (2005), reinforcing the idea that streamlined regulatory environments promote both innovation and entrepreneurial activity.

As expected from economic theory, Credit Market Regulations (CMR) have no significant impact on patents (p-value = 0.922), as patent applications generally do not require substantial investment and are less dependent on credit. However, the results reveal that credit market regulations have a positive and statistically significant impact on entrepreneurship (p-value = 0.000). Specifically, a one-unit improvement in CMR is associated with a 0.11% increase in entrepreneurial activity. This finding underscores the critical role of favorable credit conditions in fostering business creation and supporting entrepreneurial growth. This result aligns with studies like Beck et al. (2003), which highlight that while access to credit is crucial for supporting new business ventures, it may not directly drive R&D-intensive activities like patenting. Also, this aligns with findings from Braunerhjelm et al. (2023), who highlight the nuanced effects of regulatory frameworks on innovation and entrepreneurship. In contrast, entrepreneurship, which includes starting and expanding businesses, is more directly influenced by access to credit as it facilitates initial capital needs and operational scaling (Beck et al., 2003). Krammer (2009) similarly emphasizes that while financial development is crucial for fostering business growth, its role in innovation-driven processes like patenting may require targeted support. These findings suggest that institutional reforms aimed at improving judicial systems, securing property rights, and reducing regulatory burdens are pivotal for enhancing both entrepreneurial and innovative performance.

Table 4. *FGLS Results*

Dependent variables:	<i>lpat</i>	<i>lent</i>
Variables	Coefficients	Coefficients
JI	0.52***	0.47***
PRP	0.55***	0.49***
CMR	0.00	0.11***
BR	0.33***	0.38***
Wald chi2	888.60***	3146***
Notes: Coefficients: Generalized Least Squares; Panels: Heteroskedastic with Cross-Sectional Correlation; Correlation: AR(1)		
*, **, and *** denote significance at 10%, 5%, and 1%, respectively.		

Source: Authors' calculations

Moreover, the study's results align with broader empirical literature. For example, Krammer (2009) found that institutional quality positively affects national innovation in transition economies, while Zádor (2019) observed a similar dynamic in CEECs, noting that

institutional reforms post-EU accession have significantly enhanced innovation outputs, including patenting. Prokop et al. (2021) also highlighted the role of property rights and regulatory frameworks in driving innovation processes in CEECs. These results collectively demonstrate the significant interplay between robust institutions and economic dynamism, further underscoring the necessity of institutional quality for sustainable growth in emerging economies.

The results indicate that while higher levels of economic freedom positively impact both entrepreneurship and patent production, the effect is more pronounced for entrepreneurship. This is particularly evident from the statistically insignificant coefficient of CMR for patent production. Patenting activities often depend on long-term R&D investments and specialized funding mechanisms that go beyond general credit availability. Innovators typically seek venture capital, government grants, or industry-specific funding sources, which are not fully captured by broader measures of credit market efficiency. In contrast, entrepreneurship, which includes starting and expanding businesses, is more directly influenced by access to credit as it facilitates initial capital needs and operational scaling. This finding suggests that while institutional quality supports both entrepreneurship and innovation, its mechanisms—such as financial infrastructure—may play a more critical role in the early stages of business formation than in driving high-risk, capital-intensive innovation processes like patenting.

5. CONCLUSIONS AND RECOMMENDATIONS

The study provides evidence on the significant role of institutional quality in fostering entrepreneurship and innovation within CEE countries. By utilizing the Economic Freedom indicators from the Fraser Institute, the analysis reveals that higher levels of economic freedom—reflected in judicial independence, secure property rights, efficient credit markets, and streamlined business regulations—positively influence both entrepreneurial activity and patent production. However, the findings indicate that institutional quality has a stronger effect on entrepreneurship than on innovation outcomes such as patenting. This distinction highlights the different mechanisms through which institutional frameworks support these two facets of economic dynamism.

Entrepreneurial activity benefits directly from institutional improvements, as reduced bureaucratic barriers, better access to credit, and a more predictable legal environment create immediate opportunities for business formation and growth. In contrast, innovation processes, which culminate in patenting, rely on longer-term investments and more specialized funding mechanisms beyond general credit access. These results align with existing literature, including studies by Nyström (2008), Aidis et al. (2012), and Krammer (2009), which emphasize the critical role of institutional quality in supporting economic performance, particularly in transition economies.

Based on the findings, several concrete policy recommendations can be made to further enhance institutional quality and support both entrepreneurship and innovation in the CEECs. Strengthening judicial independence and property rights should be a priority, ensuring that businesses and innovators can operate in a fair and predictable legal environment. Simplifying business regulations will reduce the bureaucratic burden, making it easier to start and grow enterprises. Furthermore, although Credit Market Regulations have a limited direct impact on innovation, improving access to credit remains essential for supporting entrepreneurial ventures, which often rely on initial capital for growth. Expanding targeted financial

instruments such as venture capital, R&D grants, and tax incentives could complement these institutional improvements by addressing specialized funding needs for innovation. By implementing these measures, policymakers can create a more dynamic and competitive economic environment in the CEECs, driving sustained growth in both entrepreneurship and innovation.

REFERENCES

- Aidis, R. (2005). Institutional barriers to small-and medium-sized enterprise operations in transition countries. *Small business economics*, 25, 305-317. doi:10.1007/s11187-003-6463-7
- Aidis, R., Estrin, S., & Mickiewicz, T. M. (2012). Size matters: Entrepreneurial entry and government. *Small Business Economics*, 39(1), 119–139. doi:10.1007/s11187-010-9299-y
- AlMalki, H. A., & Durugbo, C. M. (2022). Systematic review of institutional innovation literature: Towards a multi-level management model. *Management Review Quarterly*. doi:10.1007/s11301-022-00259-8
- Bai, J., Choi, S. H., & Liao, Y. (2020). Feasible generalized least squares for panel data with cross-sectional and serial correlations. *Empirical Economics*. doi:10.1007/s00181-020-01977-2
- Beck, T., Demirgüç-Kunt, A., & Levine, R. (2003). Law and finance: Why does legal origin matter? *Journal of Comparative Economics*, 31(4), 653–675. doi:10.1016/j.jce.2003.08.001
- Boudreaux, C. J., Jha, A., & Escaleras, M. (2021). Weathering the storm: How foreign aid and institutions affect entrepreneurship activity following natural disasters. *Entrepreneurship Theory and Practice*, 104225872110021. doi:10.1177/10422587211002185
- Braunerhjelm, P., Andersson, M., Blind, K., & Eklund, J. E. (2023). Handbook of Innovation and Regulation: Introductory chapter. In *Handbook of innovation and regulation* (pp. 1–20). Edward Elgar Publishing. doi:10.4337/9781800884472.00005
- Chowdhury, F., Audretsch, D. B., & Belitski, M. (2018). Institutions and entrepreneurship quality. *Entrepreneurship Theory and Practice*, 43(1), 51–81. doi:10.1177/1042258718780431
- De Hoyos, R. E., & Sarafidis, V. (2006). Testing for Cross-Sectional Dependence in Panel-Data Models. *The Stata Journal: Promoting Communications on Statistics and Stata*, 6(4), 482–496. doi:10.1177/1536867x0600600403
- Dolfsma, W., & Leydesdorff, L. (2011). Innovation systems as patent networks: The Netherlands, India and nanotech. *Innovation*, 13(3), 311–326. doi:10.5172/impp.2011.13.3.311
- European Commission. (n.d.). *Enterprise births, by NACE Rev. 2 activity [tin00170]*. Eurostat. Retrieved October 10, 2024, from https://ec.europa.eu/eurostat/databrowser/view/tin00170__custom_13414937/default/table?lang=en
- Fraser Institute. (n.d.). *Economic freedom of the world: Annual report*. Retrieved October 10, 2024, from <https://www.fraserinstitute.org/studies/economic-freedom>
- Harraf, A., Ghura, H., Hamdan, A., & Li, X. (2020). Formal institutions and the development of entrepreneurial activity – the contingent role of corruption in emerging economies. *Journal of Entrepreneurship and Public Policy*, ahead-of-print(ahead-of-print). doi:10.1108/jep-06-2020-0033

- Jurlin, K., & Čučković, N. (2010). Comparative analysis of the quality of European institutions 2003-2009: convergence or divergence?. *financial Theory and Practice*, 34(1), 71-98.
- Karlsson, C., & Warda, P. (2014). Entrepreneurship and innovation networks. *Small Business Economics*, 43(2), 393–398. doi:10.1007/s11187-014-9542-z
- Krammer, S. M. S. (2009). Drivers of national innovation in transition: Evidence from a panel of Eastern European countries. *Research Policy*, 38(5), 845–860. doi:10.1016/j.respol.2009.01.022
- Krammer, S. M. S. (2017). Greasing the wheels of change: Bribery, institutions, and new product introductions in emerging markets. *Journal of Management*, 45(5), 1889–1926. doi:10.1177/0149206317736588
- Li, T. (2017). Entrepreneurship and environments: Start-ups, growth aspirations, and exit (Doctoral dissertation). University of Essex.
- Lubacha-Sember, J., & Godlewska, M. (2018). The role of local formal and informal institutions in microfirms' development: Evidence from Poland. *Economics & Sociology*, 11(3), 43–58. doi:10.14254/2071-789x.2018/11-3/3
- Nyström, K. (2008). The institutions of economic freedom and entrepreneurship: Evidence from panel data. *Public Choice*, 136(3-4), 269–282. doi:10.1007/s11127-008-9295-9
- Pesaran, M. H. (2007). A simple panel unit root test in the presence of cross-section dependence. *Journal of Applied Econometrics*, 22(2), 265–312. doi:10.1002/jae.951
- Poege, F., Harhoff, D., Gaessler, F., & Baruffaldi, S. (2019). Science quality and the value of inventions. *Science Advances*, 5(12), Article eaay7323. doi:10.1126/sciadv.aay7323
- Prokop, V., Stejskal, J., Klimova, V., & Zitek, V. (2021). The role of foreign technologies and R&D in innovation processes within catching-up CEE countries. *Plos One*, 16(4), Article e0250307. doi:10.1371/journal.pone.0250307
- Taalbi, J. (2022). Innovation with and without patents. arXiv preprint arXiv:2210.04102.
- Tebaldi, E. (2005). Innovation and institutions: Examining the black box (Doctoral dissertation). University of New Hampshire Scholars' Repository. Retrieved from <https://scholars.unh.edu/dissertation/274>
- Tebaldi, E., & Elmslie, B. (2008, February). Do institutions impact innovation? [MPRA Paper No. 8757]. Retrieved from <http://mpra.ub.uni-muenchen.de/8757/>
- Ugur, M. (2012, December). Governance, regulation, and innovation: Introducing new studies. [MPRA Paper No. 44151]. Retrieved from <https://mpra.ub.uni-muenchen.de/44151/>
- Werle, R. (2011, June). Institutional analysis of technical innovation: A review (SOI Discussion Paper 2011-04). Retrieved from <http://www.uni-stuttgart.de/soz/oi/publikationen/>
- World Bank. (n.d.). *World Development Indicators*. Retrieved October 10, 2024, from <https://databank.worldbank.org/reports.aspx?source=2&country=ARE>
- Zádor, Z. (2019). Effect of the 2004 EU Accession on Patent Quality in the Central Eastern European Region. *Central European University, Thesis*.

ACKNOWLEDGEMENT

This research is funded by the Ministry of Science, Technological Development and Innovation, Republic of Serbia, GRANTS: Agreement No. 451-03-66/2024-03/200378.

LOST BRILLIANCE: THE IMPACT OF BRAIN DRAIN ON ECONOMIC GROWTH

Marija Radulovic*

State University of Novi Pazar Republic of Serbia, maradulovic@np.ac.rs,
ORCID number 0000-0002-4037-415X

Abstract: *The emigration of highly skilled individuals from their home countries, also known as the brain drain, has been a concern for policymakers and economists worldwide for a long time. The aim of the paper is to examine the effect of the emigration of highly skilled individuals on the economic growth in both source and recipient countries. The paper examines how the brain drain affects the economic growth in both the source and recipient countries, and it also considers factors such as the educational opportunities and the economic and social conditions. The study analyzes data from 2006 to 2022 for 25 OECD countries using the AutoRegressive Distributed Lag (ARDL) approach to estimate the effects of the brain drain on the economic growth. The results show that the emigration of highly skilled individuals from their home countries has a negative impact on the economic growth in the source country while a positive impact on the recipient country. The results contribute to the ongoing brain drain debate and offer valuable insights for policymakers and governments. By quantifying the effects of the brain drain on the economic growth, this research provides a basis for formulating strategies to mitigate its negative consequences and maximize its potential benefits.*

Keywords: *brain drain, economic growth, OECD countries*

JEL Classification: *O47, O15, F43, F22, J61*

* Corresponding author

1. INTRODUCTION

The emigration of highly skilled individuals from their home countries, also known as the brain drain, has been a concern for policymakers and economists worldwide, especially regarding its effect on economic growth. According to the World Bank (2022), highly educated migrants comprise over 30% of the total migrant population in many low- and middle-income countries, raising questions about the long-term impact on economic growth. Bhagwati (1976) states that the economic cost of brain drain is not only in the loss of expertise but also in the subsidies that the country of origin has invested in the education of those individuals.

Emigration can benefit individuals significantly, allowing them better access to labour markets, education, better living conditions and opportunities for economic advancement. For many people, migration is a way to escape poverty, political instability or war and improve their living standards in a country that offers better economic and social conditions. Migration also allows people to acquire new skills, knowledge and experiences, which can later contribute to the society they return to (Benson and O'Reilly, 2009). However, this process can negatively affect the countries where people emigrate. Losing the labour force, especially highly skilled workers, can decrease productivity and slow economic activity. In countries with a high level of emigration, a "brain drain" occurs and highly educated and qualified individuals leave their home countries in search of better opportunities. This reduces the country's capacity to develop its industries and innovations and attract foreign investment (Dodani and LaPorte, 2005).

Therefore, the aim of the paper is to examine the effect of the emigration of highly skilled individuals on economic growth in source and recipient countries. The paper examines how brain drain affects economic growth in both the source and recipient countries, and it also considers factors such as educational opportunities and economic and social conditions. The hypotheses of the research are as follows:

Hypothesis 1. There is a long-run and short-run relationship between the emigration of highly skilled individuals ("brain drain") and economic growth in OECD countries.

Hypothesis 2. There is a long-run and short-run relationship between the immigration of highly skilled individuals ("brain gain") and economic growth in OECD countries.

The paper is structured as follows. Besides the Introduction and Conclusion, the paper has three sections. Section one presents the overview of the literature about the effect of emigration and immigration of highly skilled individuals on economic growth. Section two shows the methodology of the research. Section 3 presents research results and discusses findings about the effect of brain drain on the economic growth of source and recipient countries.

2. LITERATURE REVIEW

A review of the literature found that numerous empirical and theoretical studies have confirmed the thesis on the impact of migration of highly skilled individuals on economic growth in both developing and developed countries (Srivastava, 2018; Mohamed et al., 2024; Gibson and McKenzie, 2010; Le, 2008; Beine, Docquier, and Rapoport, 2001). Le (2008)

examined the relationship between international labour force mobility and technology transfer in 19 OECD countries from 1980 to 1990. The author found that the international labour force movement facilitates technology transfer from home countries to recipients' countries and vice versa. The results support the idea of "brain circulation" rather than "brain drain". The authors also examined the effect of human capital on the research and development diffusion process and found that a higher share of human capital improves the absorptive capacity of recipient countries, helping them better utilize foreign human capital. Ultimately, the authors indicate that emigration and immigration contribute to productivity growth.

Beine, Docquier, and Rapoport (2001) examined the impact of migration on economic growth of 37 developing economies. Authors distinguish between two effects of migration: the "brain effect", which encourages education investment due to higher expected returns abroad, and the "drain effect", which results from the emigration of highly educated individuals. The authors argue that a "beneficial brain drain" occurs when the brain effect outweighs the drain effect, leading to a situation where the average level of human capital in the economy with migration opportunities is higher than in a closed economy. Beine, Docquier, and Rapoport (2001) found that the economic growth rate is positively related to the share of educated people but negatively related to migration flows.

Srivastava (2018) examined the economic impact of brain drain on economic growth for developing and developed nations. The author argues that while there are some positive aspects of brain drain, such as the globalization of talent and increased human capital, the overall effects tend to be negative. Developing countries lose skilled workers who could contribute to their economies, resulting in slower development and a lack of technological advancement. The authors show that countries struggle to provide adequate job opportunities despite having many highly educated people. Therefore, highly educated individuals seek employment in other countries. Developed countries face challenges from an influx of highly educated migrants, leading to job saturation and potential wage decreases for skilled positions (Srivastava 2018). The author indicates the importance of addressing brain drain as it has broader implications for the global economy and social structures. The author suggests developing nations must create more competitive work environments and retain highly skilled individuals through improved opportunities and policies that encourage educated individuals to stay and contribute to their home countries.

Mohamed et al. (2024) investigated the impact of brain drain on economic growth in 140 developing countries from 2007 to 2021 and the effects of diaspora externalities. The authors find that brain drain positively affects economic growth, particularly in developing countries. The authors found that increased brain drain by 1% is related to increased economic growth by approximately 0.27% to 0.35%. The study indicates that lower-income countries experience greater positive impacts from brain drain, while the effects vary by region. Some regions benefit positively from brain drain, while others show negative effects. The results show no significant dynamic relationship between past brain drain and current economic growth, indicating that the effects of brain drain are immediate. The results also show that while brain drain contributes positively to economic growth, the externalities, measured through variables such as human capital, technical level, and governance, have negative impacts.

Gibson and McKenzie (2010) examined the economic consequences of "brain drain", focusing on the experiences of Tonga, Micronesia, Papua New Guinea, Ghana, and New

Zealand. Highly skilled individuals who migrate experience significant income gains, estimated between \$40,000 to \$75,000 per year. This is higher than the income they would have earned if they remained in their home countries. There are high emigration and return migration levels among the highly skilled individuals in observed countries. Approximately 65% of the best and brightest have migrated at some point, with an important return migration rate.

The previous research results indicate that the effects of the emigration of highly skilled individuals on economic growth are similar and indicate a negative effect of "brain drain", but there is also research that shows a negative effect. The previous research indicates that the effects of the immigration of highly skilled individuals on the economic growth of recipients' countries are not unique and depend on various factors such as the research methodology, the research period, the research area, and many other factors. Accordingly, based on the previous research, models will be formed to examine the impact of the emigration and immigration of highly skilled individuals on economic growth in OECD countries.

3. METHODOLOGY

A sample of 25 OECD countries (Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, the Slovak Republic, Spain, Sweden, Turkey, the United Kingdom and the United States) was used to test hypotheses. The annual data from 2006 to 2022 was used. Data about migration was retrieved from the OECD database and database on immigrants in OECD and non-OECD Countries (DIOC). Data about the Gross Domestic Product (GDP) growth rate, the share of people with high education, the share of unemployed people with high education, and Gross Domestic Product (GDP) per capita were retrieved from World Bank databases.

The following equations are constituting the model:

$$GDP_{it} = f(Brains_{it}, HE_{it}, UNPHE_{it}, GDPpc_{it}) \quad (1)$$

$$GDP_{it} = f(Brainr_{it}, HE_{it}, UNPHE_{it}, GDPpc_{it}) \quad (2)$$

Where GDP_{it} is Gross Domestic Product growth rate in country i in period t ; $Brains_{it}$ is the number of highly skilled emigrants in country i in period t ; $Brainr_{it}$ is the number of highly skilled immigrants in country i in period t ; HE_{it} is share of people with high education in country i in period t ; $UNPHE_{it}$ is share of unemployed people with high education in country i in period t ; $GDPpc_{it}$ is Gross Domestic product per capita in country i in period t ; $t = 2006, \dots, 2022$, $i = 1, 2, \dots, 25$. Variables GDP and GDPpc were used in log form.

The Pesaran cross-section dependence test is used to determine whether there is a cross-section dependence between panel data. If the Pesaran CD test confirms cross-section dependence, the Im, Pesaran and Shin second-generation unit root test (CIPS) was used to determine whether the data are integrated of the same order; otherwise, the Im, Pesaran and Shin first-generation unit root test (IPS). The cointegration among variables was tested using Kao's cointegration test (Kao and Chiang, 2000). If there is cointegration among variables and variables are not I(2), the Auto-Regressive Distributed Lag (ARDL) approach is used to determine whether there is a short-run and long-run relationship between economic growth and immigration and emigration of highly skilled individuals.

4. RESULTS AND DISCUSSION

Table 1 shows descriptive statistics for variables. The mean GDP growth rate in observed OECD countries from 2006 to 2022 is 1.89, ranging from -11.17 (Spain 2020) to 24.48 (Ireland 2015). The mean GDP per capita is 53431.42, ranging from 18495.40 (Türkiye 2009) to 140435.80 (Luxembourg 2007). The average number of emigrants in observed OECD countries from 2006 to 2022 is 6588401, while the average number of immigrants is 7338131. The number of immigrants ranged from 61076 (Luxembourg 2011) to 91731646 (USA 2015). The number of emigrants ranged from 35643 (Luxembourg 2011) to 100040000 (USA 2021). The lowest number of emigrants and immigrants was observed in Luxembourg in 2011. The average share of people with high education is 21.06, ranging from 0.14 (Italy 2010) to 42.33 (Luxembourg 2022). The average share of highly educated unemployed people is 4.95, ranging from 0.79 (Czech Republic 2022) to 3.15 (Luxembourg 2007).

Table 1. *Descriptive Statistics*

Variable	n	M	SD	Min	Max
GDP	425	1.89	3.60	-11.17	24.48
Brains	425	6588401	13984853	35643	91731646
Brainr	425	7338131	15300355	61076	100040000
HE	425	21.06	9.98	0.14	42.33
UNPHE	425	4.95	3.15	0.79	3.15
GDPpc	425	53431.42	23129.80	18495.40	140435.80

Note: GDP – Gross Domestic Product growth rate; Brains – number of emigrants; Brainr – number of immigrants; HE – share of people with high education; UNPHE – share of unemployed people with high education; GDPpc – Gross Domestic product per capita

Source: Authors' calculations in EViews 12

Figure 1 shows the movement of highly skilled individuals to and from OECD countries. Figure 1a shows the number of highly skilled immigrants from OECD countries to Asia, Europe, Africa and North America. The focus is on the regions because migration patterns are better visible. The diagram shows that Europe is the largest recipient of highly educated immigrants from OECD countries. The results show a high density of highly skilled immigrants within Europe, indicating strong intra-European mobility, probably due to the free movement of people, economic integration, and cultural background. Further, many highly educated immigrants from European countries such as Germany to North America, especially the USA. Africa and Asia have fewer highly educated immigrants from OECD countries.

Figure 1b shows the number of highly skilled emigrants from OECD countries to Asia, Europe, Africa and North America. According to the diagram, the emigration of highly skilled individuals from OECD countries to Africa is lower than in other regions, but significant relationships with some OECD countries are observed to be possible due to historical or economic relations. The diagram also shows a high migration density of highly skilled individuals within Europe, indicating strong intra-European mobility. Other OECD countries outside Europe also show the migration of highly skilled individuals to Europe, but less than migration within Europe. Further, the diagram shows an important movement of highly skilled individuals within North America, especially between Mexico, the USA and Canada. There is also important emigration of highly skilled individuals from OECD countries to North America, especially the USA and Canada. The chord diagram also shows that highly skilled individuals emigrate from OECD countries to Asia.

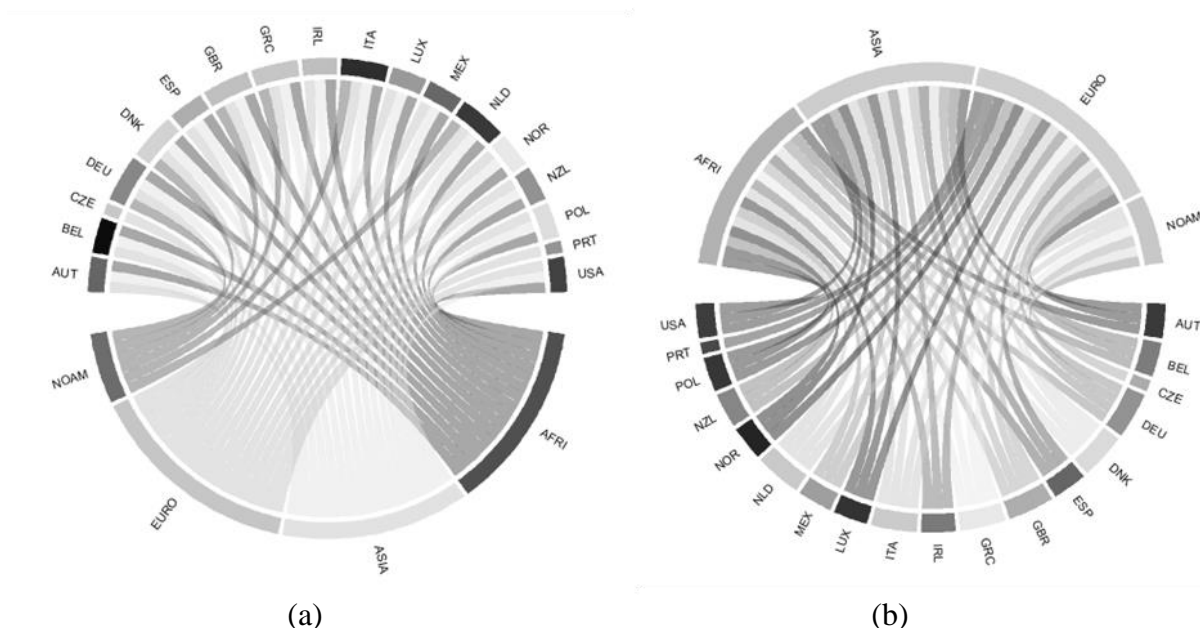


Figure 1. Number of emigrants and immigrants in OECD countries

Note. Chord diagram (a) shows the number of immigrants to OECD countries, while (b) shows the number of emigrants.

Source. Author's calculation in RStudio

Before conducting a panel analysis, testing for the cross-sectional dependence is important. If the cross-sectional dependence test is not conducted, it can lead to biased estimates. Therefore, the Pesaran (2004) cross-section dependence (CD) test was used to determine cross-section dependence in the time series GDP, Brains, Brainr, HE, UNPHE, and GDPpc. The results show that the null hypothesis that there is no cross-sectional dependence was rejected for all time series ($p < 0.01$) (Table 2).

Table 2. Results of cross-section dependence and unit root tests

Variable	Pesaran CD test	IPS unit root test		I(0) or I(1)
	t	Intercept	Intercept and trend	
GDP	51.32***	-12.77***	-9.49***	I(0)
Brains	33.77***	5.37	1.39	I(1)
ΔBrains		-2.81***	-9.87***	I(1)
Brainr	63.99***	1.59	2.60	I(1)
ΔBrainr		-3.78	-9.15***	I(1)
HE	42.37***	1.35	-0.89	I(1)
ΔHE		-11.94	-8.08***	I(1)
UNPHE	23.57***	-2.24**	-2.87***	I(0)
GDPpc	44.03***	5.01	-0.86	I(1)
ΔGDPpc		-12.19***	-11.37***	I(1)

Note: GDP – Gross Domestic Product growth rate; Brains – number of emigrants; Brainr – number of immigrants; HE – share of people with high education; UNPHE – share of unemployed people with high education; GDPpc – Gross Domestic product per capita

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$

Source: Authors' calculations in EViews 12

Because the Pesaran CD test revealed cross-section dependence in all-time series, the second generation of unit root test (CIPS, cross-section Im, Pesaran, and Shin) was used to establish the order of variable integration (Pesaran, 2007). According to the unit root test results, the series are not integrated in the same order. Variables GDP and UNPHE are I(0), while variables Brains, Brainr, HE, and GDPpc are I(1) (Table 2).

The cointegration among variables was tested using Kao's cointegration test (Kao and Chiang, 2000). The results revealed cointegration among variables ($t = -12.79$, $p < 0.001$; $t = -3.11$, $p < 0.001$) in both models (Model 1 and Model 2). Since variables are not integrated of the same order and there are no variables I(2), the panel ARDL approach by Pesaran et al. (1999) will be used to examine whether there is a short-run and long-run relationship between variables. The optimal lag length is determined using the Akaike Information Criterion (AIC) and found to be ARDL (2, 2, 2, 2, 2) for Model 1 and Model 2.

Table 3 shows the ARDL approach long-run results for Model 1 and Model 2. Model 1 shows the effect of brain drain (emigration of highly skilled individuals) on economic growth. The results show that brain drain negatively affects the economic growth of OECD countries in the long run ($p < 0.01$). This means that the emigration of highly skilled individuals from their home countries has a negative impact on economic growth in the source country. The share of highly educated individuals in the source country has a positive effect on economic growth in the source country in the long run ($p < 0.01$). This means that economic growth increases with the increase in highly educated individuals. The share of unemployed, highly educated individuals in the source country negatively affects economic growth in the source country in the long run ($p < 0.01$). Economic growth decreases with the increase in unemployed, highly educated individuals. GDP per capita has a positive significant effect on economic growth in the long run ($p < 0.01$) (Table 3).

Table 3. ARDL approach long-run results

Variable	Model (1)	Model (2)
Brains	-0.14*** (0.05)	
Brainr		0.26*** (0.14)
HE	0.02*** (0.01)	0.01*** (0.01)
UNPHE	-0.41*** (0.04)	-0.21*** (0.01)
GDPpc	12.45*** (1.49)	1.95*** (0.42)

Note: GDP – Gross Domestic Product growth rate; Brains – number of emigrants; Brainr – number of immigrants; HE – share of people with high education; UNPHE – share of unemployed people with high education; GDPpc – Gross Domestic product per capita. Standard errors in ()

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$

Source: Authors' calculations in EViews 12

Model 2 shows the effect of immigration of highly skilled individuals on economic growth. The results show that immigration of highly skilled individuals positively affects economic growth in recipient countries in the long run ($p < 0.01$). It means that the immigration of highly skilled individuals increases the economic growth of recipient countries in the long run. The share of highly educated individuals in the recipient country positively affects

economic growth in the recipient country in the long run ($p < 0.01$). This means that economic growth increases with the increase in highly educated individuals. The share of unemployed highly educated individuals in the recipient country negatively affects economic growth in the recipient country in the long run ($p < 0.01$). Economic growth decreases with the increase in unemployed, highly educated individuals. GDP per capita has a positive significant effect on economic growth in the long run ($p < 0.01$) (Table 3).

Table 4 shows the ARDL approach short-run results for Model 1 and Model 2. Model 1 shows the effect of brain drain (emigration of highly skilled individuals) on economic growth in the short run. The results show that brain drain negatively affects the economic growth of OECD countries in the short run in t and $t-1$ ($p < 0.05$). This means that the emigration of highly skilled individuals from their home countries negatively impacts economic growth in the source country in the short run. The results also show that the effect is weaker in $t-1$. The share of highly educated individuals in the source country has a positive effect on economic growth in the source country in the short-run in t and $t-1$ ($p < 0.05$) (Table 4).

Table 4. ARDL approach short-run results

Variable	Model (1)	Model (2)
ECT	-0.41** (0.18)	-0.43*** (0.15)
ΔGDP_{t-1}	0.01** (0.01)	0.02** (0.01)
ΔBrains	-0.23** (0.15)	
$\Delta\text{Brains}_{t-1}$	-0.17** (0.16)	
ΔBrainr		0.33** (0.63)
$\Delta\text{Brainr}_{t-1}$		0.07** (0.36)
ΔHE	0.04** (0.03)	0.02** (0.01)
ΔHE_{t-1}	0.03** (0.02)	0.01** (0.01)
ΔUNPHE	-0.06** (0.11)	-0.13** (0.09)
ΔUNPHE_{t-1}	-0.02*** (0.12)	-0.02* (0.09)
ΔGDPpc	103.94*** (3.01)	97.87*** (1.89)
ΔGDPpc_{t-1}	60.77** (20.15)	62.66** (15.07)
C	57.51** (25.31)	-0.67** (0.28)
trend	Yes	Yes

Note: GDP – Gross Domestic Product growth rate; Brains – number of emigrants; Brainr – number of immigrants; HE – share of people with high education; UNPHE – share of unemployed people with high education; GDPpc – Gross Domestic product per capita. Standard errors in ()

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$

Source: Authors' calculations in EViews 12

Economic growth increases with the increase of highly educated individuals in t and $t-1$, but the effect is weaker in $t-1$. The share of unemployed highly educated individuals in the source country has a negative effect on economic growth in the source country in the short-run in t and $t-1$ ($p < 0.05$). Economic growth decreases with the increase of highly educated unemployed individuals, but the effect is weaker in $t-1$. GDP per capita has a positive significant effect on economic growth in the short-run ($p < 0.05$) (Table 4).

Model 2 shows the effect of immigration of highly skilled individuals on economic growth. The results show that immigration of highly skilled individuals positively affects economic growth in recipient countries in t and $t-1$ in the short run ($p < 0.05$). This means that the immigration of highly skilled individuals increases the economic growth of recipient countries in t and $t-1$ in the short run, but the effect is lower in $t-1$. The share of highly educated individuals in the recipient country positively affects economic growth in the recipient country in t and $t-1$ in the short-run ($p < 0.05$). Economic growth increases with the increase in highly educated individuals, but the effect is weaker in $t-1$. The share of unemployed highly educated individuals in the recipient country has a negative effect on economic growth in the recipient country in t and $t-1$ in the short-run ($p < 0.05$). Economic growth decreases with the increase of highly educated unemployed individuals, but the effect is weaker in $t-1$. GDP per capita has a positive significant effect on economic growth in the short-run ($p < 0.01$) (Table 4).

The error correction term is negative and statistically significant in both models ($p < 0.05$). In Model 1, 41% of the disequilibrium caused by a shock is corrected yearly. This shows a relatively slow adjustment process since the system will remain in equilibrium for over two years. The results show that short-term fluctuations in highly skilled emigration persistently affect economic growth but gradually adjust to equilibrium. A significant negative short-run effect is lower as the country adapts to the loss of highly skilled workers in the short-run (the short-run coefficient is lower in $t-1$ than in t) (Table 4). In Model 2, 43% of the disequilibrium caused by a shock is corrected yearly, and the adjustment process is relatively slow.

5. CONCLUSIONS AND RECOMMENDATIONS

The study examined the effect of the emigration of highly skilled individuals on economic growth in source and recipient countries, considering factors such as educational opportunities and economic and social conditions. Therefore, the ARDL approach was applied to examine this relationship in the long and short run. The results of the ARDL approach showed a significant negative effect of the emigration of highly skilled individuals ("brain drain") on the economic growth of OECD countries in the short and long run. Therefore, we accepted hypothesis 1. The results align with Le (2008), Srivastava (2018) and Beine, Docquier, and Rapoport (2001) while opposite to Mohamed et al. (2024). The results also showed that the effect is stronger in the short run. This means that the more highly educated individuals leave the country, the more economic growth that country declines. One of the reasons may be that highly educated individuals contribute to economic growth through productivity, innovation and human capital. When they leave the country, they lose these benefits and contributions. Also, a stronger effect in the short term than in the long term may arise because the country loses a significant part of its most talented and educated individuals, which affects the industry, reduces innovation and leads to the loss of human capital that cannot be easily and quickly replaced in the short term. On the other hand, emigration's negative, weaker effect on economic growth may arise due to the immigration of highly educated individuals, higher

education reforms, or new individuals' education. Therefore, the emigration of highly educated individuals has a less negative effect on economic growth in the long term than in the short term.

The results of the ARDL approach showed a significant positive effect of immigration of highly skilled individuals on the economic growth of OECD countries in the short and long run. Therefore, we accepted hypothesis 2. The results also showed that the effect is stronger in the short-run period t-1 and weaker in period t. The initial influx of highly educated workers may have an immediate stronger impact, but as more time passes, the economy may adjust to their presence, leading to a reduction in the effects of immigration of highly educated individuals on economic growth. Also, the economy may need time to adjust to changes in the supply of a highly educated labour force, so the economy may eventually adjust in a way that reduces the effects of immigration on economic growth.

The results contribute to the ongoing brain drain debate and offer valuable insights for policymakers and governments. By quantifying the effects of brain drain on economic growth, this research provides a basis for formulating strategies to mitigate its negative consequences and maximize its potential benefits. Future research may be extended to individual countries over a longer period and include more explanatory variables to perform a better analysis over a longer period and draw adequate conclusions.

REFERENCES

- Bhagwati, J. N. (Ed.). (1976). *The brain drain and taxation: theory and empirical analysis* (Vol. 2). Elsevier Science & Technology.
- Beine, M., Docquier, F., & Rapoport, H. (2001). Brain drain and economic growth: theory and evidence. *Journal of Development Economics*, 64(1), 275-289.
- Benson, M., & O'Reilly, K. (2009). Migration and the search for a better way of life: a critical exploration of lifestyle migration. *The Sociological Review*, 57(4), 608-625.
- Dodani, S., & LaPorte, R. E. (2005). Brain drain from developing countries: how can brain drain be converted into wisdom gain? *Journal of the Royal Society of Medicine*, 98(11), 487-491.
- Gibson, J., & McKenzie, D. (2011). Eight questions about brain drain. *Journal of Economic Perspectives*, 25(3), 107-128.
- Kao, C., & Chiang, M. H. (2000). On the estimation and inference of a cointegrated regression in panel data. In *Nonstationary panels, panel cointegration, and dynamic panels*. Emerald Group Publishing Limited.
- Le, T. (2008). 'Brain drain' or 'brain circulation': Evidence from OECD's international migration and R&D spillovers. *Scottish Journal of Political Economy*, 55(5), 618-636.
- Mohamed, S. A. F., Amer, G., & Fattah, K. A. (2024). The Impact Of Brain Drain On Economic Growth: Addressing Diaspora Externalities. *Migration Letters*, 21, 762-786.
- Pesaran, M. H. (2007). A simple panel unit root test in the presence of cross-section dependence. *Journal of Applied Econometrics*, 22(2), 265-312.

- Pesaran, M. H., Shin, Y., & Smith, R. P. (1999). Pooled mean group estimation of dynamic heterogeneous panels. *Journal of the American Statistical Association*, 94(446), 621-634.
- Srivastava, B. (2018). Economic impact of brain drain in developed and developing countries. *New Jersey, USA: William Paterson University*.

RETHINKING THE FLEXICURITY CONCEPT IN THE POST-PANDEMIC LABOR MARKETS

Vladimir Mihajlović*

Faculty of Economics, University of Kragujevac, vmihajlovic@kg.ac.rs,
ORCID number 0000-0002-8298-3623

Gordana Marjanović

Faculty of Economics, University of Kragujevac, gmarjanovic@kg.ac.rs,
ORCID number 0000-0001-8933-1065

Abstract: *The COVID-19 pandemic fundamentally altered labor markets across the globe, exposing vulnerabilities and reshaping priorities within employment policies. The main changes in the labor markets due to the crisis were related to the increasing level of flexibility of work and the reduction of the security of employment. Although significant differences regarding these changes in the global, regional and local labor markets occurred, several general tendencies can be identified. Accordingly, this paper examines the flexicurity concept, a labor market model that combines labor flexibility with employment security, and evaluates its relevance and potential adaptations in the post-pandemic era. As economies face a new landscape characterized by hybrid work, increased automation, and elevated job insecurity, there is a need to reassess the application of flexicurity principles. The paper identifies key challenges, explores the effectiveness of the flexicurity concept during the pandemic, and suggests policy adjustments to better align with the new realities of labor markets. The main conclusion of the analysis is that the flexicurity concept can still be one of the contemporary paradigms of the labor market functioning but after necessary modifications concerning the changes in the nature of work and the specificities of the labor markets in the advanced and developing economies.*

Keywords: *Flexicurity, Labor Market, Pandemic, Gig workers, Digitalization*

JEL Classification: *J08, J24, J65, J68*

* Corresponding author

1. INTRODUCTION

The COVID-19 pandemic has triggered unprecedented shifts in labor markets worldwide, challenging traditional employment models and policy frameworks. As businesses adapted to sudden lockdowns, supply chain disruptions, and remote work requirements, the need for both flexibility and security in labor markets became increasingly evident (Spurk & Straub, 2020; Duval et al., 2022).

The flexicurity model, which integrates labor market flexibility with worker security, was initially developed in the European Union to foster adaptability and resilience in the face of economic change. However, the pandemic has highlighted both the strengths and limitations of flexicurity, raising important questions about its future role and adaptation to a vastly different employment landscape.

Originally envisioned as a balanced approach to labor market policy, flexicurity emphasizes four key components (Muffels & Wilthagen, 2013; Ferent-Pipas, 2024): flexible and reliable contractual arrangements, comprehensive lifelong learning systems, effective active labor market policies, and modern social security systems. This framework aims to facilitate job mobility and economic growth while protecting workers' welfare and fostering social cohesion. However, the disruptions brought about by the pandemic, including rising unemployment, increased job precarity, and the shift toward remote and hybrid work models, underscore the need to recalibrate flexicurity to reflect the realities of post-pandemic labor markets (Barbăneagră, 2022).

Against this background, this paper aims to evaluate the usefulness of the flexicurity concept in the time of the pandemic, taking into account its specificities, limitations, and, especially, challenges in the context of the pandemic crisis. The main finding indicates that tackling these challenges calls for an advanced version of flexicurity which adjusts to the continuous evolution of work and aims to foster inclusive and resilient labor markets.

The remainder of the paper is structured as follows. Section 2 provides a conceptualization of the flexicurity and explains its origins and principles. Section 3 analyzes the impact of COVID-19 on labor market stability and the challenges posed to traditional flexicurity mechanisms. Section 4 proposes policy recommendations to enhance the flexicurity model's relevance and effectiveness in post-pandemic economies, including hybrid work regulations, enhanced social safety nets, and targeted reskilling initiatives. Finally, Section 5 concludes with reflections on the future of flexicurity as a viable approach to labor market management in the post-pandemic period.

2. THE CONCEPT OF FLEXICURITY IN THE LABOR MARKET

Flexibility is an important feature of the labor market, which implies the ability of the labor market to adapt quickly to change. The main goal of increasing flexibility in the labor market is to reduce the unemployment rate, because it was considered that the large number of unemployed is a consequence of numerous rigidities in the labor market and the excessive role of the welfare state, especially in European countries compared to the United States (Weber et al., 2020).

There are different types of flexibility in the labor market: external numerical flexibility, internal numerical flexibility, functional flexibility, adaptability of knowledge, skills and occupations, wage flexibility and geographical mobility (Jandrić, 2019).

As a counterbalance, there are also different forms of security models (Sultana, 2012), such as job security (based on employment protection legislation), employment security (adequate employment opportunities through high levels of employability ensured by education and training), income security, and combination security (which means that workers can combine their work with other obligations that are not related to paid work).

The concept of flexicurity is a special matrix, which implies a combination of the above types of flexibility and different types of security. The concept first appeared in the Netherlands in the 1990s in legal provisions aimed at increasing flexibility in the labor market by facilitating the dismissal of employees, on the one hand, and increasing the level of security for employees in flexible forms of employment, on the other (Bekker & Mailand, 2018). This model is known as the Dutch flex model and it was quickly adopted in Germany, Belgium, and Denmark. By 2006, this concept had become widely accepted in the countries of the European Union.

The Danish model, which emerged as an alternative to the Dutch flex model, is of particular note. The Danish model implies a combination of flexibility, i.e., moderate legal protection of employment – EPL (Employment Protection Legislative), and security, which implies a generous unemployment benefits system and a high expenditure level for active labor market policies – ALMP (Active Labor Market Policy). Figure 1 shows the Danish (also known as a traditional) flexicurity model or the so-called "golden triangle", which represents the relationship between a flexible labor market, unemployment benefit systems and active labor market policy measures.

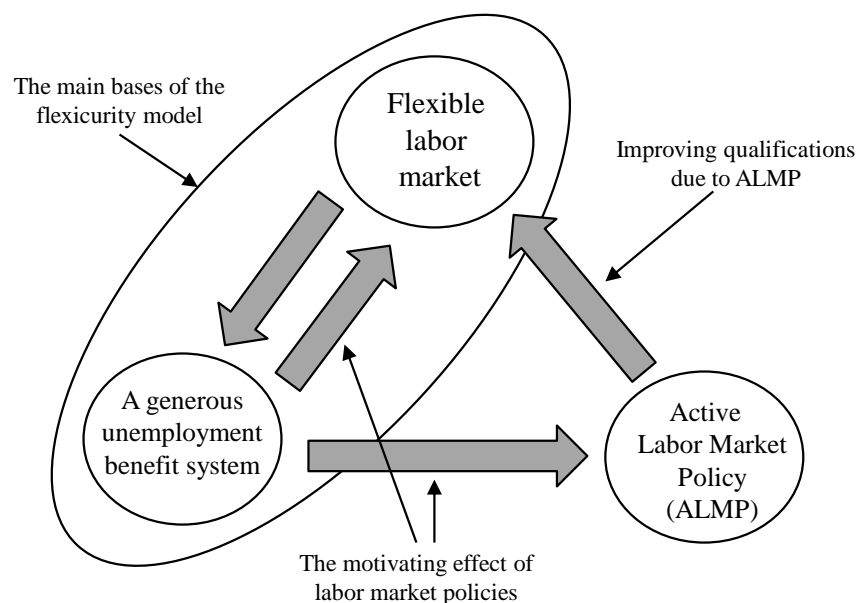


Figure 1: *Danish flexicurity model*

Source: Madsen, 2006, p. 11.

The arrows linking the unemployment benefit system and a flexible labor market indicate a stream of workers who have become unemployed, but very quickly find work again. Those who do not find a job go through active labor market policy programs. In addition to active

labor market policies, the extended flexicurity model also includes benefits for the unemployed, social protection, and the collective bargaining system (Marjanović, 2010). Thus, the Danish flexicurity model is a combination of a flexible labor market and a welfare state that guarantees a high level of social security. In this way, employers have the necessary flexibility, and workers, if they remain unemployed, have a stable income through the unemployment benefit system.

It must be noted that European countries balance flexibility and security in many different ways. This variety of flexibility-security intensity combinations can be presented in the so-called “Flexicurity quadrant” (Figure 2). Five different regimes based on the combination of flexibility and security can be identified: Anglo-Saxon, Nordic, Continental, Mediterranean, and Eastern regimes. All of the regimes can be positioned in the four quadrants, with two extremes (flexicurity and inflexicurity) and two quadrants which represent the trade-off between flexibility and security in the labor market (Muffels & Wilthagen, 2013).

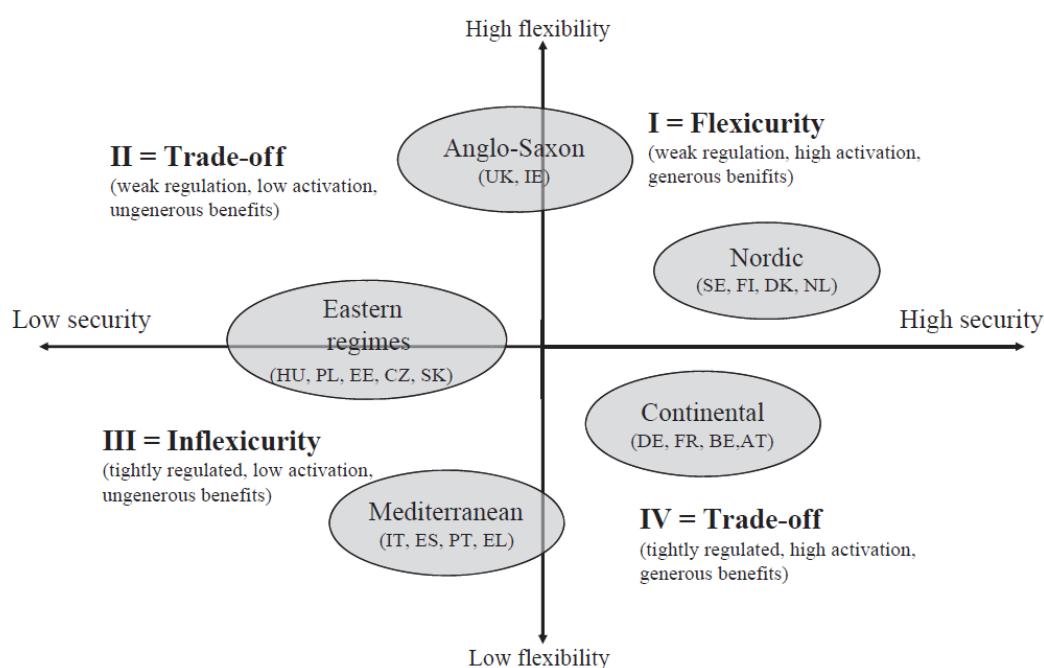


Figure 2: The “Flexicurity quadrant” with the classification of countries and policy regimes
Source: Muffels & Luijkx (2008)

Overall, as key features of the flexicurity concept, these four aspects can be included: flexible labor market policies, robust social security systems, active labor market programs, and lifelong learning and education initiatives. All these aspects were under the impact of the pandemic, which left long-lasting consequences on the essence of this concept.

3. CHALLENGES TO THE FLEXICURITY DUE TO PANDEMIC

The COVID-19 pandemic has introduced significant challenges to implementing flexicurity, as it reshaped labor markets, introduced unprecedented risks, and disrupted traditional employment practices. *First*, the rapid acceleration of digitalization and automation has reshaped the skills demanded in the labor market, creating a greater need for reskilling and upskilling (Petropoulos, 2021). *Second*, the rise of hybrid work has blurred traditional boundaries between work and personal life, creating new challenges in terms of worker rights,

health, and productivity. *Third*, the pandemic exposed gaps in social protection systems, especially for non-standard workers such as freelancers, gig workers, and temporary employees (Ghorpade, Abdur Rahman & Jasmin, 2023). Addressing these issues requires an evolved form of flexicurity - one that adapts to the ongoing transformation of work and seeks to promote inclusive and resilient labor markets.

Some of the additional challenges that flexicurity faces in the post-pandemic environment are as follows:

- Increased job instability and unemployment – the pandemic led to layoffs across multiple sectors, thus raising the unemployment rate. In addition, it induced precarious employment growth, as many jobs created during and after the pandemic are in the gig or freelance economy, where flexibility is high, but security is minimal;
- Widening inequalities in job security and income – certain sectors, like the tech industry, bounced back quickly, while others (e.g., hospitality, retail) are still struggling, which makes the implementation of the flexicurity concept more challenging. The income gaps also became wider, as higher-income earners recovered faster than low-income earners;
- Increased need for digital and hybrid skills – The demand for digital and technical skills has soared, creating a skill mismatch that flexicurity systems need to address. However, training programs have not scaled quickly enough to meet these new demands, leaving many workers underqualified and unable to transition smoothly. Flexicurity is also hindered by the need for widespread reskilling, especially in industries that experienced rapid technological transformation.
- Insufficient digital infrastructure for remote work – There is unequal access to digital tools, as not all workers can access the technology and internet required for remote work. Flexicurity principles, which emphasize flexible working conditions, are challenged by this digital divide, making it difficult to offer equal opportunities for remote and flexible work. Furthermore, ensuring fair wages, working conditions, and benefits for remote workers requires complex regulatory updates, which have been slow to materialize, complicating the integration of remote work into flexicurity frameworks (Barański, 2022);
- The pressure on social security systems – Implementing flexicurity requires a robust safety net, which may be difficult to sustain given the economic aftershocks of the pandemic. Also, governments face budget constraints and are often unable to extend benefits without risking unsustainable debt. This financial strain hinders the ability to fund adequate protections, training, and income support, which are foundational to flexicurity;
- Institutional inertia – Regulatory bodies and institutions are often slow to adapt to labor market shifts. Implementing flexicurity requires new policies and legal frameworks, which can be delayed by bureaucratic processes and resistance to change.

The challenges for flexicurity implementation due to the pandemic are even more pronounced in emerging market (transition) countries. In addition to the insufficient base for financing relatively high unemployment benefits, which is ultimately conditioned by the relatively low gross domestic product, these economies are also characterized by the relative inflexibility of the labor market. It is mostly the result of labor legislation that makes it difficult to hire and fire workers, but also how working hours are organized, which primarily refers to part-time work, work from home, and the like (Marjanović & Mihajlović, 2021).

Besides the aforementioned challenges, it must also be noted that the flexicurity model has its shortcomings, which can be grouped into three key areas (Burroni & Keune, 2011; Sehnbruch, 2024). *First*, flexicurity is only sustainable if enough workers hold stable, long-term jobs and contribute regularly to the tax and social security systems. If too many jobs are flexible, the model struggles. Workers in insecure jobs contribute less and require more support, increasing demands on the system. These jobs are also linked to poorer physical and mental health, raising healthcare costs. *Second*, insecure job conditions often overlap, creating clusters of disadvantages. Many workers in low-quality jobs face both low wages and other precarious conditions, making it harder for them to find stable work. This combination of disadvantages raises the cost of flexibility, weakens productivity, and undermines the social contract. While the benefits system considers multiple disadvantages, active labor policies do not. *Third*, the flexicurity model can worsen existing inequalities in the labor market. For instance, workers in insecure jobs contribute less to the pension system, resulting in lower benefits for them. Vulnerable workers may even miss out on unemployment insurance if they haven't contributed enough or consistently.

4. RECOMMENDATIONS FOR FLEXICURITY ADJUSTMENT IN POST-PANDEMIC LABOR MARKETS

Adjusting the flexicurity model for post-pandemic labor markets involves integrating lessons learned from the crisis to enhance labor market resilience, support evolving work trends, and mitigate inequalities. In line with that, the main recommendations for the adaptation of the flexicurity concept after the pandemic could be grouped into the following four groups:

- *Strengthening social safety nets*, by expanding unemployment insurance, healthcare access, and retirement benefits to cover non-standard workers, such as freelancers and gig workers;
- *Hybrid work regulations*, by developing standards for remote work to ensure fair labor practices, including work-life balance protections and digital rights;
- *Lifelong learning and reskilling initiatives*, by creating more flexible and accessible learning programs to meet the demands of a rapidly changing job market, and
- *Enhanced social protection for vulnerable workers*, by introducing targeted benefits and support measures for low-income and at-risk groups.

An additional recommendation would be to enhance employment transition programs like job search assistance, career counseling, and wage subsidies that help workers transition to new jobs, particularly in regions or sectors undergoing structural shifts. The focus should be on vulnerable groups such as youth, women, older workers, and people from marginalized communities who may face greater barriers to reemployment and upskilling. These measures should be coupled with the promotion of remote and hybrid work models, which allow for maintaining flexibility while ensuring worker rights, such as data privacy and ergonomics support. The social protection for non-standard workers, such as gig workers, freelancers, and self-employed individuals should also be strengthened. Expanding coverage to include these workers can provide income security and better protection against income shocks.

These adjustments can make the flexicurity model more adaptable to the needs of a digital, diverse, and flexible workforce, enabling economies to remain competitive while protecting and empowering workers in post-pandemic labor markets. However, the measures for the flexicurity model adjustment should be tailored to the specificities of a particular country.

Since there could be identified several different regimes of flexicurity in the European countries (Nordic, Anglo-Saxon, Eastern, Continental, and Mediterranean) (Muffels & Luijkx, 2008), the policy recommendations should respect the differences among these regimes concerning the extent of flexibility and security of the labor market.

In the case of transition economies, the measures aimed at increasing the flexibility of the labor market should be implemented in parallel with measures aimed at improving job security, as this is the essence of the concept of flexicurity. Along with the change in labor legislation, in terms of facilitating the transition of workers from employment to unemployment, and *vice versa*, a more effective system of unemployment benefits should be applied and significantly more funds should be allocated for financing active labor market policies. Only in this way is it possible to take advantage of all the positive aspects of the concept of flexicurity, without the risk of jeopardizing the position of the workforce due to excessive insistence on creating a flexible labor market that is not accompanied by an improvement in the level of security. Of course, to implement this concept in the right way, it is necessary to create basic conditions, such as dynamic and balanced economic growth, so an integrated approach is certainly needed to build a more advanced system of labor market organization on a sustainable basis.

5. CONCLUSION

The concept of flexicurity, as a policy framework in labor economics, aims to combine flexibility for employers and security for employees. Developed primarily in the context of European labor markets, flexicurity is seen as a way to balance the needs of a competitive economy with strong social protections. It is increasingly relevant as global markets shift toward knowledge-based industries, digitalization, and a need for adaptable workforces.

The COVID-19 pandemic has highlighted both the resilience and the gaps within the flexicurity framework. While flexicurity remains a valuable model for labor market management, it must evolve to accommodate the emerging realities of post-pandemic work. A revised flexicurity approach – one that includes robust protections for all workers, support for new work models, and effective reskilling opportunities – can play a vital role in building resilient labor markets that balance flexibility with economic and social security.

However, implementing flexicurity in developing economies, like Serbia, comes with unique challenges and opportunities. These markets often have lower levels of social security coverage and limited funding for ALMPs. However, with careful design, elements of flexicurity, such as promoting labor mobility through digital education and improving regulatory frameworks, can still enhance labor market resilience and support long-term economic stability.

As flexicurity represents an effort to create a balanced approach to labor policy that addresses the needs of both employers and employees in dynamic, often unpredictable labor markets, its success often depends on robust institutional support and social investment. These are exactly the factors that vary significantly across economies. This is why future research should explore specific policy measures and cross-country comparisons to further refine this model, ensuring its effectiveness in a world increasingly defined by uncertainty and constant transformation.

REFERENCES

- Barański M. (2022). Employment flexibility in times of crisis. *Studia Iuridica*, 95, 9-29
<https://doi.org/10.31338/2544-3135.si.2022-95.1>
- Barbăneagră, O. (2022). Flexibility and security of the labor market in a pandemic context. *Annals of the „Constantin Brâncuși” University of Târgu Jiu, Economy Series*, Issue 1/2022, 127-138.
- Bekker, S., & Mailand, M. (2018). The European flexicurity concept and the Dutch and Danish flexicurity models: How have they managed the Great Recession? *Social Policy & Administration*, 53(1), 142-155. <https://doi.org/10.1111/spol.12441>
- Burroni, L., & Keune, M. (2011). Flexicurity: A conceptual critique. *European Journal of Industrial Relations*. <https://doi.org/10.1177/0959680110393189>
- Duval R., Ji Y., Li L., Oikonomou M., Pizzinelli, C., Shibata I., Sozzi A., & Tavares M. M. (2022). Labor Market Tightness in Advanced Economies. *IMF Staff Discussion Notes SDN/2022/001*. Washington: International Monetary Fund.
- Ferent-Pipas, M. (2024). Flexicurity and employment inflows in the EU28 countries: a panel data analysis. *International Journal of Manpower*, 45(8), 1589-1606. <https://doi.org/10.1108/IJM-10-2022-0460>
- Ghorpade Y., Abdur Rahman A., & Jasmin, A. (2023). Social Insurance for Gig Workers: Insights from a Discrete Choice Experiment in Malaysia. *Policy Research Working Paper 10629*. Washington: World Bank Group.
- Jandrić, M. (2019). *Tržište rada u makroekonomskoj teoriji*. Centar za izdavačku delatnost, Ekonomski fakultet, Beograd.
- Madsen, P. K. (2006). How can in possibly fly? The paradox of a dynamic labour market in a Scandinavian welfare state. In Campbell J. A., Hall J. A., and Pedersen, O. K. (eds.): *National Identity and the varieties of Capitalism: The Danish Experience*, McGill-Queen's University Press, Montreal, 321-355
- Marjanović, G. (2010). Uticaj institucija tržišta rada na fleksibilnost i sigurnost. U: Leković, V. (red). *Institucionalne promene kao determinanta privrednog razvoja Republike Srbije*, Ekonomski fakultet, Kragujevac, 227-237.
- Marjanović, G., & Mihajlović, V. (2021). Mogućnosti primene koncepta fleksigurnosti na tržište rada u Republici Srbiji. In Furtula, S., Bogićević, J., Erić Nielsen, J., Bošković, N. & Milanović, M. (Eds.), *Mogućnosti i perspective privrede Republike Srbije u procesu evropskih integracija*. Kragujevac: Ekonomski fakultet Univerziteta u Kragujevcu.
- Muffels, R., & R. Luijkx (2008). The Relationship between Labour Market Mobility and Employment Security for Male Employees: Trade-off or Flexicurity? *Work, Employment and Society*, 22(2), 221-42.
- Muffels, R., & Wilthagen, T. (2013). Flexicurity: A New Paradigm for the Analysis of Labor Markets and Policies Challenging the Trade-Off Between Flexibility and Security. *Sociology Compass*, 7(2), 111-122. <https://doi.org/10.1111/soc4.12014>
- Petropoulos, G. (2021). Automation, COVID-19, and labor markets. *ADB Working Paper Series, No. 1229*. Tokyo: Asian Development Bank Institute.
- Sehnbruch, K. (2024). Why the “flexicurity” model of the labour market is not sustainable. Retrieved October 28, 2024, from: <https://blogs.lse.ac.uk/inequalities/2024/09/17/why-the-flexicurity-model-of-the-labour-market-is-not-sustainable/>

- Spurk, D., & Straub, C. (2020). Flexible employment relationships and careers in times of the COVID-19 pandemic. *Journal of Vocational Behavior*, 119, 103435. <https://doi.org/10.1016/j.jvb.2020.103435>
- Sultana, G. R. (2012). Flexicurity: Implications for Lifelong Career Guidance. ELGPN Concept Note No. 1, European Lifelong Guidance Policy Network.
- Weber T., Hurley J., Mandl I., Bisello M., & Vacas-Soriano, C. (2020). Labour market change: Trends and policy approaches towards flexibilisation. *Challenges and prospects in the EU series*, Luxembourg: Eurofound.

THE ROLE OF ECONOMIC POLICY IN THE DEVELOPMENT OF SUSTAINABLE TOURISM IN SERBIA

Aleksandra Ranković*

University of Kragujevac, Faculty of Economics, rankovic.a1997@gmail.com,
ORCID number 0009-0007-6866-9068

Nikola Bošković

University of Kragujevac, Faculty of Economics, nikolab@kg.ac.rs,
ORCID number 0000-0003-2105-6196

Srdan Furtula

University of Kragujevac, Faculty of Economics, furtulas@kg.ac.rs,
ORCID number 0000-0002-0692-6539

Miloš Dimitrijević

University of Kragujevac, Faculty of Economics, mdimitrijevic@kg.ac.rs,
ORCID number 0000-0002-7922-8299

Abstract: *The economic development of countries should be based on the concept of sustainability to establish a connection between economic and ecological benefits. Tourism presents a potential for the economic development of Serbia. The development of tourism should not compromise ecological, social, and cultural goals, but rather support their achievement in a balanced and sustainable manner. Such tourism development would be possible if it is based on the concept of sustainable development. In the process of developing sustainable tourism, state support through appropriate economic policy plays a significant role. Accordingly, the subject of this research is the role of tourism policy, fiscal and monetary policy in promoting the development of sustainable tourism in Serbia, aiming to determine the possibility of developing sustainable tourism with the support of economic policy. Additionally, the research aims to identify a more effective economic policy, or one that has a greater impact on the development of sustainable tourism in Serbia. The study of the impact of economic policy on the development of sustainable tourism in Serbia was conducted by forming a multiple regression model. The results indicate that tourism, fiscal, and monetary policies have a statistically significant impact on the development of sustainable tourism, following the indicators of sustainable development. Tourism and fiscal policies have a more direct impact on sustainable tourism indicators, which is why their effects are greater than those of monetary policy. The scientific contribution of this work is reflected in the significant improvement of research on the role of economic policy in the development of sustainable tourism, providing a more complex understanding of potential directions for economic policy actions in this field.*

Keywords: Sustainable Tourism, Economic Policy, Republic of Serbia

JEL Classification: E52, E62, Z32

* Corresponding author

1. INTRODUCTION

Tourism plays a significant role in the economic development of countries, but, at the same time, its development can cause negative externalities on the environment of tourist destinations, including ecological and cultural degradation (Brokaj, 2014). Therefore, it is important to establish a connection between economic and ecological benefits. Sustainable tourism is an approach that enables achieving this balance. All forms of tourism should become more sustainable, which not only involves reducing the negative impacts of tourism on the environment but also raising stakeholder awareness of the importance of environmental conservation (UNEP, 2005). Sustainable tourism represents a comprehensive development that should enable the achievement of economic, social, and societal goals while protecting the ecological, social, and cultural values of destinations (Bošković, 2020). As such, it not only contributes to the sustainability of social and economic well-being but also expands the capacities for production, employment, and international trade by integrating tourism with other sectors, thereby generating income and profit (Chen, 2022). According to UNWTO data, the share of tourism in global GDP is 2.5%. However, the estimated global carbon dioxide (CO₂) emissions from tourism range between 8% and 11%, with projections suggesting that this could rise by an additional 25% by 2030 (OECD, 2022). These figures highlight the need for the development of sustainable tourism to both preserve and increase the share of tourism in global GDP while simultaneously reducing negative externalities. In the process of developing sustainable tourism economic policy also plays a crucial role.

In line with the previously emphasized importance of developing sustainable tourism at the global level, the subject of this research is to examine the role of economic policy in the development of sustainable tourism in Serbia, focusing on fiscal, monetary, and tourism policies during the period from 2014 to 2021. Based on the defined research subject, the aim of the study is to determine which of the mentioned economic policies has the most significant impact on the development of sustainable tourism in Serbia, with the goal of identifying of the main problems and challenges that limit the development of sustainable tourism.

The following hypotheses will be tested in the study:

H1: Fiscal, monetary, and tourism policies have a statistically significant impact on the indicators of tourism sustainability in the development of sustainable tourism.

H2: Among the economic policy, monetary policy has the least impact on sustainable tourism indicators compared to fiscal and tourism policies.

In order to analyze the role of economic policy in promoting the development of sustainable tourism in Serbia, appropriate qualitative and quantitative research methodologies were employed. The qualitative methodology is based on the application of inductive and comparative methods, while the quantitative methodology is reflected in the application of multiple regression analysis through the statistical program SPSS. Regression analysis is applied with the aim of determining the mutual impact among the monitored variables (reference interest rate, revenue from environmental taxes, revenue from tourism services, tourism income inflow, number of tourist overnight stays, share of employment in tourism, share of tourism in GDP, air quality, and waste production in tourism). Data will be tracked from 2014 to 2021. Secondary data were used for analysis. The paper is divided into four segments. The first part presents the research of various authors on the role and instruments of economic policy in the process of developing sustainable tourism. The second part is focused

on an overview of the relevant qualitative and quantitative methodologies that will be used in the study to test the proposed hypotheses. The third part presents the research findings, while the fourth part engages in a discussion of the obtained results.

2. LITERATURE REVIEW

The basic concept of sustainability in tourism includes economic, ecological, and social components and policymakers should focus their activities on these aspects of sustainability to achieve the set goals. To establish sustainable tourism, government action is required that considers all industries and resources related to tourism. However, for tourism policy to lead to the development of sustainable tourism, a long period of time is necessary, as its implementation can be limited by factors such as a lack of integration and cooperation among government sectors, prioritizing economic issues over ecological and social ones, and limited participation from the private sector and local communities in policy implementation (Dodds, 2007). Furthermore, developing countries, which face macroeconomic problems (high inflation, unemployment, high public debt, etc.), prioritize economic issues while neglecting ecological and social concerns, which leads to unsustainable tourism development (Cetinel & Yolal, 2009). Similarly, Božović et al. (2022) argue that although Serbia has the potential for developing sustainable and ecotourism, the greatest barriers to development are attracting foreign capital, insufficient ecological awareness, and a lack of infrastructure. Moreover, formulation of economic policy that would promote the sustainability of tourism is limited by a lack of cooperation among local authorities and the weakness of state institutions.

Economic development also enables the development of sustainable tourism. Chen (2022) found that Gross Domestic Product (GDP), Foreign Direct Investment (FDI), and Net National Income (NNI) are positively correlated with the development of sustainable tourism. Thus, the direct impact of economic policy on employment, production, and investment indirectly leads to the development of sustainable tourism. On the other hand, Ohlan (2017) points out that economic growth can be based on the development of tourism, as tourism revenues increase GDP. This process emphasizes the mutual impact of tourism and economic development, where one stimulates the other. Additionally, during crises, when macroeconomic policy struggles to stimulate the economy, tourism can positively affect the recovery from the crisis, as it increases employment opportunities, personal income, taxes, investments (Besana & Bagnasco, 2014).

Economic instruments for development of sustainable tourism operate indirectly through costs, revenues, and prices, influencing decisions made by businesses and consumers (UNEP & UNWTO, 2005). Some of the economic policy instruments for the development of sustainable tourism include government subsidies, financial agreements, regulations, and the information and education of stakeholders (Theobald, 2005). Yang (2019) indicates that fiscal policy best promotes the development of sustainable tourism through economic competitiveness, transformation, and improvement of the tourism industry, using China as an example. Additionally, the introduction of various types of taxes, as a fiscal policy measure, can influence sustainable tourism by changing the behavior of consumers and businesses, while the collected taxes should support further sustainable tourism development (UNEP & UNWTO, 2005). According to UNWTO (2020), specific fiscal policy measures aimed at tourism include exemptions, deferrals, and reductions in taxes related to tourism (e.g., environmental protection fees, tourist permits, marketing taxes, etc.). Ecological taxes aim to create funds for environmental improvement and raise awareness among tourists and

companies about the sustainability of destinations (Asalos, 2018). Gomez et al. (2007) suggest that increasing the tourist tax can enhance environmental quality and trade conditions, as well as lead to higher consumption, thus achieving the long-term economic well-being of the local community. Furthermore, increasing the tourist tax may lead to higher tourism revenues, although it may decrease the number of visitors, which can be compensated for by higher prices for tourism services. Changes in fiscal policy measures, especially taxation, should not be frequent, as any changes in taxation affect the decisions of tourists, which in turn shape tourism demand (Crismaru et al., 2020).

According to UNWTO (2020), monetary policy measures include reducing interest rates, subsidizing interest rates on loans, special credit lines for small and medium-sized enterprises (SMEs), the availability of loans for SMEs in tourism, price stability, and the national currency, as well as incentive programs aimed at airlines. According to OECD (2018), financial instruments for developing sustainable tourism related to monetary policy are indirect and pertain to green financing, credit guarantees, and the development of hybrid financing instruments such as crowdfunding and mezzanine financing.

In addition to the aforementioned policies, for tourism to be developed and sustainable, it is essential to have a defined tourism policy, a tourism development strategy, and relevant laws and regulations. Tourism policy should set objectives for the development of tourism, which should be aligned with the goals of other economic policies, as well as manage these processes (European Commission, 2013). During times of crisis, tourism policy should support sustainable tourism by providing financial support for hospitality establishments, the airline industry, as well as employment programs, supporting the development of domestic and regional tourism through taxation, tourism promotion, and providing travel vouchers (Persson-Fisher & Liu, 2021). Schonherr et al. (2023) highlight the need for sustainable tourism, emphasizing that after the crisis caused by the COVID-19 pandemic, the world should not return to mass tourism that threatens the environment.

3. METHODOLOGY

To investigate the significance of economic policy for the development of sustainable tourism in Serbia, the study focuses on the period from 2014 to 2021. Secondary data were collected from statistical databases of the Statistical Office of the Republic of Serbia (RZS), the National Bank of Serbia (NBS). The data on monitored indicators were obtained in absolute terms in millions of RSD (inflow tourism revenue, environmental tax revenue, revenue from tourism services-accommodation, food, sports and entertainment), in percentage terms (reference interest rate, tourism's contribution to GDP, tourism's share of employment), and in absolute units (number of tourists overnight stays, waste production in tourism and air quality).

The research employed an appropriate methodology. Within the qualitative research methods, both inductive and comparative methods were utilized. The inductive research method leads to general conclusions about the development of sustainable tourism in Serbia through a review of individual cases in various countries around the world. The comparative method compares data from different impacts of various economic policy on the development of sustainable tourism in Serbia. The quantitative research method is reflected in the statistical analysis used to evaluate the established hypotheses. Multiple regression analysis was used to assess the formulated hypotheses. Multiple regression analysis is a statistical tool for

examining the relationship between two or more variables, which includes a variable to be explained (the dependent variable) and multiple variables believed to influence the dependent variable (independent variables) (Rubinfeld, 2011, p. 305). In this case, the hypothesis will be assessed using the following equations:

1. TOURISM'S SHARE IN GDP= $a*ET + b*RET + c*RIR$
2. AIR QUALITY= $a*TR + b*RIR + c*RTS$
3. WASTE PRODUCTION= $a*RET + b*NOT + c*RIR$

The indicators Tourism's share in GDP, Air quality and Waste production represent the dependent variables, while independent variables denote instruments of economic policy which are represented by the following abbreviations: RIR (referent interest rate of NBS), ET (employment in tourism), RET (environmental tax revenue) TR (tourism revenue inflow in millions of RSD), RTS (revenue (tax) from tourism services - accommodation, food, sports and entertainment), NOT (number of overnight stays by tourists). The letters a, b and c represent coefficients measuring the impact of independent variables on dependent variables.

4. RESEARCH RESULTS

Table 1 presents the descriptive analysis of the observed variables in the model. The average share of employment in tourism, relative to the total number of employed people in Serbia is 1.83%. The minimum value of employment in tourism is 1.79%, and the maximum is 1.9%. Based on the data, employment in tourism did not experience significant fluctuations during the observation period. The average contribution of tourism to GDP is 1.83%, indicating that tourism has a small share of GDP compared to other sectors of the economy. The variable related to air quality is measured by the emission of pollutants in Serbia (in mg), with its arithmetic mean amounting to 676.987,88 units.

Table 1. *The Descriptive Statistics of the Observed Variables in the Model*

<i>Variable</i>	Arithmetic Mean	Standard deviation	Minimum	Maximum
<i>Employment in Tourism (% of total employment)</i>	1,83	0,04	1,79	1,9
<i>Tourism's share in GDP in %</i>	2,31	0,13	2,03	2,45
<i>Air quality (in mg)</i>	676987,88	192211,7	269970	904324
<i>Waste production</i>	266301	37887	201409	310510
<i>Tourism Revenue Inflow (millions of RSD)</i>	138374,76	29375,12	101009,18	186738,56
<i>Reference interest rate in %</i>	2,97	1,43	1	4,5
<i>Revenue from tourism services- accommodation, food, sports, and entertainment in millions of RSD</i>	279,81	77,63	147,67	348,52
<i>Environmental tax revenue in millions of RSD</i>	199.998.88	30342.87	152867	243933
<i>Number of overnight stays by tourist</i>	6858766	2831001	825144	10073299

Source: Calculation by the authors using the databases of RSZ, NBS and OECD

The minimum pollutant emission was recorded in 2021, which was a result of the decline in economic activity due to restrictive measures to curb the COVID-19 pandemic, while the maximum occurred in 2016. The average amount of waste generated by tourism activities is 266.301 units. The highest tourism revenue was recorded in 2021, implying a recovery in the tourism sector and an increase in tourist interest in domestic destinations, while the lowest revenue was achieved in 2014. The lowest reference interest rate was achieved during 2020 and 2021 because of the actions of NBS aimed at stimulating the economy during the economic instability caused by the pandemic, while the highest reference interest rate occurred in 2014 and 2015. The highest value of revenue from accommodation, food, sports, and entertainment services in tourism was recorded in 2021, when tourist activity increased, and the lowest value occurred in 2014. Similarly, revenues from environmental protection fees peaked in 2021 and reached their minimum in 2014.

To evaluate formulated hypotheses, a normality test of data distribution for both dependent and independent variables in the model was conducted. The sample includes eight observations units (Serbia during the period from 2014 to 2021), which is fewer than fifty units. Therefore, the Shapiro-Wilk test was used to check the normality of the data distribution. According to the test results, the p-value for all observed variables is greater than the significance level (0.05), indicating that the data follows a normal distribution. This means that the first condition for applying regression analysis is satisfied. The data are presented in Table 2.

Table 2. Normality of the data distribution

<i>Variable</i>	<i>Significance level (p)</i>
<i>Employment in Tourism (% of total employment)</i>	0,058
<i>Tourism's share in GDP in %</i>	0,079
<i>Air quality (in mg)</i>	0,231
<i>Waste production</i>	0,437
<i>Tourism Revenue Inflow (millions of RSD)</i>	0,850
<i>Reference interest rate in %</i>	0,213
<i>Revenue from tourism services-accommodation, food, sports, and entertainment in millions of RSD</i>	0,080
<i>Environmental tax revenue in millions of RSD</i>	0,945
<i>Number of overnight stays by tourist</i>	0,179

Source: Calculation by the authors using the databases of RSZ, NBS and OECD

The first regression model relates the impact of fiscal, tourism and monetary policies on the share of tourism in GDP. The characteristics of the model are presented in Table 3. The coefficient of determination is 0.962, meaning that 96.2% of the variability in the share of tourism in GDP is explained by the variability in revenue from employment in tourism, environmental tax revenue, and the reference interest rate. The remaining 3.8% of the variability in the share of tourism in GDP is due to the variability of other factors. The model is statistically significant, with the p-value of 0.003, which is below the significance level of

0.05, confirming the significance of the regression. Furthermore, there is no autocorrelation in the model, as the Durbin-Watson statistic is 1.817, which is within the reference range, thus satisfying the second condition for the regression.

Table 3. *Characteristics of the regression model of the impact of fiscal, tourism and monetary policies on the Tourism Share in GDP*

<i>Dependent variable</i>	R Square	Significance level (p)	Durbin-Watson
<i>Tourism's share in GDP in %</i>	0,962	0,003	1,817

Source: Calculation by the authors using the databases of RSZ, NBS and OECD

The regression equation for the model of the impact of employment in tourism, revenue from environmental taxes, and the reference interest rate on the share of tourism in GDP is presented as follows, while the data on the regression equation coefficients can be found in Table 4:

$$\text{TOURISM'S SHARE IN GDP} = 0.536 \cdot \text{ET} + 1.079 \cdot \text{RET} - 0.094 \cdot \text{RIR}$$

Table 4. *The regression model of the impact of fiscal, tourism and monetary policies on the Tourism Share in GDP*

<i>Model</i>	β	Significance level (p)	VIF
<i>ET</i>	0,536	0,013	1,632
<i>RET</i>	1,079	0,011	5,944
<i>RIR</i>	-0,094	0,731	6,847

Source: Calculation by the authors using the databases of RSZ, NBS and OECD

There is no multicollinearity in the model, as the Variance Inflation Factor (VIF) is below 10. The regression equation shows that an increase in employment in tourism by one standard deviation leads to an increase in the share of tourism in GDP by 0.536 standard deviations, indicating that a higher number of employees in tourism contributes to the growth of tourism, and consequently to the share of tourism in GDP. Furthermore, when revenue from environmental taxes increases by one standard deviation, the share of tourism in GDP rises by 1.079 standard deviation, suggesting that fiscal policy aimed at ecology positively affects the tourism sector. In contrast, an increase in the reference interest rate by one standard deviation results decrease in the share of tourism in GDP by 0.094 standard deviation, with the impact of the reference interest rate in the observed model not being statistically significant.

The second regression model shows how fiscal, tourism and monetary policies affect air quality. The results of the model indicate that 85.9% of the variability in air quality is explained by the variability in revenue from tourism services, the reference interest rate and tourism revenue inflow. The model is statistically significant, as the p-value is below the significance level of 0.05. Additionally, the condition of no autocorrelation is met, as the

Durbin-Watson coefficient is within the reference range, indicating the validity of the observed model.

Table 5. *Characteristics of the regression model of the impact of fiscal, tourism and monetary policies on the Air Quality*

<i>Dependent variable</i>	R Square	Significance level (p)	Durbin-Watson
<i>Air Quality</i>	0,859	0,035	2,158

Source: Calculation by the authors using the databases of RSZ, NBS and OECD

The regression model can be shown by the following regression equation, while the data on the coefficients that make up this equation are presented in Table 6.

$$\text{AIR QUALITY} = -1.618 \cdot \text{TR} + 0.137 \cdot \text{RIR} + 1.228 \cdot \text{RTS}$$

Table 6. *The regression model of the impact of fiscal, tourism and monetary policies on Air Quality*

<i>Model</i>	β	Significance level (p)	VIF
<i>TR</i>	-1,618	0,012	3,963
<i>RIR</i>	0,137	0,647	2,192
<i>RTS</i>	1,228	0,028	3,790

Source: Calculation by the authors using the databases of RSZ, NBS and OECD

There is no multicollinearity in the model, as the VIF is below 10. The results of the regression model show that tourism revenue inflow has a negative impact on air quality, meaning that an increase in the tourism revenue inflow by one standard deviation leads to a decrease in air quality by 1.618 standard deviations, due to the increase in pollutant emissions. On the other hand, the reference interest rate has a positive impact on air quality, but this effect is not statistically significant. A higher amount of revenue for tourism services by one standard deviation increases air quality by 1.228 standard deviations.

The third regression model relates to the impact of fiscal, tourism and monetary policies on waste production. The model shows that 90.2% of the variability in waste production is explained by the variability in reference interest rate, environmental tax revenue and the number of overnight stays by tourists, which means that these factors are key in the amount of waste produced. The model is statistically significant, as the p-value is 0.05. The condition of no autocorrelation is met, as Durbin-Watson statistic is 2.448, which falls within the reference range.

Table 7. *Characteristics of the regression model of the impact of fiscal, tourism and monetary policies on Waste Production*

<i>Dependent Variable</i>	R Square	Significance level (p)	Durbin-Watson
<i>Waste Production</i>	0,902	0,050	2,448

Source: Calculation by the authors using the databases of RSZ, NBS and OECD

Table 8 represents the characteristics of the coefficients of the regression equation, which is presented as follows:

$$\text{WASTE PRODUCTION} = 2.416 * \text{RET} - 0.212 * \text{NOT} + 2.282 * \text{RIR}$$

Table 8. *The regression model of the impact of fiscal, tourism and monetary policies on Waste Production*

<i>Model</i>	β	Significance level (p)	VIF
<i>RET</i>	2,416	0,014	6,754
<i>NOT</i>	-0,212	0,364	1,213
<i>RIR</i>	2,282	0,015	6,238

Source: Calculation by the authors using the databases of RSZ, NBS and OECD

There is no multicollinearity in the model, as the VIF is below 10. The model shows that an increase in environmental fees by one standard deviation leads to an increase in waste production by 2.416 standard deviations, indicating that higher economic activity increases the amount of waste produced, and thus the obligation to pay environmental tax. The effect of the number of overnight stays by tourists is not statistically significant for waste production. An increase in the reference rate by one standard deviation results in an increase in waste production by 2.282 standard deviations.

5. DISCUSSION OF THE RESULTS

Based on the analysis of the impact of fiscal, tourism and monetary policies on the development of sustainable tourism, the research results provide insight into the complexity of the relationship between economic policies and the development of sustainable tourism in Serbia. Although the observed economic policies influence sustainable tourism indirectly, their impact is significant, which aligns with Chen's (2022) assertion that economic policy should create the necessary conditions for the development of sustainable tourism and the economy. The results of the regression analysis indicate that fiscal policy has the most significant impact on the development of sustainable tourism, while the variable related to monetary policy does not have a statistically significant impact on the observed indicators. This is in line with the Yang's (2019) argument that fiscal policy best promotes sustainable tourism through its measures, and with Gomey et al. (2007) who suggest that fiscal policy improves environmental quality and economic well-being. However, the impact of fiscal policy on sustainable tourism in Serbia can have different effects on various indicators of sustainable tourism. For example, an increase in revenue from environmental protection taxes could lead to increased waste production in tourism, which is opposite of the expected outcome. Such a result is consistent with the views of Dodds (2007), Cetinel & Yolal (2009), and Bozovic et al. (2022), who indicate that the effects of economic policy may be delayed due to the influence of other factors, such as a weak bureaucracy, lack of trust, low ecological awareness, and prioritizing economic goals over ecological and social ones. In addition to the policies mentioned, the research shows that an increase in tourism may contribute to the deterioration of air quality, highlighting the challenges of reconciling ecological and economic goals, i.e., the growth of tourism and the environment. That suggests the need for

the development of sustainable tourism and a reduction in mass tourism, which is consistent with the view of Schonherr et al. (2023).

6. CONCLUSIONS

In developing countries, creating a competitive tourism sector is an important aspect of economic development, given the potential for tourism growth in Serbia. To create the necessary conditions for the development of sustainable tourism in Serbia, it is essential for policymakers to act through clearly defined strategies, instruments, and measures.

The objective of this research was to examine the impact of economic policy on key indicators of sustainable tourism in Serbia and to determine the significance of these policies in achieving sustainability in tourism and the overall economy. The study evaluated two hypotheses: the first suggests that fiscal, tourism and monetary policies have a statistically significant impact on the development of sustainable tourism in Serbia, and the second assumes that monetary policy has a lesser impact compared to fiscal and tourism policies.

The research results indicate that economic policy has a statistically significant impact on the observed indicators of sustainable tourism development. All regression models are statistically significant, with the variability of the monitored indicators of sustainable tourism development explained by over 80% of the variability in economic policy instruments, thus confirming the first hypothesis. Furthermore, based on the results, it can be concluded that fiscal and tourism policies have a significant impact on the movement of sustainable tourism indicators, while the impact of monetary policy is less pronounced. In particular, the positive impact of fiscal policy on environmental performance stands out, which can support the development of sustainable tourism. These results also confirm the second hypothesis.

Eliminating barriers that hinder the development of sustainable tourism, such as inefficiencies in bureaucracy, lack of cooperation between local authorities, weaknesses in state institutions, underdeveloped infrastructure and low ecological awareness, can have a crucial role, not only in improving the development of sustainable tourism, but also in generating economic benefits that will positively influence the increase in living standards. Additionally, the clear integration of ecological, social, and economic goals contributes to guiding the effects of economic policy, thus creating a long-term approach to the sustainable development of tourism and the economy.

This research contributes to a clearer understanding of the role of economic policy in the development of sustainable tourism in Serbia, given the lack of literature addressing the impact of economic policy on sustainable tourism. However, a major limitation of the research is its focus on only selected indicators of sustainable tourism and instruments of economic policy. This limitation also provides a direction for future research that could expand the analysis to include a broader range of sustainable tourism indicators and instruments of economic policy, to gain a more comprehensive insight into the interrelations between economic policy and sustainable tourism in Serbia.

REFERENCES

- Asalos, N. (2018). Impact of green taxes and of fiscal measures on competitive sustainable tourism in Romania. *The USV Annals of Economics and Public Administration*, 18 (2), 28-35.
- Bošković, N. (2020). *Održivi razvoj turističkih destinacija*. Ekonomski fakultet Univerziteta u Kragujevcu, Kragujevac.
- Božović, I., Božović, J. (2022). Izazovi finansiranja ekoturizma u Republici Srbiji. *Ecologica*, 29(108), 570 -576. <https://doi.org/10.18485/ecologica.2022.29.108.14>
- Brokaj, R. (2014). Local Government's Role in the Sustainable Tourism Development of a Destination. *European Scientific Journal*, 10(31), 103-117.
- Cetinel, F., Yolal, M. (2009). Public Policy and Sustainable Tourism in Turkey. *Tourismos: An International Multidisciplinary Journal of Tourism*, 4(3), 35-50.
- Chen , Q. (2022). The impact of economic and environmental factors and tourism policies on the sustainability of tourism growth in China: evidence using novel NARDL model. *Environmental Science and Pollution Research*, 30, 19326-1934. <https://doi.org/10.1007/s11356-022-22925>
- Crismariu, O.D., Betu, I., Curteanu, B.A., Tenie, I. (2020). Tourism fiscal and monetary policies adjustments during COVID-19 pandemic. *BASIQ INTERNATIONAL CONFERENCE: New Trends in Sustainable Business and Consumption*, 1279-1286.
- Dodds, R. (2007). Sustainable Tourism and Policy Implementation: Lessons from Case of Calvia, Spain. *Current Issues in Tourism*, 10(4). <https://doi.org/10.2167/cit278.0>
- European Commission & UNWTO (2013). *Sustainable Tourism for Development Guidebook: Enhancing capacities for Sustainable Tourism for development in developing countries*. UNWTO, Madrid.
- Gomez , C., Lozano, J., Rey-Maqueira, J. (2007). Environmental policy and long-term welfare in a tourism economy. *Spanish Economic Review*, 10(1), 41-62. <https://doi.org/10.1007/s10108-007-9028-0>
- National Bank of Serbia. <https://www.nbs.rs/>. (01.10.2024.)
- OECD (2018). *Tourism Trends and Policies*. OECD Publishing, Paris. <https://doi.org/10.1787/tour-2018-en>
- OECD (2022). *Tourism Trends and Policies*. OECD Publishing, Paris. <https://doi.org/10.1787/a8dd3019-en>
- Ohlan , R. (2017). The relationship between tourism, financial development, and economic growth in India. *Future Business Journal*, 3(1), 9-22. <https://doi.org/10.1016/j.fbj.2017.01.003>
- Person-Fisher, U., Liu, S. (2021). The Impact of a Global Crisis on Areas and Topics of Tourism Research. *Sustainability*, 13 (2), 906. <https://doi.org/10.3390/su13020906>
- Rubinfeld, D. (2011). Reference Guide on Multiple Regression. In: *Reference Manual on Scientific Evidence: Third Edition*, The National Academies Press, Washington, D.C, 303-358.
- Schonherr, S., Peters, M., Kuscer, K. (2023). Sustainable tourism policies: From crisis-related awareness to agendas towards measures. *Journal of Destination Marketing & Management*, 27(100762). <https://doi.org/10.1016/j.jdmm.2023.100762>
- Statistical Office of the Republic of Serbia. <https://www.stat.gov.rs/> (01.10.2024.)
- Theobald , W. (2005). *Global Tourism: Third edition*. Elsevier Inc., Routledge.
- UNEP & UNWTO (2005). *Making Tourism More Sustainable: A Guide for Policy Makers*.
- UNWTO (2020). *How are countries supporting tourism recovery?*. UNWTO Briefing Note- Tourism and COVID-19, Issue 1.

- Yang, C. (2019). The Research of China's Fiscal Policy to promote Sustainable Tourism Development. *Financial Infrastructure and Sustainable Development: Collection of Scientific Papers*, International scientific conference, Kyiv, 6-9.
- World Tourism Organization. <https://www.unwto.org/>. (02.10.2024.)

EVALUATING SUSTAINABLE PRACTICES IN RURAL TOURIST HOUSEHOLDS: A STUDY FROM THE REPUBLIC OF SERBIA

Jovana Davidović

University of Kragujevac, Faculty of Hotel Management and Tourism, jsdavidovic@gmail.com,
ORCID number 0009-0004-8002-2636)

Danijela Pantović*

University of Kragujevac, Faculty of Hotel Management and Tourism, danijela.durkalic@kg.ac.rs,
ORCID number 0000-0001-8605-8614

Tijana Babović

University of Kragujevac, Faculty of Hotel Management and Tourism, tijanapetrovic650@gmail.com,
ORCID number 0000-0001-5918-3778

Abstract: Agritourism plays a vital role in promoting sustainable development in rural regions. The application of sustainable practices in agritourism increases its overall sustainability. Through this approach, this type of tourism is positioned as a key strategy for improving rural development, offering a stable and sustainable model for the future. An increasing number of studies focus on this topic, emphasizing rural tourism and agritourism as primary catalysts for the sustainable development of rural areas. In order to examine the state of sustainable practices in the rural areas of the Republic of Serbia, a survey was conducted that included 73 rural tourist households. The research deals with the ecological, social, and economic components of these households, and the results are presented through descriptive statistics. While the findings are predominantly positive, indicating respondent satisfaction with the performance of the identified sustainable components, there is still a need for improvement and promotion of sustainable development within this sector of rural tourism. Greater emphasis must be placed on the ecological component, considering that the social and economic components are more represented in the business of these households. The findings of this study contribute to the existing literature on agritourism by promoting the need for its sustainable growth.

Keywords: Sustainability, Rural development, Rural community, Agritourism, Rural tourist households.

JEL Classification: Q56, R20, Z32

* Corresponding author

1. INTRODUCTION

The pursuit of sustainable tourism poses a challenge in integrating economic, social, and environmental considerations into tourism planning (Kernel, 2005). Multidimensional approaches to sustainability are widely accepted in agricultural and tourism contexts (Ammirato et al., 2020). Sustainability and rural tourism are increasingly interconnected, highlighting the growing interest of tourists in experiencing rural environments and becoming part of the social fabric of local communities (Sims, 2009). Rural tourist households play a significant role in this context through the offerings they provide as part of their business.

Focus of this study is the analysis of rural households engaged in agritourism, specifically those registered as rural tourist households. The objective of this research is to assess the adherence to and prevalence of sustainability principles within agritourism practices.

The principles of environmental sustainability which ensuring that development aligns with the preservation of essential ecological processes, along with the principle of social sustainability, which emphasizes traditional values, and the principle of economic sustainability, focused on fostering economic development, were specifically examined.

The paper is organized into three interconnected sections. The first section provides a comprehensive review of the relevant literature on the topic under investigation. The second section outlines the research methodology employed in the study, while the third section presents the research findings along with suggested recommendations for future action.

2. LITERATURE REVIEW

The concept of sustainable development has become crucial for many sectors, including tourism. In this context, sustainable development in tourism encompasses the integration of environmental, social, and economic dimensions aimed at conserving resources while concurrently fostering the growth of local communities and economies (Bramwell and Lane, 2014). Nistoreanu (2006) posits that the objectives, principles, and requirements of sustainable tourism development are frequently associated with ecotourism, rural tourism, agritourism, and cultural tourism. Maria-Irina (2017) surmise that certain factors led to the expansion of these niche market types of tourism, such as the new kind of lifestyle, the evolving tourist behavior and continuously changing customer preferences, coupled with the widespread concern about the environment, industrial heritage and sustainable development. Muresan et al. (2016) pointed out that agritourism is a tourism activity that connects the ecological, social and economic components of sustainable development.

Agritourism, defined as tourism that takes place in rural areas with a focus on agricultural holdings and activities, presents a distinctive opportunity to embed sustainability principles within tourism offerings (Leonte et al., 2016). In the development of the concept of sustainable rural development, agriculture plays a special role, which is seen as the most traditionally represented activity in rural areas (Petrović & Miletić, 2023). According to Dimitrijević et al. (2022), the extensive restructuring of the agricultural sector in the economically developed countries focused on the diversification and development of new economic activities in rural areas and linking them with agricultural activities.

Melović (2017) says that agritourism includes a combination of agricultural and tourist activities, where tourists observe or participate in traditional agricultural activities without negative impacts on the ecosystem or on the productivity of rural households (p.10).

According to Petrović (2014), agritourism activities are characterized by two approaches: modern and traditional approach. The modern approach involves the inclusion of tourists in the daily life and activities of rural households, while the traditional approach involves a passive stay and observation of the host's business.

Agritourism is referred to as both a traditional and a modern form of tourism based on geographical features, culture, traditions and customs (Franić & Cunj, 2007). Agritourism helps sustainable development by providing a chance to discover new cultures and to expand one's view of the world. It also helps to conserve the tourist destinations cultural heritage and natural wonders and supports the local with a means of livelihood (Kothari & Perwej, 2021).

This modality of tourism has the potential to reconcile the demands of tourists with the necessities of rural communities, thereby facilitating economic and social development while simultaneously alleviating negative environmental impacts (Ammirato et al., 2020). In addition to eliminating the negative impact of business on the environment, sustainable development should also improve the quality of life of the local population (Nastić et al., 2024).

Most countries in the world promote agritourism with the aim of sustainable rural development (Adamov et al., 2020). In Serbia, there has been a marked increase in interest in agritourism, driven by both rural demand and the diverse resources available in these regions. The effective utilization of these resources has the potential to align with prevailing trends in sustainable development.

Data from the E-turista platform indicates a significant rise in the number of registered rural tourist households, coinciding with an increasing capacity for conducting business in accordance with sustainable principles.

Njegovan (2016) argues that the economic significance of agritourism stems from tourist spending on accommodation and food services. This consumption generates various economic benefits for the agricultural sector, other businesses, and the local community. From a social perspective, the author emphasizes the effects on both rural residents and tourists. He also highlights the ecological role of agritourism, particularly in raising awareness about environmental protection, improving infrastructure, and enhancing the aesthetic appeal of rural homes. Based on that, an insight into the three mentioned components was included through the research.

Tourism products and services, along with their environmental and social factors, significantly impact the value and overall satisfaction of tourists (Torres-Sovero et al., 2012). Yazdanifard and Merci (2011) assert that this principle is also relevant to the agricultural sector, emphasizing satisfaction as an important performance measure. The satisfaction of the tourists, ecology and relationship with local communities are three important factors that must be accommodated in the development of a sustainable tourism industry (Sumantra et al., 2017). The study explored the satisfaction of agritourism service providers concerning the sustainable aspects of their offerings.

In addition to the above, it is important to mention the impact that sustainable practices have on the business of rural tourist households. Yusuf and Wulandari (2023) particularly emphasize favorable agribusiness management, institutional and support facilities etc.

3. METHODOLOGY

The primary objective of this research is to analyze rural tourist households and assess the implementation of sustainable practices within these businesses. Sustainable tourism is increasingly recognized as a vital component of rural development, supporting environmental preservation, enhancing the social well-being of local communities, and promoting economic stability. By focusing on rural households involved in tourism, this study explores their awareness, adoption, and challenges related to sustainable practices.

The study involved 73 rural tourist households, selected based on their active engagement in tourism-related activities. Data collection took place during September and October 2024 through structured questionnaire. The questionnaire utilized a 7-point Likert scale, where 1 represented "strongly disagree" and 7 represented "strongly agree," to assess respondents' perspectives on various statements related to sustainable practices.

To ensure robust data analysis, the Statistical Package for the Social Sciences (SPSS), version 26, was employed. This software enabled the application of descriptive statistical methods to summarize key findings, including frequency distributions, mean scores, and standard deviations. The characteristics of the sample and respondents' views on the stated claims are presented in tabular form.

This study contributes to the growing body of literature on sustainable tourism by highlighting the current state of sustainable practices in rural areas. The findings underscore the importance of fostering a balance between economic growth and environmental and social responsibility in rural tourism.

4. RESULTS AND DISCUSSION

Table 1 shows the details related to the respondents' demographic variables and their characteristics. Within 73 rural tourist households, more women (49) participated in the research, and the largest number of respondents is in the age group of 51-60 years. More than half of the respondents have completed high school (38), and 59 of them are employed full-time. Monthly incomes between 501 and 700 EUR have the largest number of respondents (20).

Table 1. *Characteristics of respondents*

<i>Gender</i>	Men	24
	Women	49
<i>Education</i>	Primary school	1
	Secondary school	38
	Student	1
	BSc	24
	MSc	9
<i>Work status</i>	Unemployed	4
	Part time	3
	Full time	59
	Retiree	7
<i>Age</i>	18 – 30	15
	31 – 40	15
	41 – 50	15
	51 – 60	18
	>60	10

<i>Income</i>	301 – 500 EUR	10
	501 – 700 EUR	20
	701 – 1000 EUR	11
	>1000 EUR	6
	Without declaring	26

Source: Author's research

From the total number of rural tourist households included in the research, 20 households pointed out that they do not operate according to sustainable principles. This highlights a significant gap in the adoption of sustainable practices within the rural tourism sector. Detailed data on the sustainability components of rural tourist households are presented below, as well as respondents' views on the same.

Table 2. Sustainability components of rural tourist households

<i>Components</i>	Examined claims	AM	SD
<i>Ecological component</i>	Energy-efficient operations are highlighted	3.62	1.371
	Environmentally safe products and services are highlighted	4.14	1.251
	Pollution control is emphasized	3.75	1.152
	A green image contributes to a household's competitive advantage	5.10	1.396
<i>Social component</i>	Owners/employees are educated on the concept of sustainability	4.97	1.472
	Social responsibility is emphasized	4.84	1.190
	The traditional values of the local community are highlighted	6.32	0.808
	Rural identity is highlighted	6.18	0.805
<i>Economic component</i>	The affordable price of products and services is highlighted	6.11	0.792
	The economic impact on local development is highlighted	4.78	1.407

*AM – Arithmetic Mean; SD – Standard deviation

Source: Author's research

Based on what is shown in Table 2, it is possible to conclude that the social and economic components were evaluated with higher average scores compared to the ecological component. Sustainable products and services, with an average score of 4.14, are integrated into the operations of rural tourist households and are deemed crucial for attaining a competitive advantage. Notably, there is a strong emphasis on the traditional values of the local community (6.32) and the preservation of rural identity (6.18). Furthermore, rural tourist households highlight the affordability of their products and services (6.11), which significantly enhances their competitive position.

The respondents' satisfaction with the environmental, social, and economic components of their households was evaluated, as presented in the following table.

Table 3. Satisfaction with the sustainability components of rural tourist households

<i>Examined claims</i>	AM	SD
Satisfaction with the performance of the <i>ecological</i> component within the household	4.74	1.334
Satisfaction with the performance of the <i>social</i> component within the household	5.32	1.413
Satisfaction with the performance of the <i>economic</i> component within the household	5.14	1.273

*AM – Arithmetic Mean; SD – Standard deviation

Source: Author's research

The satisfaction levels reported by owners and employees of households regarding the performance of sustainability components yielded relatively high results. Notably, the social component received the highest average score (5.32), closely followed by the economic component with an average of 5.14. As anticipated, the environmental component received a slightly lower average rating (4.74). This pattern highlights the varying perceptions of sustainability components among the respondents.

The importance of sustainable business for the development of rural tourist households was further discussed.

Table 4. Significance of sustainability for the operations of rural tourist households

<i>Examined claims</i>	AM	SD
Doing business according to sustainable principles affects growth and development of the household	4.58	1.353
Sustainable business contributes to creating a positive image of the household	4.81	1.163
Sustainable business enables long-term planning and improvement of economic opportunities	4.23	1.219
Sustainable business enables the use of state subsidies for responsible business	4.63	1.242

*AM – Arithmetic Mean; SD – Standard deviation

Source: Author's research

The responses from participants indicate that adhering to sustainable principles positively influences the growth and development of agritourism households while also fostering a favorable public image. It is considered that sustainable business enables long-term planning and improvement of economic opportunities, while at the same time it has an impact on obtaining and using state subsidies for responsible business.

The research confirmed the implementation of sustainable principles within rural tourist households. Additionally, it highlighted an awareness of the benefits that responsible business practices can provide, particularly concerning competitiveness and eligibility for subsidy programs. The findings submitted particularly positive results regarding the social aspects of the offerings from rural tourist households.

5. CONCLUSIONS AND RECOMMENDATIONS

In addition to the growing need and desire of tourists to travel in a rural environment, sustainable business in agritourism can improve the competitiveness of this market, which would contribute to their environmental, social and economic development.

The research analyzed the green or responsible business practices of rural tourist households and their contribution to household development. Special attention should be directed toward enhancing energy efficiency and adhering to technical principles of sustainability. The provision of sustainable products and services within these households is deemed important and should be increased, particularly concerning competitive advantage and economic development. Traditional values are already well represented to rural tourists, alongside the affordable prices offered by these households.

The importance of sustainability for the business of rural tourist households is known to the owners and employees of the same. Therefore, special attention should be paid to applying for state subsidies and planning long-term sustainable business.

One of the limitations of the research may be the number of respondents. A recommendation for future research is to increase the number of rural tourist households that will be included in the research. Also, there is a potential for misunderstandings regarding the questionnaire items among respondents, particularly considering that a significant proportion lacks higher education. Therefore, it is advisable for future research to develop a clear and accessible questionnaire tailored to their comprehension levels.

REFERENCES

- Adamov, T., Ciolac, R., Iancu, T., Brad, I., Peț, E., Popescu, G., & Șmuleac, L. (2020). Sustainability of agritourism activity. Initiatives and challenges in Romanian mountain rural regions. *Sustainability*, 12(6), 2502. <https://doi.org/10.3390/su12062502>
- Ammirato, S., Felicetti, A. M., Raso, C., Pansera, B. A., & Violi, A. (2020). Agritourism and sustainability: What we can learn from a systematic literature review. *Sustainability*, 12(22), 9575. <https://doi.org/10.3390/su12229575>
- Bramwell, B., & Lane, B. (2014). The “critical turn” and its implications for sustainable tourism research. *Journal of Sustainable Tourism*, 22(1), 1–8. <https://doi.org/10.1080/09669582.2013.855223>
- Dimitrijević, M., Ristić, L., & Bošković, N. (2022). Rural tourism as a driver of the economic and rural development in the Republic of Serbia. *Hotel and Tourism management*, 10(1), 79–90. <http://dx.doi.org/10.5937/menhottur2201079D>
- Franić, R., & Cunj, L. (2007). Društveno-gospodarski preduvjeti razvitka agroturizma u Zagrebačkoj županiji. *Agronomski glasnik*, 69(5), 381–400.
- Kernel, P. (2005). Creating and implementing a model for sustainable development in tourism enterprises. *Journal of Cleaner Production*, 13(2), 151–164. <http://dx.doi.org/10.1016/j.jclepro.2003.12.023>
- Kothari, H., & Perwej, A. (2021). Agro tourism: A way of sustainable development. *Wesleyan Journal of Research*, 13(68), 2–10.
- Leonte, E., Chiran, A., & Miron, P. (2016). Implementing agritourism marketing strategy as tools for the efficiency and sustainable development of rural tourism. *Environmental*

- Engineering & Management Journal*, 15(12), 2663–2669.
<http://dx.doi.org/10.30638/eemj.2016.292>
- Maria-Irina, A., (2017). Ecotourism, agro-tourism and rural tourism in the European Union. *Cactus Tourism Journal*, 15(2), 6–14.
- Melović, M., (2022). Agritourism in Montenegro – Empirical research in the fuction of strategic development. *Hotel and Tourism Management*, 10(1), 9–24.
<http://dx.doi.org/10.5937/menhottur2201009M>
- Muresan, I. C., Oroian, C. F., Harun, R., Arion, F. H., Porutiu, A., Chiciudean, G. O., Todea, A., & Lile, R. (2016). Local residents' attitude toward sustainable rural tourism development. *Sustainability*, 8(1), 100. <https://doi.org/10.3390/su8010100>
- Nastić, S., Vujko, A., & Dragosavac, M. (2024). Does economic indicators of sustainable tourism present a promising trend of rural destination development? Attitudes of Vojvodina rural residents. *Economics of Agriculture*, 71(1), 275–291.
<https://doi.org/10.59267/ekoPolj2401275N>
- Nistoreanu, P. (2006). *Ecoturism si turism rural*. 3rd ed. Bucharest: Editura ASE.
- Njegovan, Z. (2016). *Ekonomika turizma i seoskog turizma*. Poljoprivredni fakultet, Novi Sad.
- Petrović, M. D. (2014). *Kvalitet agroturizma Vojvodine i njegov uticaj na stavove lokalnog stanovništva* (Doctoral dissertation, Ph. D. thesis–in Serbian). University of Novi Sad, Faculty of Sciences, Department of Geography, Tourism and Hotel Management, Novi Sad, Serbia).
- Petrović, T., & Miletić, R., (2023). Održivi razvoj turizma kao faktor razvoja i konkurentnosti ruralne destinacije. *Međunarodna konferencija – Jahorinski poslovni forum: Turizam u funkciji domaćeg poljoprivredno – prehrambenog sektora*, 26-28 april, Jahorina, Republika Srpska, 448–455.
- Sims, R. (2009). Food, place and authenticity: local food and the sustainable tourism experience. *Journal of sustainable tourism*, 17(3), 321–336.
<https://doi.org/10.1080/09669580802359293>
- Sumantra, I. K., Yuesti, A., & Sudiana, A. A. (2017). Development of agrotourism to support community-based tourism toward sustainable agriculture. *Australian Journal of Basic and Applied Sciences*, 11(13), 93–99.
- Torres-Sovero, C., González, J. A., Martín-López, B., & Kirkby, C. A. (2012). Social-ecological factors influencing tourist satisfaction in three ecotourism lodges in the southeastern Peruvian Amazon. *Tourism Management*, 33(3), 545–552.
<https://doi.org/10.1016/j.tourman.2011.06.008>
- Yazdanifard, R., & Mercy, I. E. (2011). The impact of green marketing on customer satisfaction and environmental safety. *International Conference on Computer Communication and Management*, 5(1), 637–641.
- Yusuf, E. S., & Wulandari, S. (2023). Agritourism development: Designing an effective model for sustainable growth. *BIO Web of Conferences*, 69, p. 04023.
<http://dx.doi.org/10.1051/bioconf/20236904023>

ACKNOWLEDGEMENT

This research is supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia by the Decision on the scientific research funding for teaching staff and researchers at the accredited higher education institutions in 2024 (No. 451-03-65/2024-03/200375 of February 5, 2024).

SERBIA`S TRADE DEFICIT: MADE IN CHINA?

Božidar Čakajac*

University of Kragujevac, Faculty of Economics, bozidar.cakajac@kg.ac.rs,
ORCID number 0000-0002-8764-6407

Nenad Janković

University of Kragujevac, Faculty of Economics, njankovic@kg.ac.rs,
ORCID number 0000-0001-6881-0067

Abstract: *The trade deficit is one of the most consistent macroeconomic constraints of the Serbian economy, simultaneously reflecting negatively on the country's external position. Despite the fact that during the observed period (2007-2023) the average export growth rate was higher than the import growth rate, the trade balance deficit has remained an unsolvable enigma for Serbian economic policymakers. The trend of decreasing the trade balance deficit, established after the global economic crisis, was interrupted in 2016 when it began to rise again. Simultaneously, since 2016, there has been more intensive economic cooperation between Serbia and China, especially in the merchandise trade. By the end of the observed period, China had become Serbia's second most important foreign trade partner, which affected the reduction of the share of traditionally the most significant trade partners of Serbia in the trade of goods: Italy, Russia, and Bosnia and Herzegovina. The importance of China as a foreign trade partner is more evident on the import side, but in recent years, China has also become an increasingly significant export market for Serbia. This is understandable considering the fact that Chinese companies are currently the largest exporters from Serbia and key generators of export growth to China. The faster growth of imports from China compared to exports has led to an increase in the trade deficit with the Chinese economy. Compared to other major trading partners, Serbia has the highest trade deficit with China, which in 2023 accounted for more than half of Serbia's total trade deficit. Given that the trade deficit is the key cause of the balance of payments imbalance in the domestic economy, reducing the trade deficit with China will be very important for improving Serbia's balance of payments position.*

Keywords: *Trade deficit, Current account deficit, Import, Export, Serbia, China*

JEL Classification: *F15, F16, F21, F32*

* Corresponding author

1. INTRODUCTION

The continuously growing trade surpluses of the Chinese economy represent a significant source of external imbalance in many national economies and contribute to the global external imbalance as a whole (Bagnai, 2009). The increasing surpluses of the Chinese economy simultaneously lead to current account deficits in both developed and many developing countries. At the same time, key economic players today, such as the United States and European Union countries, record their highest trade deficits specifically with the Chinese economy (Gao et al., 2018; Garcia-Herrero & Xu, 2022). Owing to high domestic accumulation and a policy of currency devaluation, China has become the world's largest exporter and an increasingly important financial creditor globally (Jaćimović et al., 2018).

China's demonstrated global economic expansion has significantly aligned with the developmental needs of the Serbian economy. This alignment influenced Serbia to officially join China's Belt and Road Initiative at the end of 2015 (Nedopil, 2023). The formalization of economic cooperation between Serbia and China has resulted in an increase in foreign trade exchange, a rise in Chinese capital inflows into the Serbian economy, and greater participation of Chinese companies in implementing key infrastructure projects in Serbia (Ivanović & Zakić, 2023).

The research subject of this paper is based on analyzing the trade exchange between the Serbian and Chinese economies nearly a decade after the establishment of more intensive economic cooperation between these economies. Accordingly, the primary objective of the research is to determine how the intensified economic cooperation of these economies has affected Serbia's trade balance, specifically to what extent Serbia's trade deficit stems from its trade deficit with China. Additionally, the derived objective of the research is to illustrate the effects of foreign trade with China on Serbia's balance of payments.

Besides the introduction and concluding considerations, the paper consists of three sections. The first section presents the key characteristics of the foreign trade of the Republic of Serbia and its most significant trade partners during the observed period (2007-2023). The second section analyzes the foreign trade cooperation between Serbia and China, with a focus on the characteristics of foreign trade with Serbia's major trade partners: Germany, Italy, and Russia. The third section illustrates the implications of Serbia-China foreign trade cooperation on Serbia's current account. Concluding considerations are presented in the final section of the paper.

2. SERBIA'S EXTERNAL TRADE

Foreign trade represents a significant segment of the successful functioning of a national economy. At the same time, the state of the trade balance is an important determinant of the external macroeconomic position. Following the wartime events, sanctions, and adverse economic trends during the last decade of the 20th century, the beginning of the new millennium saw a stronger reintegration of the Serbian economy into global economic flows (Božić & Nikolić, 2017). This reintegration simultaneously led to an increase in trade volume, which more than doubled during the observed period (2007-2023), so that by the end of 2023, Serbia's foreign trade exceeded 67 billion dollars (Figure 1).

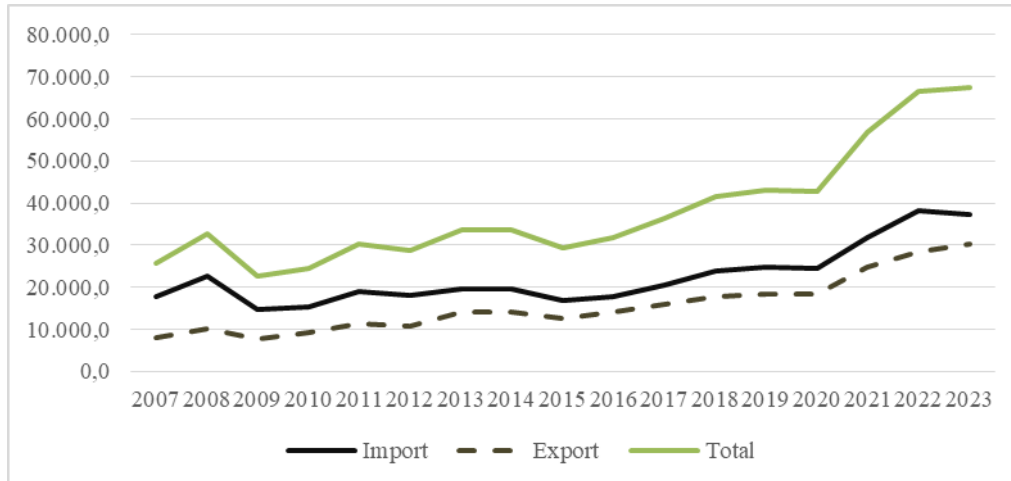


Figure 1. *The external trade of the Republic of Serbia (mln usd)*
Source: Statistical Office of the Republic of Serbia (2023)

The increase in trade volume was largely driven by export growth compared to imports (Nikolić & Nikolić, 2018). Specifically, during the observed period, the value of exports increased by just over 22 billion dollars, while import growth was more modest - 19.6 billion dollars. This trend can also be confirmed in relative terms, as the average export growth rate during the observed period was 11.3%, while the average import growth rate was 7.8% (Figure 2).

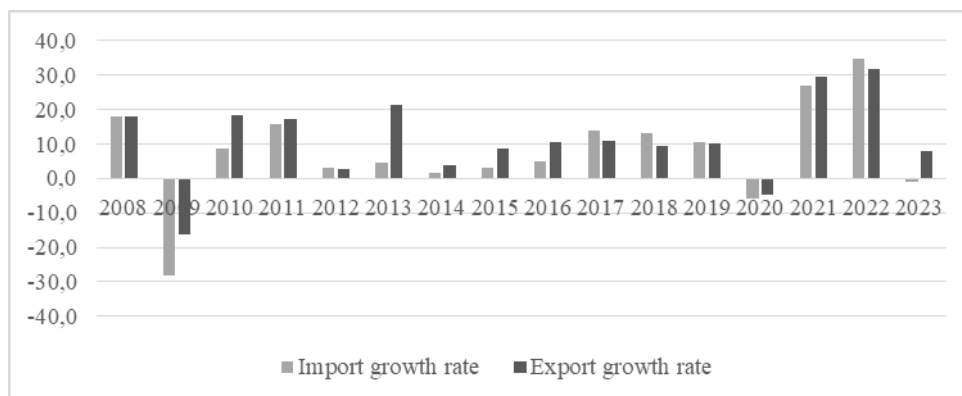


Figure 2. *The import and export growth rates (in %)*
Source: Authors' calculation

The faster growth of exports compared to imports during the observed period also led to an increase in the import coverage ratio (Figure 3). Specifically, in 2007, this indicator reached its lowest value during the observed period (44.9%), while at the end of the period, the import coverage ratio rose to 80.9%. This also represents the highest value of this indicator throughout the entire observed period.

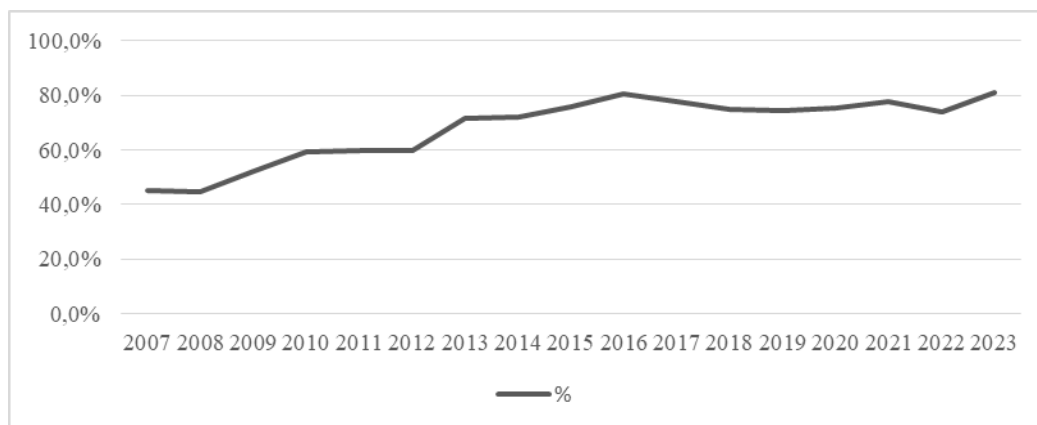


Figure 3. Coverage of import by export (in %)

Source: Author's calculation based on Statistical Office Republic of Serbia

The increase in trade volume also influenced the rise in the openness of the Serbian economy (Kovačević, 2021). The degree of openness of a national economy is calculated by relating the sum of imports and exports to its gross domestic product – GDP (Dugalić et al., 2023). When foreign trade grows faster than GDP, the openness of the national economy increases, and vice versa. This is the case with the Republic of Serbia, where trade volume grew faster than GDP during the observed period. During this period, the degree of openness of the Serbian economy increased from 80% in 2007 to 123.1% by the end of the analyzed time frame (Figure 4).

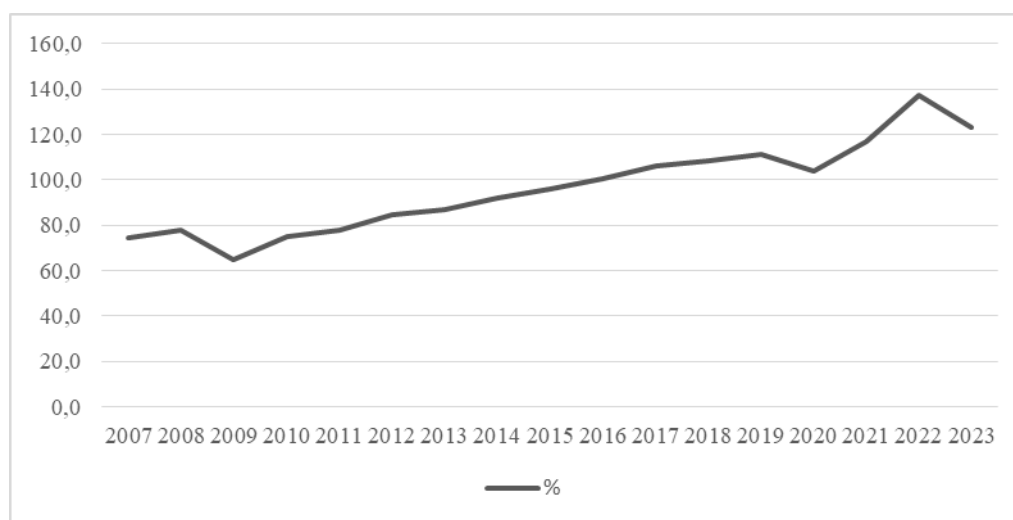


Figure 4. The degree of openness of Serbian economy (in %)

Source: Authors' calculation

Observing the geographical structure of foreign trade (Table 1), it can be noted that Serbia's most significant trade partners are the European Union countries and neighboring countries. Among the European Union economies, Germany is Serbia's most important trade partner, consistently recording a double-digit share in the trade structure throughout the observed period. In addition to Germany, Italy is a significant trade partner for Serbia, primarily due to Fiat's entry into the Serbian market. However, unlike Germany, which has shown growth in its share of trade structure, Italy's share in total foreign trade decreased by 4% over the observed period compared to the beginning of the analyzed time frame. Apart from these economies, Russia had a notable share in the trade structure during the initial years of the

observed period, whereas by the end of the period, trade with Russia accounted for only 4.3% of Serbia's foreign trade.

Table 1. Participation in Serbia's merchandise trade (in %)

Year	ITA	GER	RUS	CHN	BIH	MNE	MKD	SLO	CRO	HUN	ROM
2007	11.4%	12.2%	12.1%	5.4%	6.1%	4.2%	2.9%	4.4%	3.4%	4.0%	2.7%
2008	10.2%	12.3%	12.5%	5.0%	6.1%	4.6%	2.7%	3.8%	3.2%	4.2%	3.4%
2009	10.4%	12.4%	10.3%	4.9%	6.5%	4.5%	2.9%	3.8%	3.1%	3.9%	4.5%
2010	10.3%	11.2%	11.0%	4.8%	6.7%	4.0%	3.0%	3.8%	3.0%	4.5%	5.1%
2011	10.2%	11.5%	11.4%	5.0%	6.2%	3.4%	2.8%	3.7%	3.2%	4.2%	5.6%
2012	10.5%	11.7%	10.2%	4.8%	5.4%	3.2%	2.7%	3.5%	3.2%	4.3%	6.0%
2013	14.2%	11.9%	8.9%	4.5%	5.0%	3.0%	2.5%	3.1%	2.6%	4.2%	4.1%
2014	14.4%	12.3%	10.0%	4.4%	5.5%	2.4%	2.5%	3.1%	3.0%	4.1%	4.2%
2015	13.8%	13.2%	8.4%	5.0%	5.4%	2.5%	2.5%	3.3%	3.2%	4.1%	4.3%
2016	13.0%	13.7%	7.2%	4.9%	5.3%	2.5%	2.5%	3.3%	3.1%	4.3%	4.4%
2017	12.2%	13.5%	7.1%	5.0%	5.5%	2.5%	2.4%	3.2%	3.2%	4.7%	4.1%
2018	11.5%	13.9%	7.3%	5.4%	5.5%	2.4%	2.4%	3.3%	3.1%	5.1%	4.5%
2019	10.0%	13.8%	8.3%	6.6%	5.3%	2.3%	2.4%	3.1%	2.9%	4.7%	4.6%
2020	9.0%	14.2%	5.8%	8.2%	4.8%	2.1%	2.4%	3.2%	2.9%	5.3%	4.9%
2021	8.6%	13.6%	4.9%	9.0%	5.2%	2.0%	2.4%	3.0%	2.9%	5.0%	4.3%
2022	7.3%	13.1%	6.4%	9.2%	5.2%	2.1%	2.3%	2.7%	3.2%	5.9%	3.6%
2023	7.1%	14.6%	4.3%	9.0%	4.8%	2.2%	2.2%	2.6%	3.0%	5.0%	4.1%

Source: Author's calculation based on Statistical Office Republic of Serbia

Regarding neighboring countries, Serbia records the highest trade volume with Bosnia and Herzegovina and Hungary (Lazarov & Miteva Kacarski, 2023). The share of trade with Bosnia and Herzegovina in Serbia's total trade shows a slight decrease compared to the beginning of the observed period, with similar trends in trade with North Macedonia, Montenegro, Slovenia, and Croatia. On the other hand, Hungary and Romania's share in Serbia's total trade has shown a slight increase by the end of the observed period.

Apart from these economies, Serbia has experienced the largest growth in trade volume with China. At the beginning of the observed period, trade with China accounted for only 5.4% of Serbia's total trade. However, by the end of the period, this figure has nearly doubled, making China Serbia's second most significant trade partner after Germany, primarily due to high import values from the Chinese economy. Considering the above, the following section of the paper will provide a more detailed analysis of the trade characteristics between the Serbian and Chinese economies.

3. TRADE RELATIONS WITH CHINA

The dynamic growth of China's economy on a global scale is largely based on its foreign trade performance. China's economic ascent, initiated by its entry into the World Trade Organization at the end of 2001, has led to it becoming the world's largest exporter and the second-largest importer, following only the United States. However, despite its high import value, China generates a trade surplus and is the economy with the highest current account surplus globally.

The growing surpluses of the Chinese economy are considered one of the key causes of today’s global external imbalance. In 2023, 150 world economies recorded a trade deficit with China, while only 31 economies achieved a surplus in their trade with China. Economies rich in natural resources, such as Congo, Angola, Turkmenistan, and Brazil, are among the few able to “boast” a positive trade balance with China. Among the 150 economies with a trade deficit with China, 92 report a trade deficit with China that constitutes between 1 and 5% of their GDP. For 36 economies, the trade deficit with China accounts for between 5 and 10% of GDP, while for 7 economies, the trade deficit with China exceeds 10% of their GDP (Matthes, 2024).

The Republic of Serbia belongs to the group of countries with a trade deficit with the Chinese economy (Figure 5). Throughout the entire period, the value of Serbian imports from China was significantly higher than the value of Serbian exports to China. At the same time, the trade deficit consistently exceeded the value of Serbian exports to China. The highest value of imports from China was recorded in 2022—approximately 5 billion dollars. On the other hand, Serbian exports to the Chinese market remained relatively negligible. Between 2007 and 2018, the value of Serbian exports to China totaled only 272 million dollars. Since 2019, however, there has been a notable increase in Serbian exports to China, initially rising to 329 million dollars in 2019, with Serbian exports to China exceeding one billion dollars during the last two years of the observed period (NBS, 2023). The highest export value to the Chinese market was recorded in 2023, when goods worth approximately 1.3 billion dollars were exported. The primary contributors to this growth in Serbian exports to China have been Chinese companies that have entered Serbia since 2016, such as HBIS Group, Serbia Zijin Mining d.o.o., and Serbia Zijin Bor Copper. These companies have been among Serbia’s largest exporters for several years (Ministry of Finance of Serbia, 2023). Regarding the product structure, Serbia primarily imports consumer goods from China, mainly telecommunications devices. On the other hand, Serbia’s exports to China are dominated by copper and copper ores and concentrates, accounting for more than 90% of Serbian exports to this market (Zubalova et al., 2023).

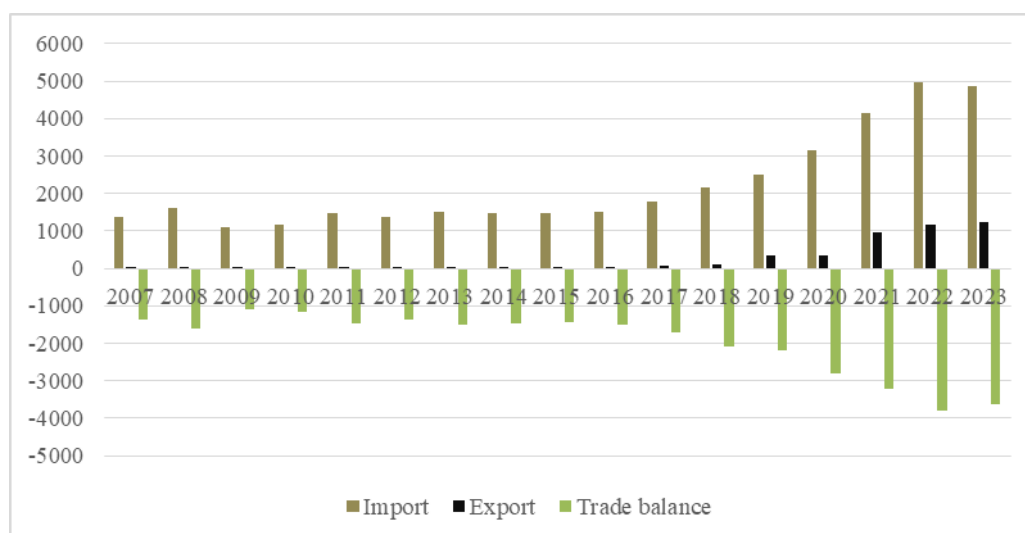


Figure 5. *Serbian trade balance with China*
 Source: Statistical Office of the Republic of Serbia (2023)

Despite the rapid growth of exports to the Chinese market over the last two years of the observed period, there has been an increase in the trade deficit with China compared to 2007. Specifically, in 2007, the trade deficit with China amounted to 1.3 billion dollars, while in 2023, the trade deficit reached 3.6 billion dollars. The lowest trade deficit with China was recorded in 2009 - 1.1 billion dollars, whereas in 2022, the trade deficit reached its highest value at 3.8 billion dollars. Observing the dynamics of the trade deficit with China and the overall trade deficit of the Republic of Serbia (Figure 6), it can be noted that since 2016, there has been a simultaneous intensification of the trade deficit with China and the growth of the overall trade deficit (Jovičić & Stojanović, 2022).

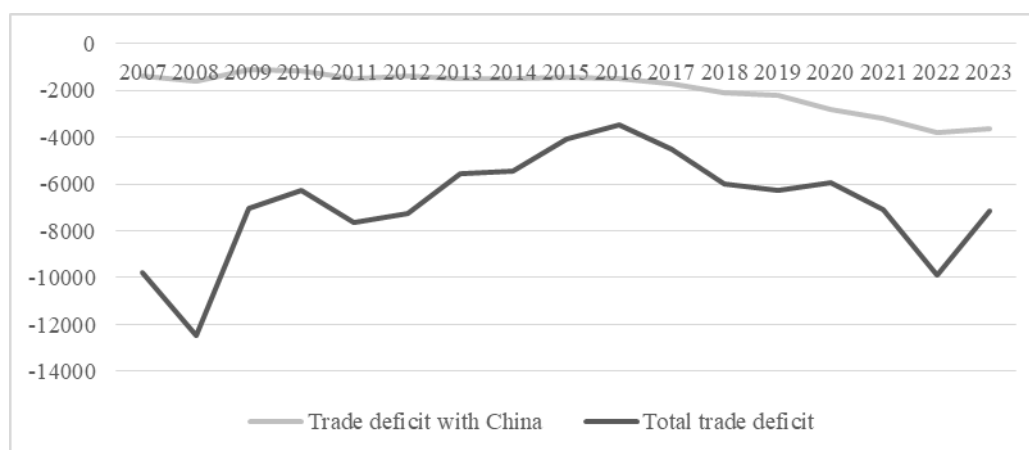


Figure 6. Trade deficit with China and total trade deficit of the Republic of Serbia (mln usd)

Source: Statistical Office of the Republic of Serbia (2023)

Relatively low values of Serbian exports to China during the initial years of the observed period contributed to a very low import coverage ratio in trade with China (Figure 7). Between 2007 and 2018, this indicator was below 5%, with the import coverage ratio with China being less than 1% for most of that period (Jovičić et al., 2020). However, thanks to the dynamic growth of Serbian exports to China, initially in 2019 and then over the last two years of the analyzed period, the value of this indicator significantly increased, reaching 25.4% by the end of 2023. Over the entire observed period, the average value of the import coverage ratio in trade with China was 6.6%.

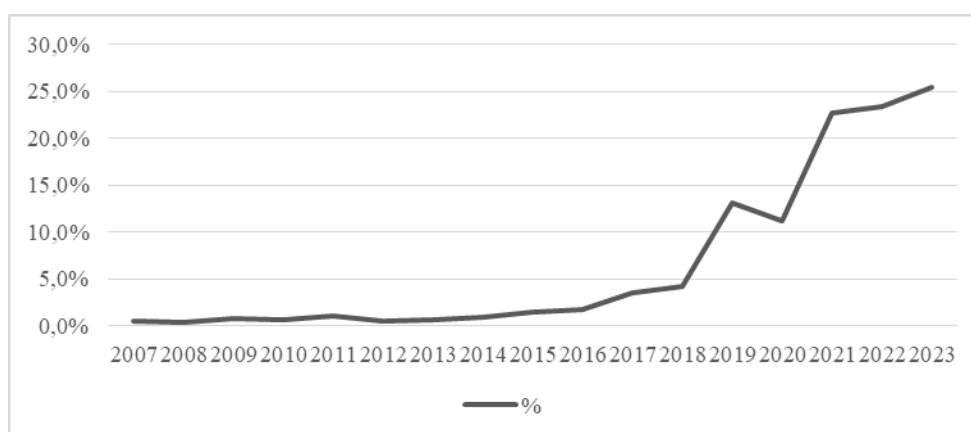


Figure 7. Coverage of imports by exports in China

Source: Authors' calculation

Despite the positive trend of reducing the share of the trade deficit in gross domestic product (GDP), the trade deficit still represents a significant portion of Serbia's GDP. In 2007, the trade balance deficit accounted for 22.7% of Serbia's GDP, while at the end of the observed period, its share was 9.4%. A single-digit trade deficit share in GDP was achieved in 2016 and 2023. Conversely, the trade deficit with China represents an increasingly substantial part of Serbia's GDP. In 2007, the trade deficit with China represented 3.2% of Serbia's GDP, rising to 4.8% by 2023 (Figure 8). Based on this, Serbia belongs to the group of 41 countries with a trade deficit with China between 3 and 5% of GDP.



Figure 8. Trade deficit as a % of GDP and trade deficit with China as a % of GDP
Source: Authors' calculation

The scale of the trade deficit with China can best be observed by comparing it with Serbia's other major trade partners. At the beginning of the observed period, Serbia recorded its largest trade deficit with the Russian Federation, primarily due to high import dependency on energy resources (Brkić, 2024). Until 2009, the trade deficit with Germany was somewhat higher compared to the trade deficit with China, but since 2012, Serbia has recorded its highest trade deficit with China. Throughout the observed period, Serbia recorded only a brief trade surplus with Italy between 2013 and 2017. At the same time, for most of the observed period, Serbia recorded its lowest trade deficit values with Italy.

Beyond the fact that Serbia's largest trade deficit is with China, the dynamics of this deficit in comparison to the other three observed economies are also concerning. Compared to 2007, the trade deficit with Germany decreased by 700 million dollars, while the trade deficit with Russia was 1.5 billion dollars lower at the end of the observed period (with a significant increase in 2022 during the energy crisis). Meanwhile, over the observed period, the trade deficit with Italy increased by slightly over 240 million dollars, whereas the trade deficit with China rose by 2.3 billion dollars (Figure 9).

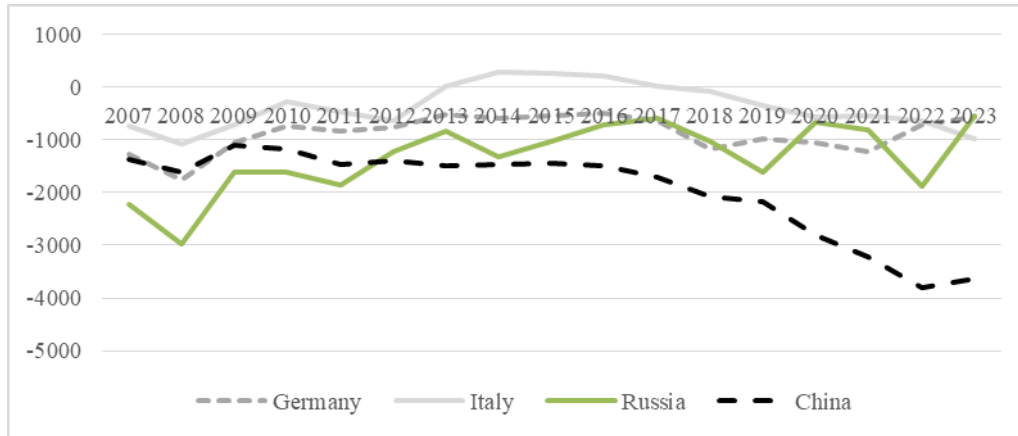


Figure 9. Serbia's trade balance with most important trading partners (mln usd)
Source: Statistical Office of the Republic of Serbia (2023)

Similar trends can be observed when examining the structure of Serbia's trade deficit (Figure 10). At the beginning of the observed period, the largest share of Serbia's trade deficit was with Russia. The trade deficits with China and Germany had approximately equal shares, while the trade deficit with Italy had the lowest share. However, by the end of the observed period, the trade deficit with China accounted for more than half of Serbia's total trade deficit. Since 2015, the trade deficit with China has represented more than a third of the total goods trade deficit of the Republic of Serbia (Jovičić & Marjanović, 2024).

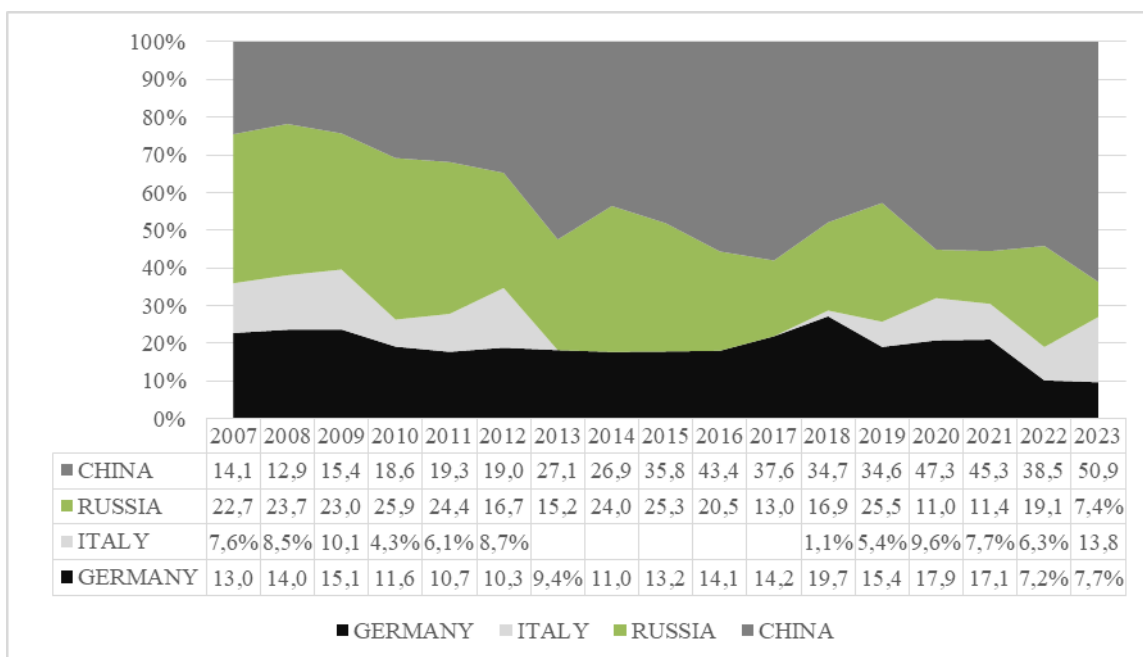


Figure 10. Structure of Serbian trade deficit by the most important trading partners (in %)
Source: Authors' calculation based on Statistical Office of the Republic of Serbia

Observing the remaining major trade partners of the Republic of Serbia, the trade deficit with Russia represented a quarter of Serbia's trade deficit in the initial years of the observed period, but by the end of the period, this share had decreased to 7.4%. During the first half of the observed period, the trade deficit with Italy had a single-digit share in the total trade deficit, reaching its highest value in 2023 at 13.8%. Finally, the share of the trade deficit with

Germany in Serbia's total trade deficit decreased from 13% at the beginning of the observed period to 7.7% in 2023. Compared to the beginning of the period, the share of the four most significant trade partners in Serbia's total trade deficit increased from 57.4% in 2007 to 79.8%. More precisely, these four economies account for nearly 80% of Serbia's trade deficit—50% attributable to China, and 30% collectively to Germany, Italy, and Russia.

4. IMPLICATIONS ON CURRENT ACCOUNT

The state of the trade balance directly impacts the balance of payments position of a national economy. Empirical experiences from global economies suggest that, in most cases, countries with a trade deficit simultaneously face a current account deficit (Cota et al., 2017). This is also evident in the case of the Republic of Serbia, which recorded a current account deficit throughout the observed period, due to both the trade deficit and the primary income account deficit (Kovačević, 2020). However, in the initial years of the observed period, the current account deficit was also driven by a deficit in the services balance, which has shown continuously increasing surpluses since 2011 (Figure 11). Along with the services balance, the Republic of Serbia has recorded surpluses in the secondary income account throughout the observed period, thanks to a high inflow of remittances from abroad (Čakajac et al., 2023).

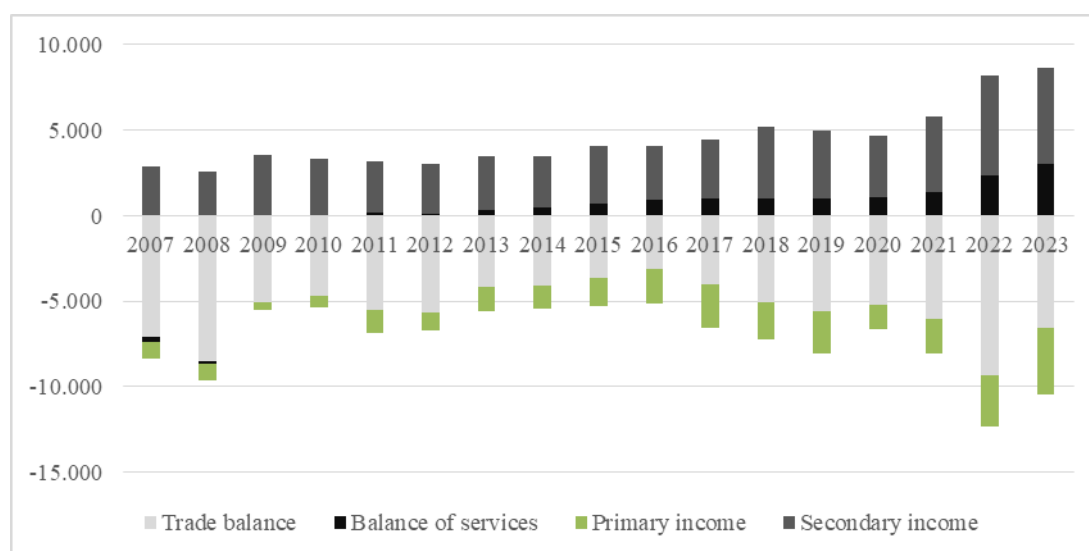


Figure 11. Structure of Serbia's current account (mln eur)

Source: National Bank of Serbia (2023)

An examination of the structure of the current account of the Republic of Serbia reveals that the most significant deficit components are the trade balance and the primary income account. Among these, the trade balance deficit represents a considerably more serious issue compared to the primary income deficit. Observing the structure of the deficit components of Serbia's current account, in the initial years, the trade balance deficit had a very high share (91.4%), primarily due to lower deficits in the primary income account and the services account. However, an intensified inflow of foreign capital into the Serbian economy, mainly through foreign direct investments, led to an increase in the primary income account deficit, primarily due to expenses related to foreign direct investments (Kovačević, 2022). Nevertheless, despite the significant primary income deficit in the second half of the observed period, the trade balance deficit remained the most significant deficit reporting component of Serbia's current account, with a share exceeding 60% among the deficit components (Figure 12). Over the

entire observed period, the average share of the trade balance deficit within the structure of Serbia's current account deficit components was 75%, while slightly less than 25% pertained to the primary income account.

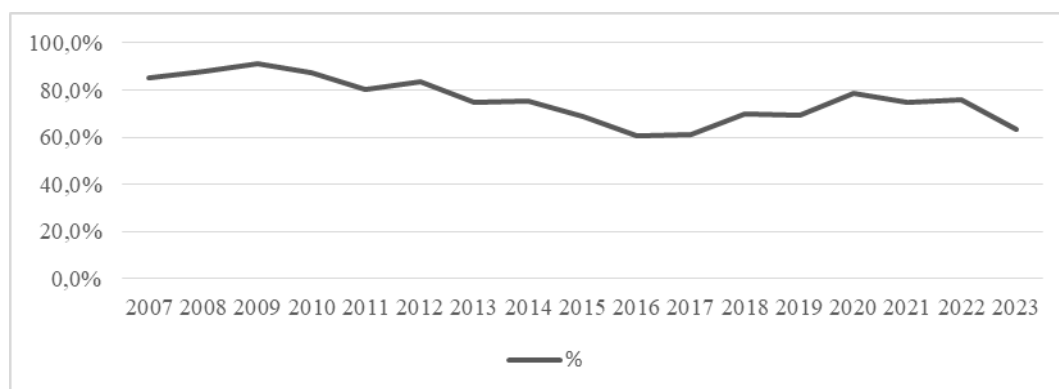


Figure 12. Trade deficit as a deficit reporting component of Serbia's current account (in %)
Source: Authors' calculation based on National Bank of Serbia

Considering that the trade balance deficit is the most significant deficit reporting component of Serbia's current account, and that the trade deficit with China represents more than half of Serbia's trade deficit, it is crucial to determine the extent to which the trade deficit with China impacts Serbia's balance of payments position, specifically the current account deficit. Figure 13 shows that in the initial years of the observed period, the trade deficit with China contributed less than 20% to the structure of Serbia's current account deficit reporting components. However, in the second half of the period, this figure nearly doubled, so that by the end of 2023, the trade deficit with China accounted for 32.1% of the current account deficit reporting components of the Republic of Serbia. The highest share of the trade deficit with China in the current account deficit structure was recorded in 2020 at 37.2% (Figure 13). This implies that nearly a third of Serbia's current account deficit components stem from the trade deficit with China. Accordingly, to improve Serbia's balance of payments position and bring the current account deficit within sustainable limits, it is essential to reduce the high trade deficit that Serbia has been recording with the Chinese economy since 2016.

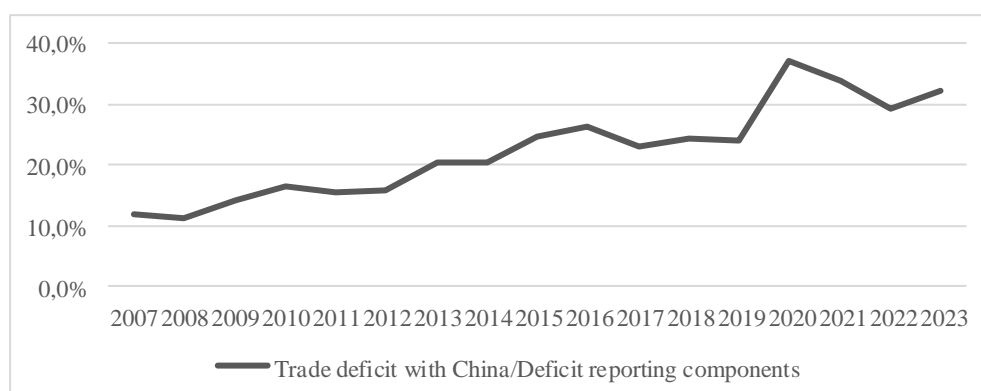


Figure 13. Share of trade deficit with China in deficit reporting components (in %)
Source: Authors' calculation based on National Bank of Serbia

At the same time, reducing the high trade deficit with the Chinese economy is important both in terms of its financing and the financing of the current account deficit as a whole. Adequate sources of financing are necessary for both mentioned deficits, currently achieved through a

high inflow of foreign direct investments (FDI) (Ercegovic & Beker Pucar, 2022). The increase in FDI inflows over the past decade into the Serbian economy has been crucial for financing and sustaining the current account deficit, as annual FDI inflows fully cover the current account deficit. However, the net effect would be considerably greater if current expenditures on foreign direct investments were significantly lower than they currently are.

After Serbia formally joined the Belt and Road Initiative in 2015, it became an attractive market for Chinese investors (Rogers, 2022; Cotella & Berisha, 2022). As a result, Serbia is currently the largest recipient of Chinese investments in the region (Marjanović et al., 2021). From 2010 to 2023, the total value of Chinese FDI in Serbia amounted to just over 5.5 billion euros, with half of this net inflow realized in the last two years of the observed period (NBS, 2023). In terms of inflow structure, most Chinese FDI was directed towards the automotive industry and the mining sector (Ivanović & Zakić, 2023). Some of the largest Chinese investments in Serbia include the purchase of RTB Bor by the Chinese company Zijin Mining (€1.26 billion), the investment by Linglong Tire in Zrenjanin (€800 million), the acquisition of the Smederevo steel plant by HBIS Group (€466 million), and the investment by Minh Group (€370.9 million) (Liu, 2019; Zakić, 2020).

The substantial inflow of Chinese capital is particularly significant from the perspective of financing the growing trade deficit with China (Figure 14). Until 2017, Chinese FDI was sufficient to finance less than 15% of Serbia's trade deficit with China. However, in 2018 and during the last two years of the observed period, there were substantial FDI inflows from China, which enabled the financing of one-third of the trade deficit with China. Nevertheless, over the entire observed period, Chinese FDI on average covered only 14% of Serbia's trade deficit with China.

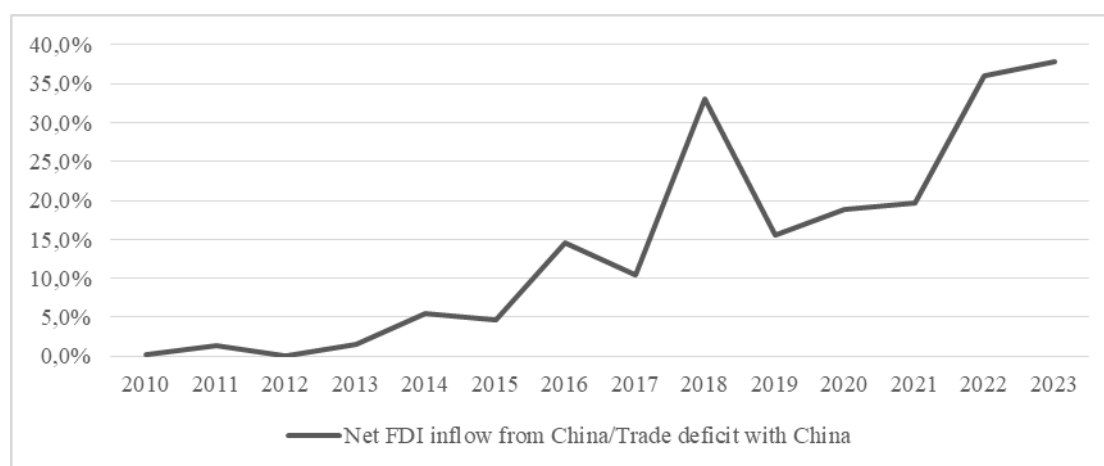


Figure 14. *Financing the trade deficit with China by net FDI inflow from China (in %)*

Source: Authors' calculation based on National Bank of Serbia

Given the above, it follows that the trade deficit with China is a crucial determinant of Serbia's balance of payments imbalance. The trade deficit with China accounts for more than half of Serbia's total trade deficit and constitutes a third of the current account deficit components. Accordingly, reducing the existing trade deficit with China is of great importance for improving Serbia's balance of payments position. A promising opportunity for this lies in the trade agreements signed with the Chinese delegation in the middle of the current year, which could enable a more dynamic growth of Serbian exports to China and create conditions to reduce both the trade deficit and the current account deficit as a whole.

5. CONCLUSIONS AND RECOMMENDATIONS

The growing and sustained trade surpluses of the Chinese economy are considered one of the key causes of global external imbalance. A large number of world economies, both developed and developing, are characterized by a trade deficit with China due to significantly lower exports compared to imports. This is also the case with Serbia, which has recorded a trade deficit with China throughout the observed period, representing 4.8% of Serbia's GDP in 2023. At the same time, China, along with Germany, has become Serbia's most significant trade partner.

However, for the Republic of Serbia, the presence of a trade deficit with China is not as concerning as the trend of this deficit. Over the observed period, the trade deficit with China has almost tripled, so that by the end of 2023, more than half of Serbia's total trade deficit is with China. Additionally, the trade deficit with China is 3.5 times greater than the deficit with Italy and 7 times greater than the deficits with Germany and Russia individually. In absolute terms, during the last four years of the analyzed period, Serbia has recorded a larger trade deficit with China than with Russia, Germany, and Italy combined.

These trends negatively impact Serbia's external position, creating pressure on the balance of payments imbalance. The trade deficit with China occupies an increasingly significant share of Serbia's current account deficit components, thus further contributing to the deepening balance of payments imbalance. At the end of the observed period, the trade deficit with China constituted one-third of Serbia's current account deficit components. Moreover, for most of the period, the trade deficit with China exceeded the primary income account deficit, the second most significant deficit component of Serbia's current account.

Summarizing the above, it is undeniable that since 2016, and the intensification of economic cooperation between these countries, Serbia's trade deficit has predominantly resulted from its trade deficit with China. Accordingly, in the coming period, it is desirable to leverage the benefits of the trade agreements signed with China in the middle of the current year to improve trade relations and reduce the high trade deficit. Besides increasing export revenues, this would positively impact Serbia's balance of payments position and greatly facilitate the financing of the existing deficit.

REFERENCES

- Bagnai, D. (2009). The role of China in global external imbalances: Some further evidence. *China Economic Review*, 20(3), 508-526. <https://doi.org/10.1016/j.chieco.2008.11.002>
- Božić, D., Nikolić, M. (2017). Serbian foreign trade and importance of agrarian sector. *Themes*, 41(3), 711-730. <https://doi.org/10.22190/2FTEME1703711B>
- Brkić, D. (2024). Serbian Energy Sector in a Gap Between East and West. *Energy, Exploration & Exploitation*, 42(1), 330-340. <http://dx.doi.org/10.1177/01445987231215445>
- Cota, B., Erjavec, N., Bogdan, Ž. (2017). External imbalances in emerging and advanced European countries. *Economic Research*, 30(1), 1553-1571. <https://doi.org/10.1080/1331677X.2017.1340179>

- Cotella, G., Berisha, E. (2022). The impact of China's Belt and Road Initiative on the Western Balkan Region: An erosion of EU conditionality? *European Spatial Research and Policy* 28(2), 165-186. <http://dx.doi.org/10.18778/1231-1952.28.2.09>
- Čakajac, B., Janković, N., Luković, S. (2023). The Role of Remittances in Financing the Current Account Deficit: The Case of Serbia. *Our Economy*, 69(3), 35-44. <http://dx.doi.org/10.2478/ngoe-2023-0016>
- Dugalić, V., Kovačević, R., Janković, N. (2023). *International Finances*. Faculty of Economics, University of Kragujevac
- Ercegovac, D., Beker Pucar, E. (2022). The nexus between FDI and external balance in selected Emerging European Economies – a panel data approach. *The Annals of the Faculty of Economics in Subotica*, 58(47), 147-164. <http://dx.doi.org/10.5937/AnEkSub2247147E>
- Gao, Y., Cheng, W., Yuan, Q. (2018). Understanding the global imbalance from the perspective of processing trade value added of China. *Journal of Chinese Economic and Business Studies*, 16(1), 1-20. <http://dx.doi.org/10.1080/14765284.2018.1504529>
- Garcia – Herrero, A., Xu, J. (2022). EU-China Trade: A Review of the Facts and Where We Stand. In Chan Kim, Y. (ed) *China and the Belt and Road Initiative*. Springerlink. pp 1-14. http://dx.doi.org/10.1007/978-3-030-86122-3_1
- Ivanović, V., Zakić, K. (2023). Belt and Road investments in Serbia: Is China a new savior or a new threat? *International affairs*. 75(1), 65-92. <https://doi.org/10.2298/MEDJP2301065I>
- Jaćimović, D., Dragutinović Mitrović, R., Bjelić, P., Tianping, K., Rajković, M. (2018). The role of Chinese investments in the bilateral exports of new E.U. member states and Western Balkan countries. *Economic Research*, 31(1), 1185-1197. <https://doi.org/10.1080/1331677X.2018.1456357>
- Jovičić, E., Stevanović, S., Beraha, I. (2020). Serbia-China Bilateral Trade Relations: Major Challenges and Opportunities. *Economic Analysis*. 53(2), 133-144. <https://doi.org/10.28934/ea.20.53.2>
- Jovičić, E., Stojanović, D. (2022). Key Features and Challenges of the China-Western Balkan Countries Merchandise Trade Development. *Economic Analysis*, 55(2), 79-90. <https://doi.org/10.28934/ea.22.55.2.pp79-90>
- Jovičić, E., Marjanović, D. (2024). The Contemporary Development of Serbia-China and Serbia-Russia Relations: Is This the Opportune Moment for Economic Cooperation Expansion? *The Review of International Affairs* 75(1190), 109-137. https://doi.org/10.18485/iipe_ria.2024.75.1190.5
- Kovačević, R. (2020). The causal relationship between current account and financial account balance in Western Balkan countries: The case of Serbia. *Banking*, 49(4), 9-41. <http://dx.doi.org/10.5937/bankarstvo2004009K>
- Kovačević, R. (2021). Serbia's foreign exchange reserve adequacy and the factors influencing their accumulation. *Economic Horizons*, 23(1), 33-53. <https://doi.org/10.5937/ekonhor2101033K>
- Kovačević, R. (2022). The effects of FDI net inflow on the current account of Southeast Europe countries – a panel causality analysis. *Economic Annals* 67(235), 95-122. <https://doi.org/10.2298/EKA2235095K>
- Lazarov, D., Miteva – Kacarski, E. (2023). Intra-regional trade perspective and untapped trade potentials of the Western Balkan region. *Economic Horizons*, 25(3), 243-259. <https://doi.org/10.5937/ekonhor2303261L>
- Liu, Z. (2019). China's Investments in the Balkans under the Belt and Road Initiative: A Chinese Perspective. *Insight Turkey*, 21(2), 91-105. DOI: 10.25253/99.2019212.07

- Marjanović, D., Jovičić, E., Stojanović, D. (2021). The Global Distribution of Chinese Investments- Importance for the Economy of Serbia. *Ekonomika*. 67(1), 43-55. <https://doi.org/10.5937/ekonomika2101043M>
- Matthes, J. (2024). China's Trade Surplus – Implications for the World and for Europe. *Intereconomics*. 59(2), 104-111. <https://doi.org/10.2478/ie-2024-0022>
- Ministry of Finance of Serbia (2023). Current macroeconomic trends. Available at: <https://www.mfin.gov.rs/dokumenti2/tekuca-makroekonomska-kretanja-prezentacija>
- National Bank of Serbia (2023). Balance of payments statistics. Available at: https://www.nbs.rs/sr_RS/drugi-nivo-navigacije/statistika/platni_bilans/
- Nedopil, C. (2023). „Countries of the Belt and Road Initiative“ Green Finance & Development Center, FISF Fudan University Shanghai. Available at: <https://greenfdc.org/countries-of-the-belt-and-road-initiative-bri/?cookie-state-change=1721470868020>
- Nikolić, G., Nikolić I. (2020). The structural changes of the Serbian merchandise trade during transition process: comparative analysis of main trade indicators. *Economics of Enterprise*. 68(5-6), 383-399. <https://doi.org/10.5937/EKOPRE2006383N>
- Rogers, S. (2022). Illiberal capitalist development: Chinese state-owned capital investment in Serbia. *Contemporary Politics*. 28(3), 347-364. <https://doi.org/10.1080/13569775.2021.2022876>
- Statistical Office of the Republic of Serbia (2023). External trade. Available at: <https://www.stat.gov.rs/en-us/oblasti/spoljna-trgovina/>
- Zakić, K. (2020). The results and risks of China's Belt and Road investment projects in Serbia. *The Review of International Affairs*, 71(11180), 45-71. https://doi.org/10.18485/iipe_ria.2020.71.1180.3
- Zubalova, L., Drienikova, K., Ujlaky, L., Dureckova E.M. (2023). The European Union and China Trade Presence in Serbia. *Journal of Liberty and International Affairs*. 9(3), 370-405. <https://doi.org/10.47305/JLIA2393370z>

THE IMPACT OF THE COVID-19 CRISIS ON BANKING MARKET CONCENTRATION AND COMPETITION IN THE WESTERN BALKANS

Nada Đurić*

University of Kragujevac, Faculty of Economics, nadja.djuric@ef.kg.ac.rs
ORCID number 0000-0003-4358-7465

Andrijana Đurđević

University of Kragujevac, Faculty of Economics, andrijana.djurdjevic@ef.kg.ac.rs
ORCID number 0000-0001-9381-0712

Zlata Đurić

University of Kragujevac, Faculty of Economics, zlata.djuric@ef.kg.ac.rs
ORCID number 0000-0003-1101-4822

Abstract: *This paper analyzes the impact of the COVID-19 pandemic crisis on the structure of the banking market, with a specific focus on concentration levels and competition intensity within the banking sector of Western Balkan countries. Both competition and concentration are critical factors that significantly affect not only the profitability and operational efficiency of banks but also have extensive implications for macroeconomic trends and the overall stability of the financial system. The primary objective of this research is to identify key trends and structural changes in the market due to the COVID-19 crisis, using three relevant indicators: The Concentration Ratio (CR), the Entropy Index, and the Herfindahl-Hirschman Index (HHI). The findings will provide significant information for bank management, aiding in timely decision-making and strategic adjustments in response to future crises, thereby enabling more effective risk management and preservation of competitive market positions. This study is based on an empirical analysis of balance sheet data from all commercial banks in the region, covering the period from 2019 to 2022, which includes pre-crisis, crisis, and post-crisis phases. The results aim to contribute to the broader understanding of how systemic shocks like pandemics reshape banking structure dynamics and inform policymakers in designing measures to enhance financial sector resilience.*

Keywords: *COVID-19 crisis, banking market structure, market concentration, banking competition, Western Balkans countries*

JEL Classification: *G21, G28, L11*

* Corresponding author

1. INTRODUCTION

The financial market of the Republic of Serbia is predominantly bank-centric, with commercial banks holding over 90% of the financial sector's market share (NBS, 2020). High levels of competitiveness in Serbia's core economic sectors are essential for effective and efficient functioning. Continuous monitoring of competition levels, with regulatory frameworks in place, is required to prevent monopolistic, duopolistic, or oligopolistic market conditions (Filipović, Avramović & Račić 2016).

The number of banks in Serbia has been decreasing, primarily due to mergers and acquisitions. According to the National Bank of Serbia, there were 34 banks in 2009, compared to 20 banks operating in 2023, of which 16 are foreign-owned, while four are domestic (two state-owned and two privately held). Market concentration stands out as a key measure of economic competitiveness. In the banking sector, competition influences both efficiency and the quality of products and services offered (Alihodžić, 2019). Highly concentrated markets are typically characterized by relatively lower competition, and vice versa (Mirković, 2016). The significant influence of concentration on the economic environment motivated this study's focus on examining competition in the Republic of Serbia following the economic disruptions caused by the pandemic. The primary research question explores how the crisis period caused by the COVID-19 pandemic has affected the levels of concentration and competition in the banking sector of Serbia, and what lessons can be drawn for future crises.

The goal of this paper is to analyze the evolution of market concentration and competition in the banking sector of the Western Balkans, with a special focus on Republic of Serbia. We investigate whether the pandemic has led to significant changes in these dynamics and what consequences these changes have on the stability and efficiency of the banking system. The analysis covers the period from 2019 to 2022, including the pre-crisis, crisis, and post-crisis phases, and uses balance sheet data from all commercial banks operating in Republic of Serbia. This paper is structured into three sections. Following the introductory part, a review of relevant literature discusses the concentration of banks and its implications for competitiveness in the banking sector. The research focuses on frequently analyzed balance sheet components: assets, total capital, lending activities, and the deposit potential of banks in Serbia. Based on the analysis of the results, the study seeks to determine whether, and to what extent, concentration levels may threaten competitiveness within Serbia's banking market.

The second section presents an analysis of concentration in the banking sector using the Concentration Ratio (CR), Entropy Measure, and the Herfindahl-Hirschman Index (HHI). The third section provides an analysis of concentration levels in the Serbian banking market from 2019 to 2022, including a comparative analysis with regional countries. In conclusion, the key findings and a commentary on the results are summarized.

2. LITERATURE REVIEW

One of the pioneering studies on concentration and competition in the banking sector was conducted by Bain (1951), who argued that high market concentration leads to higher prices and above-average profit margins. Berger & Hannan (1989) found that banks in the United States operating in highly concentrated markets (measured by the Herfindahl-Hirschman Index and the market share of the largest banks) tend to charge higher interest rates on loans

and offer lower rates on deposits, resulting in increased net interest margins. Their claim suggests that more efficient banks acquire those that are less efficient. Demirguc-Kunt, Laeven & Levine (2003), in their study on the relationship between concentration, regulatory policy, competition, and key indicators of financial intermediation efficiency (including net interest margin), arrived at ambiguous conclusions. They observed that increased concentration and restrictive regulatory policies, characterized by high entry barriers and extensive regulation, contribute to higher net interest margins. However, after controlling for variables such as regulatory policy, general business conditions, and property rights protection, these effects lose statistical significance. Bhattacharya & Das (2003) provide evidence from India showing a high degree of correlation between concentration measures over an extended period. Claessens & Laeven (2003), in their research, did not find a negative correlation between the level of competition and concentration in the banking sector. They concluded that a higher concentration level could actually enhance competition. Gelos & Roldós (2004) examined banking sector concentration across Central Europe. Their analysis suggests that a decrease in the number of banks does not necessarily lead to increased concentration. In fact, as the number of banks declined, concentration levels also dropped. Increased competition, driven by the reduced number of banks, was identified only in Latin America, where early foreign capital entry led to concentration often accompanied by banking crises. Levy & Micco (2007) conducted a comprehensive study in Latin America, identifying a trend of fewer banks coupled with increased concentration. They concluded that the rise in concentration did not reduce competition; instead, it was primarily driven by the early entry of foreign banks. This influx led to high levels of risk and instability in the region's banking sector. In the Republic of Serbia, several studies have addressed this topic. All have indicated that the concentration in Serbia's banking sector remains moderate despite a continuous decline in the number of banks (Marinković, 2006; Lončar & Rajić, 2012; Miljković, Filipović & Tanasković, 2013; Barjaktarović, Filipović & Dimić, 2013; Filipović, Avramović & Račić, 2016; Mirković, 2016).

3. METHODOLOGY

Analyzing the degree of market concentration, along with appropriate regulatory measures, enables the timely prevention of market principal disruptions across all economic sectors. To ensure that competition assessment processes are not solely based on subjective evaluations and analyses, specific mathematical models have been developed to quantify the level of competition in the market (Radivojević, 2013). Among the numerous indicators available, the most prominent ones used to measure market concentration include the concentration ratio, the Herfindahl-Hirschman Index (HHI), the Lorenz curve, the Gini coefficient, the entropy index, the relative entropy index, the comprehensive index of industrial concentration, the Hannah & Kay Index, the Hall-Tideman Index, and the Hause Index (Dumičić, Pavković & Akalović Antić, 2012).

This study examines the values of the following indicators: the concentration ratio (CR5, CR10), the entropy index, and the Herfindahl-Hirschman Index (HHI). The mathematical formula for calculating the concentration ratio is as follows (Savić, 2000, p. 4):

$$CR_n = X_1 + X_2 + \dots + X_n$$

$$CR_n = \sum_{i=0}^n X_i$$

where X_i represents the individual market share of the i -th bank. The market share of the i -th bank is calculated as follows (Kostić, 2008, p. 92):

$$X_i = q_i / Q \cdot 100$$

Where q_i is the output of the i -th bank, and Q is the total output of the industry. For ease of interpretation, the concentration ratio is expressed as a percentage, categorized as follows (Kostić, 2008; Dimić, 2015): $CR = 0\%$ indicates perfect competition (no concentration), $CR < 25\%$ signifies low market concentration, $CR < 50\%$ denotes moderately concentrated markets, $CR > 50\%$ represents highly concentrated markets, and $CR = 100\%$ denotes full concentration.

The entropy index also accounts for all banks in market (Galetić & Obradović, 2018) and is calculated using:

$$E = - \sum_{i=1}^n x_i \cdot \log_2 x_i$$

Where x_i is the market share of each bank, and n is the number of banks in the industry. The entropy coefficient is an inverse measure of concentration, with values ranging from $[0, \log_2 n]$. This indicator is low in cases of high concentration; for instance, it equals 0 in a monopoly and reaches $\log_2 n$ when market shares are equal (Ljuba, 2005).

The Herfindahl-Hirschman Index (HHI) is considered the most precise concentration metric because it aggregates the market shares of all banks, accounting for the size of each market share among competitors (Filipović, Avramović & Račić, 2016). The formula for calculating this indicator is (Šaj, 2005, p. 172):

$$HHI = \sum_{i=0}^n (X_i)^2$$

Where n is the total number of banks, and x_i is the market share of the i -th bank within the sector. If $HHI < 0.1$, the market is unconcentrated; values between 0.1 and 0.18 indicate moderate concentration, while values from 0.18 to 0.26 signify high concentration (Begović et al., 2002).

4. RESULTS AND DISCUSSION

The analysis of concentration in the banking market of the Republic of Serbia has already been a focus of the scientific community, based on publicly available data from the Reports on Business Performance from 2009 to 2019. The results of previous studies indicated low concentration levels among banks, with an expected trend of further consolidation in the banking sector and a subsequent deterioration of competition (Stojmenović, 2021). This research covers a longer time horizon, including the years of the global health crisis caused by

COVID-19. Data from the balance sheets of all banks, available in the National Bank of Serbia's database, were used for the fourth quarter of each observed year from 2019 to 2022. Table 1 presents an overview of the concentration ratios of the top five banks based on total assets, total deposits (including the sum of deposits and other financial liabilities to banks, financial organizations, the central bank, and deposits from other clients), total loans and capital.

Table 1. Concentration Ratio of the Top 5 Banks (CR5)

Year	Total Assets	Total deposits	Total loans	Capital
2019	63.11%	64.40%	59.34%	57.14%
2020	63.86%	64.77%	60.34%	58.52%
2021	65.04%	65.69%	63.53%	63.34%
2022	61.12%	60.89%	62.56%	62.04%

Source: Author based on data sourced from www.nbs.rs.

In 2019, the top five banks accounted for 63.11% of total assets, while the remaining 21 banks held only 36.89% of total balance sheet assets. A similar disparity is evident across other observed balance sheet components. A high concentration of all observed parameters is noticeable. The concentration levels for all observed balance sheet components increased in the years most affected by the pandemic, particularly in 2020 and 2021.

After the concentration of all observed categories peaked in 2021, bank mergers during this year appear to have had a positive effect, leading to a slight decline in concentration by 2022. When comparing these results to the number of banks, the concentration ratios were similar in 2019 and 2020, when there were 26 commercial banks operating in Serbia. However, as the number of banks decreased in 2021, concentration ratios increased across all observed components. Interestingly, in 2022, despite a further reduction in the number of banks, the CR5 ratios dropped significantly, reaching levels below those of 2019. This raises the question of whether a reduction in the number of banks truly leads to higher concentration.

Observing the concentration among the top 10 banks (Table 2), an almost monopolistic concentration of assets and deposits is evident, with the remaining banks holding less than 10% of the market share.

Table 2. The concentration ratio of the top 10 banks – CR10

Year	Total Assets	Total deposits	Total loans	Capital
2019	91.36%	89.95%	90.99%	91.35%
2020	91.09%	97.75%	90.87%	91.49%
2021	91.84%	91.84%	91.63%	91.75%
2022	91.65%	91.84%	91.99%	90.17%

Source: Author based on data sourced from www.nbs.rs.

The exceptionally high relative share of the top 10 banks did not decrease due to mergers; rather, the concentration of assets, deposits, and loans increased in 2021 compared to 2019, when six more banks were present in the market. A slight decrease in concentration was observed following bank mergers in 2021. This ratio reached its highest value in total deposits in 2020 (97.75%). When comparing this with the number of banks, the concentration ratio

shows resilience to a declining number of banks, with no evident relationship between the observed indicator and the number of market participants.

As the concentration ratio emphasizes the impact of a selected number of banks while disregarding the influence of smaller banks, the entropy coefficient is considered a more representative measure because it also accounts for market participants with a share of less than 1%. Unlike other indices, the values of this index range from 0 to $\log_2 n$ (Bajo-Rubio & Salas, 2004).

Table 3. *The value of the entropy coefficient*

Year	$\log_2 n$	Total Assets	Total deposits	Total loans	Capital
2019	4.700439718	3.5098438	3.2962026	3.5159938	3.5311583
2020	4.700439718	3.5270532	3.5146921	3.5220434	3.5220434
2021	4.523561956	3.5118927	3.5058237	3.4819016	3.4904052
2022	4.32192809	3.5891828	3.5852860	3.5852860	3.5631011

Source: Calculation by the author based on data sourced from www.nbs.rs.

The results in Table 3 indicate a very low concentration across all analyzed categories. A limitation of this indicator lies in the fact that the range of its values-and thus the measure of concentration-depends on the parameter n , or the number of market participants. The values of the entropy coefficient show very little variation with changes in the number of banks, yet they are highest in 2022, when the number of operating banks is at its lowest.

The predominant measure of concentration in the banking sector is the Herfindahl-Hirschman Index (HHI), which is also reported by the National Bank of Serbia in its banking market reports. This coefficient is proportional to the relative market share and is weighted by the market share of each bank. An increase in the Herfindahl-Hirschman Index generally indicates a reduction in competition and an increase in market power. When the index value is below 0.1, the market is considered unconcentrated; index values ranging from 0.1 to 0.18 indicate moderately concentrated markets, while values between 0.18 and 0.26 characterize highly concentrated markets (Begović, 2002).

Table 4. *The values of the Herfindahl-Hirschman Index*

Year	Total Assets	Total deposits	Total loans	Capital
2019	0.1128079	0.1410961	0.1122778	0.1094101
2020	0.1102570	0.1109311	0.1105160	0.1117305
2021	0.1080935	0.1082327	0.1130409	0.1128166
2022	0.0985406	0.0988005	0.1033850	0.1007211

Source: Calculation by the author based on data sourced from www.nbs.rs.

The Herfindahl-Hirschman Index (HHI) values calculated for the banking market in the Republic of Serbia (Table 4) indicate low concentration levels for assets, deposits, loans and capital. During 2021 and 2022, this concentration declined, and by the end of 2022, the index values suggested an absence of concentration in assets and total deposits. The operations of the fewest banks in 2022 resulted in a decrease in concentration across all observed balance sheet components. However, this indicator also reveals a negative correlation between concentration and the number of commercial banks.

Comparative Analysis of Concentration with Regional Countries

The selected Western Balkan countries (Croatia, North Macedonia, Montenegro, and Bosnia and Herzegovina) share a similar socio-economic background, with a transition from a socialist political system to a free-market economy marked by military conflicts, hyperinflation, and economic sanctions. Given that these developing countries have bank-centric financial systems, an analysis of concentration and bank competitiveness in these markets was conducted (Figure 1).

According to the asset concentration ratio of the top five banks, Croatia demonstrates a high level of competition, which has been increasing by one percentage point each year with a decreasing number of banks. North Macedonia has also experienced rising concentration as the number of banks has declined, with its banking market becoming highly concentrated by 2021. In the other countries, concentration among the top five banks remains moderate, with only Bosnia and Herzegovina showing a downward trend.

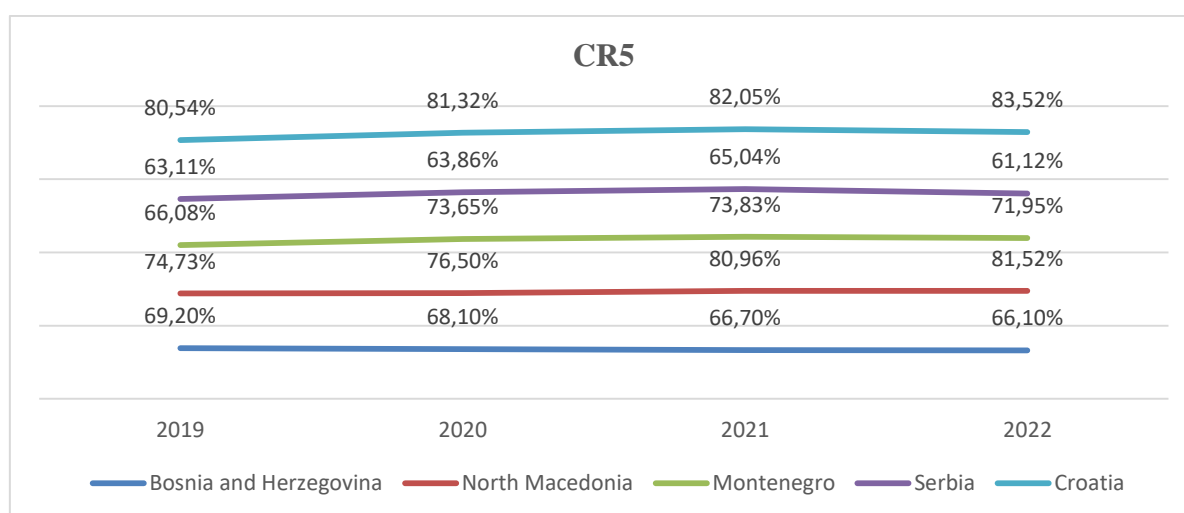


Figure 1: Asset Concentration Ratio CR5

Source: Authors based on the obtained data.

This indicator also highlights that the pandemic led to an increase in asset concentration among the top five banks, particularly during the first and second years of the pandemic, except in Bosnia and Herzegovina, where asset concentration has shown a consistently declining trend across all observed years. A high level of asset concentration is observed among the top five banks in all the analyzed countries in the region. The value of the CR5 indicator is the lowest in Serbia every year, while the highest values are recorded in Croatia and North Macedonia.

An examination of the Herfindahl-Hirschman Index (HHI) trends in asset concentration (Figure 2) reveals the highest concentration among all observed components in Croatia, with a steady increase approaching high concentration levels. Conversely, Serbia shows a declining trend, moving from a medium concentration level to an unconcentrated market by 2022. Bosnia and Herzegovina displays a consistent downward trend in the HHI for assets, while North Macedonia, which also has a medium concentration level, experiences an upward trend in this indicator. In Montenegro, after a sharp rise in the first year of the pandemic, concentration levels gradually decreased, though they remain at a medium level. The

Herfindahl-Hirschman Index also confirms the previous result, indicating that asset concentration was the lowest in Serbia throughout the entire observed period.

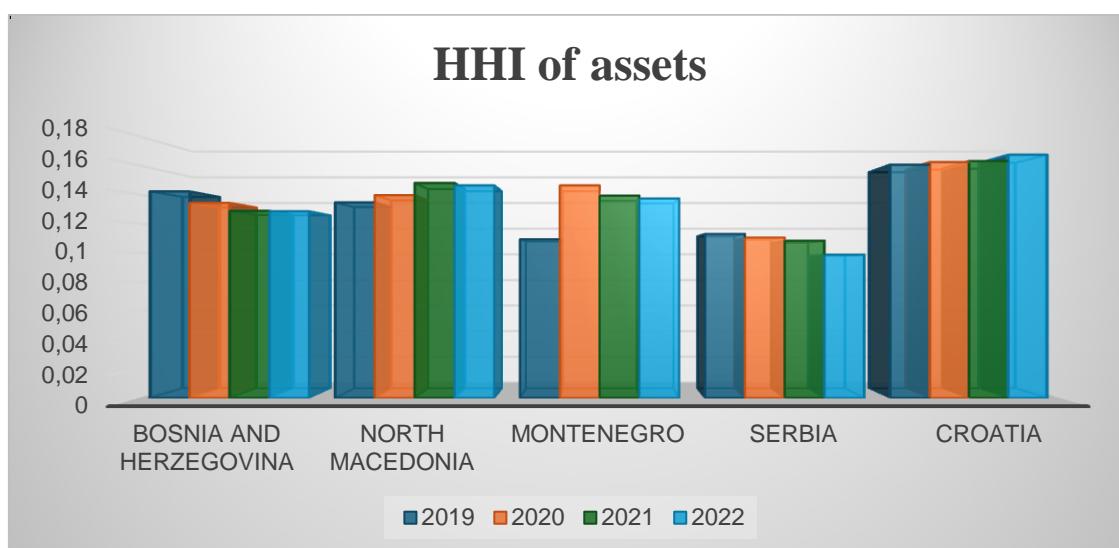


Figure 2: *HHI of assets*
Source: Authors based on the obtained data

5. CONCLUSION

The bank-centric nature of the financial sector in the Republic of Serbia calls for continuous monitoring of the stability and efficiency of commercial banks by both academia and industry professionals. Since market concentration and competition within this sector impact the profitability, operational efficiency, and quality of services provided by banks, this study examined the concentration of Serbia's banking market from 2019 to 2022 using balance sheet data from all banks. The research question focused on the impact of the COVID-19 pandemic on banking market consolidation. Although the decline in the number of banks operating in Serbia has been ongoing since 2009, the sharpest decrease was in 2021, when three banks ceased operations and merged with other banks, indicating the pandemic's substantial effect on market consolidation in Serbia.

The concentration ratio of the top five banks revealed a high concentration in assets, deposits, and loans. Notably, concentration increased across all balance sheet components during the pandemic's peak years, 2020 and 2021. The concentration coefficient for the top ten banks highlighted an almost monopolistic concentration of assets, with the remaining banks holding less than 10% of the market share. The top ten banks' relative share significantly increased in 2021 compared to 2019, with only a slight decrease in concentration in 2022. The coefficient values were highest in 2020 for total deposits (97.75%), likely due to uncertain and slowed market activity amid the health crisis. Conversely, entropy measures indicated very low concentration across all analyzed categories, and Herfindahl-Hirschman Index (HHI) values suggested low concentration in assets, deposits, loans and capital. This concentration decreased in 2021 and 2022, so by the end of 2022, the HHI values indicated an absence of concentration in assets and total deposits.

A comparative analysis of bank numbers and asset concentration across select Western Balkan countries (Serbia, North Macedonia, Montenegro, Bosnia and Herzegovina, and Croatia) pointed to a varied impact of the pandemic over the observed period. The pandemic led to market consolidation across all countries, with Serbia experiencing the most substantial impact, as the number of banks fell from 26 in 2019 to 20 in 2022 after economic shocks from the pandemic. Other countries also saw a decline in the number of commercial banks, albeit less pronounced. This reduction influenced asset concentration among the top five banks differently: in North Macedonia and Bosnia and Herzegovina, concentration consistently declined, while in Croatia and North Macedonia, it continued to increase and remained high post-pandemic in 2022. In Serbia, asset concentration rose during the pandemic but fell below pre-pandemic levels in 2022. Montenegro recorded an increase in asset concentration among the top five banks during the pandemic, followed by a gradual decline afterward. Looking at the asset concentration of the overall banking sector through the Herfindahl-Hirschman Index, we observe a variable impact from economic fluctuations caused by the health crisis, yet the crisis positively influenced Serbia's banking sector, leading to a non-concentrated market status. However, generalizing this result is not possible as it was not observed in other Western Balkan countries.

According to experts from the Association of Serbian Banks, the low concentration across observed categories in 2022 will not halt further consolidation of the Serbian banking market, where the optimal number of banks would be around 15, based on the orthodox banking rule (one bank per million inhabitants). This trend is largely driven by technological advancements and the introduction of innovations in banking, which enable reductions in high operational costs, especially for smaller banks.

The bank-centric nature of the financial market in the Republic of Serbia necessitates constant analysis of concentration and competition among market participants. Future research will encompass a greater number of indicators to mitigate the inconsistencies observed in the measures applied here. As the issues of concentration and competition remain critical for the economic and business environment of the Republic of Serbia, it is essential to focus on aligning domestic legislation with existing EU regulations, particularly in the field of competition protection. This includes ongoing training for employees in relevant institutions.

REFERENCES

- Alihodžić, A. (2019). Tržišna koncentracija banaka i nezaposlenost: Evidencija na tržištu banaka Bosne i Hercegovine i Srbije. *Bankarstvo*, 48(2), 32–59. <https://doi.org/10.5937/bankarstvo1902032A>
- Bain, J. S. (1951). Relation of profit rate to industry concentration: American manufacturing, 1933–1940. *The Quarterly Journal of Economics*, 65(3), 293–324. <https://doi.org/10.2307/1882217>
- Bajo-Rubio, O., & Salas, R. (2004). Decomposing change in industry concentration. *The Empirical Economics Letters*, 3(6), 311–319.
- Bhattacharya, K., & Das, A. (2003). Dynamics of market structure and competitiveness of the banking sector in India and its impact on output and prices of banking services. *Reserve Bank of India Occasional Papers*, 24(3), 123-159.

- Barjaktarović, L., Filipović, S., & Dimić, M. (2013). Concentration level of the banking industry in CEE countries. *Industrija*, 41(3), 36–54. <https://doi.org/10.5937/industrija41-4712>
- Berger, A. N., & Hannan, T. H. (1989). The price-concentration relationship in banking. *Review of Economics and Statistics*, 71(2), 291–299. <https://doi.org/10.2307/1926975>
- Begović, B., Bukvić, R., Mijatović, B., Parivodić, M., Pavić, V., Sepi, R., Stojanović, B., Hiber, D. (2002) *Antimonopolska politika u SR Jugoslaviji - analiza postojećih tržišnih struktura i antimonopolskih institucija*. Beograd: Centar za liberalno-demokratske studije
- Claessens, S., & Laeven, L. (2003). What drives bank competition? Some international evidence. *World Bank Policy Research Working Paper*, 3113. Retrieved January 5, 2021, from <https://openknowledge.worldbank.org/bitstream/handle/10986/18121/multi0page.pdf?sequence=1&isAllowed=y>
- Demirguc-Kunt, A., Laeven, L., & Levine, R. (2003). Regulations, market structure, institutions, and the cost of financial intermediation.
- Dimić, M. (2015). *Analiza Nivoa Koncentracije u Bankarskom Sektoru i u Sektoru Osiguranja u Zemljama Centralne i Istočne Evrope* (Doctoral dissertation, Singidunum University (Serbia)).
- Dumičić, K., Pavković, A., & Akalović Antić, J. (2012). Mjerenje koncentracije u bankarstvu u Republici Hrvatskoj. *Zbornik Ekonomskog fakulteta u Zagrebu*, 10(2), 117-136.
- Filipović, M., Avramović, V., & Račić, Ž. (2016). The analysis of concentration in the banking sector of Serbia in the post-crisis period. *Škola biznisa 2/2016*, 111-119. DOI 10.5937/skolbiz2-11822
- Galetić, F., & Obradović, T. (2018). Measuring concentration of the banking market of the Republic of Croatia. In *6th International OFEL Conference on Governance, Management and Entrepreneurship. New Business Models and Institutional Entrepreneurs: Leading Disruptive Change. April 13th-14th, 2018, Dubrovnik, Croatia* (pp. 598-625). Zagreb: Governance Research and Development Centre (CIRU).
- Gelos, R. G., & Roldós, J. (2004). Consolidation and market structure in emerging market banking systems. *Emerging Markets Review*, 5(1), 39–59. <https://doi.org/10.1016/j.ememar.2003.12.002>
- Gelos, R. G., & Roldos, J. (2004). Consolidation and market structure in emerging market banking systems. *Emerging Markets Review*, 5(1), 39–59. <https://doi.org/10.1016/j.ememar.2003.12.002>
- Kostić, M. (2008). Mjerenje koncentracije ponude grane. *Ekonomski horizonti*, 10(1), 89–108.
- Levy, Y., & Micco, A. (2007). Concentration and foreign penetration in Latin American banking sectors: Impact on competition and risk. *Journal of Banking & Finance*, 31(6), 1633–1647. <https://doi.org/10.1016/j.jbankfin.2006.11.003>
- Lončar, D., & Rajić, V. (2012). Koncentracija i konkurentnost bankarskog tržišta Srbije – Postojeće stanje i moguće promene pod uticajem buduće tržišne konsolidacije. *Ekonomika preduzeća*, 60(7-8), 372–385. <https://doi.org/10.5937/ekopre1208372L>
- Marinković, S. (2006). Stepen konkurencije u bankarskom sektoru Srbije kao faktor konkurentnosti nacionalne ekonomije. *Ekonomске teme*, 44(4-5), 71–84.
- Miljković, M., Filipović, S., & Tanasković, S. (2013). Tržišna koncentracija u bankarskom sektoru – Primer Srbije. *Industrija*, 41(2), 7–25. <https://doi.org/10.5937/industrija41-4064>

- Mirković, V. (2016). The Analysis of Concentration Trend in Serbian Banking Industry. In *Book of Proceedings* (pp. 175-184).
- Narodna banka Srbije. (2020). Bankarski sektor u Srbiji – Kvartalni izveštaj za period od 2009. godine do 2019. godine (Arhiva). Retrieved from https://nbs.rs/sr_RS/finansijske-institucije/banke/izvestaji-i-analize/
- Narodna banka Srbije. (2020). *Prikaz vesti*. Retrieved from https://www.nbs.rs/sr_RS/scripts/showcontent/index.html?id=15274&konverzija=no
- Radivojević, V. (2013). *Merenje koncentracije i tržišne moći privrednih subjekata u funkciji unapređenja politike zaštite konkurencije* [Doctoral dissertation, Univerzitet u Nišu – Ekonomski fakultet].
- Stojmenović, M. (2021). Analysis of market concentration in the banking sector of the Republic of Serbia. *Bankarstvo*, 50(1), 134-153.
- Šaj, O. (2005). *Industrijska organizacija – Teorija i primena*. Beograd: Ekonomski fakultet.
- Savić, Lj. (2000). Tržišne strukture u Jugoslovenskoj industriji. *Industrija*, 26(1-4), 1–19.

THE DYNAMICS OF DIGITAL TRANSFORMATION: REGIONAL TRENDS AND THEIR INTERCONNECTIONS

Cetulean Maxim*

The Bucharest University of Economic Studies, maxim.cetulean@economie.ase.ro,

Abstract: Digital transformation is considered as an important force for economic development in times of structural changes in regions emerging 'out of the fringes' and integration into global markets. This paper views the dynamics of digital transformation: regional trends and their interconnections through the example of Serbia, Georgia, and Moldova. The analysis has established major thematic areas highlighting the development of digital infrastructure, the role of innovation in economic modernization, as well as the integration of digital strategies into the public and private sectors. The research closely examines the relationship between Internet connectivity and economic growth in the countries under study. For this purpose, such indicators as the level of broadband penetration, and GDP growth rates. The research findings reveal a significant association between Internet connectivity and economic performance improvements in various sectors, such as digital services, technology-driven industries, and e-commerce. Such findings only confirm the transformative potential that digitalization has in achieving economic resilience as well as innovation. This paper adds to the existing academic literature on digital transformation, by providing empirical evidence of how digital connectivity influences economic growth. This emphasizes the necessity of strategic investment in digital infrastructure and the formulation of policy frames to address regional disparities and attain and enhance sustainable development. The paper's conclusions will be significant for policymakers and other concerned stakeholders intent on realizing the potential for economic progress and regional integration through the proper application of digital transformation.

Keywords: Digital transformation, emerging economies, regional development, economic growth, resilience

JEL Classification: O33, O47, R58

* Corresponding author

1. INTRODUCTION

Technological progress in the last half-century has brought many innovations and improvements to infrastructure, and one of the most transformative developments has come from telecommunications. Wireline telecommunications laid the foundation for the world to become interconnected and enabled fixed-line telephony and then data. The major breakthrough came in the 1980s with wireless telecommunications networks, which drastically changed technology by making it much more accessible and mobile. The ICT sector has moved well beyond simple telephony since that time and has offered more excellent possibilities for global data transmission through Broadband Internet Technologies like DSL and Cable Internet (Röller & Waverman, 2001). Recent years have seen a further revolutionizing of connectivity through the deployment of next-generation broadband networks, particularly the rollout of fiber-based wireline broadband technologies. Additionally, hybrid solutions, such as Fiber-to-the-Cabinet (FTTC) or Fiber-to-the-Node (FTTN) coaxial or copper-based networks, along with more fiber-based networks, now provide much faster upload and download speeds compared to previous setups (OECD, 2020). The development of mobile broadband since the initial introduction of 4G Long Term Evolution (LTE) technology in 2010, has considerably improved wireless network capacity and speed, further expanding access to digital resources.

The economic implications of such advancements are indeed great. As Crandall and Jackson (2001) had it in their early research, broadband technologies contribute greatly to consumer surplus and economic productivity; they go further to cite numerous studies supporting their assertion. For example, one such study noted that broadband employment increased by three-tenths of one percent after the implementation of a new telecommunications policy (Atasoy, 2013). Additionally, it was seen that the deployment of broadband facilities enhances innovation, supports technology-based industries, and increases the competitive level of digital economies (Katz & Callorda, 2018).

With such measurable benefits, the expansion of broadband had been placed at the top of various government and policy agendas worldwide. For instance, a rather ambitious goal was targeted by the United States in its National Broadband Plan of 2010, aiming to provide affordable high-speed internet access to all Americans by the year 2020 (FCC, 2010). Similar ambitious targets have also been set under the Digital Agenda for Europe to provide all Europeans with internet access at a speed higher than 30 Mbps and to have 50% of European households receive more than 100 Mbps by that same year (European Commission, 2010). This, of course, begs the question of just how much investment in communication infrastructure, particularly in fiber-based networks, is needed to achieve the goals and what the payback in economic terms over the long run might be (Czernich et al., 2011). The process becomes quite different if emerging economies are taken into consideration, such as Serbia, Georgia, and Moldova. The dynamics of digital transformation are challenging in these countries as they try to become part of the global markets for development based on their digital connections. Several studies have revealed that the adoption of digital technology has accelerated economic growth in these areas, increased access to global markets, and encouraged innovation. However, the variation in digital infrastructure across regions highlights the necessity for specific policies focusing on bridging digital divides to achieve development that is equal in nature.

Perhaps the most fundamental of all facets in these regions that will be affected by ICT is the interrelation between online connectivity and financial progress. Provisioning of adequate broadband access becomes one of the marks for determining digital preparedness as well as playing a catalytic role in economic modernization. Broadband availability is positively correlated with GDP growth, especially in technology- and innovation-led sectors, as the Koutroumpis (2009) study noted. This holds significance more so for a country like Serbia, Georgia, and Moldova, where emphasis is being laid on the development of the digital sector. Such transformative potential of digital connectivity is not confined only to the digital services and e-commerce sectors but also includes technology-driven industries. For example, as Qiang et al. (2009) provide empirical evidence, increasing the penetration of the Internet enhances productivity and efficiency in businesses, especially small and medium enterprises (SMEs) — the backbone of most emerging economies. Especially important to note is the growth of e-commerce in these countries quite indicative of how digital platforms can help foster cross-border trade as well as regional economic integration. There are still challenges even though the advantages are evident. Broadband infrastructure, digital literacy, and accessibility to technology still present regional divides and have not allowed the full potential of digital transformation to be realized. For example, many emerging economy rural areas are far behind their urban centers in terms of connectivity, thus limiting opportunities for inclusive growth. The way to tackle these divides is by ‘strategic investment in digital infrastructure and the adoption of policy interventions tailored to avoiding any region from being left behind’.

Their experiences as they navigate their digital transformation journey offer valuable lessons for other regions with identical socio-economic conditions. By examining the interrelations between Internet connectivity, innovation, and economic growth, this paper aims to contribute to the broader understanding of digital transformation dynamics. The findings underscore the importance of a comprehensive approach that combines technological advancement and supportive policy frameworks for the effective and efficient fostering of sustainable development.

The empirical review on the impact of digital connectivity on the economic performance of Serbia, Georgia, and Moldova adds up to the existing literature stressing strategic investment in broadband infrastructure and policy formulation to help address regional disparities as a matter of importance. Through this, the paper seeks to update the policy actors and others how best to utilize the benefits from digital transformation for regional integration and economic resilience.

This paper hypothesizes that there is a strong relationship between GDP evolution and fixed broadband subscriptions in Serbia, Georgia, and Moldova. The paper has been organized into various sections, starting with the Introduction that exposes the very important transformational role of broadband infrastructure in economic development in emerging economies. It also fastens upon ways by which digital connections have brought about innovation, business productivity, and global competitiveness. The section named Literature Review which linking telecommunications infrastructure with economic growth, found unanimous positive correlation among different regions and contexts. For examining the matter under study, linear regression analysis along with quantitative techniques has been exercised over data covering a ten-year-period (2014-2023) which are available from the World Bank database, while examining the relationship between GDP and fixed broadband subscriptions. The succeeding part, Results & Discussion draws upon evidence of statistically

significant relationships but varying in magnitude from one to another among the three countries. Finally, Conclusion & Recommendations center on policy implications and what needs to be done for reaping maximum economic fruits from broadband connections.

2. LITERATURE REVIEW

The relationship between telecommunications infrastructure and economic growth is a widely examined matter, with the nuance of varying from region to region. For instance, early investigations for the United States within the period 1958–1988 like that of Cronin et al. (1991) indicated that there exist bidirectional causality between telecommunications investments and GNP. More investment-related benefits in telecommunications which pass through to the overall economy indicate that there may be a reinforcing effect between telecommunications infrastructure and economic growth. Madden and Savage (1998) took the study to a broader geographical spectrum, analyzing twenty-seven Central and Eastern European nations over the period 1990–1995. They discovered that a higher proportion of telecommunications investment to GDP led to a substantial increase in the level of real GDP growth per capita, primarily in industrial sectors. Their findings, confirmed by Granger causality tests, imply that telecommunications infrastructure serves both as a driver and beneficiary of economic development within these nations. Expanding their research, Madden and Savage (2001) examined information from 43 countries over the period 1975-1990. The results revealed a significantly positive impact of telecommunications infrastructure on the growth of GDP per capita, underscoring the productivity gains and economic resilience garnered from telecommunications. Their instrumental variable regression results provide powerful confirmation of the role technology plays in an economy. Dutta (2001) investigated the deterministic nature of telecommunications infrastructure on economic growth in a sample of 30 countries balanced between developed and underdeveloped nations. It was found that in more than half of the developing nations, telecommunications infrastructure leads to economic growth as observed through the Granger approach, thereby showing its importance as a neoclassical growth precursor. Röller and Waverman (2001) revealed the relationship between telecommunications infrastructure and GDP growth to be inherently nonlinear. More specifically, a penetration level in excess of 40% was related to significantly higher rates of economic growth for 21 OECD countries over the period 1970-1990. Hence, the critical mass is a proviso stating that in order to benefit fully from telecommunications infrastructure, the technology must be broadly applied.

The spatial implications of telecommunications investments in the USA during the period 1970-1997 were examined by Yilmaz et al. (2002). It was revealed from their findings that increased telecommunications capital positively related to state-level economic output. However, spillover effects appeared negative for adjacent states. Such findings indicate that said telecommunications investments have to balance local as well as regional strategies.

Dutta (2001), in a study on 22 OECD countries over the period 1980 to 1992, found that the increase in access lines per 100 inhabitants had significantly contributed to enhancing GDP per capita. They further argued that the influence of telecommunications infrastructure is more pronounced in that it impacts countries with low initial connectivity more and hence could act as an instrument for leapfrogging by developing economies. Other researchers, for example, Roller et al. (2001), have insisted more on mobile telecommunications in developing nations by taking information between 1996 to 2003. Their research established that growth in Gross Domestic Product was positively affected by the adoption of mobile

telecommunications, with the highest impact being felt in the low-income states. This underlined the revolutionizing role that mobile technology had played in filling development gaps within poor technology service provision regions.

They stressed the importance of mobile infrastructure in advancing economic development in those regions. As an example, Gruber and Koutroumpis (2011) have shown, based on information for 192 countries for the period 1990-2007, the non-linear impact of mobile telecommunications on the gross domestic product growth. The threshold of critical mass is 30%, and they concluded that wide adoption amplifies the benefits of this technology when economically favorable. Their results reemphasize the necessity for the types of targeted investments needed to push markets over those critical adoption thresholds.

Lee et al. (2012) worked on Sub-Saharan Africa and found that while the adoption of landlines had some influence on GDP growth in the long run, it was mobile telephony that had a significant influence on GDP growth, post-2000. This denotes the evolutionary role of mobile technology while maturing and diffusing, especially in a developing context.

Telecommunications infrastructure and economic growth in emerging economies have been exemplified by Serbia, Georgia, and Moldova. For instance, investment in broadband and mobile telecommunications has supported Serbia's IT sector and industrial competitiveness within the framework of EU digital policies. Georgia's Open Net project has enhanced rural connectivity and drawn e-commerce and digital services to drive economic development, while Moldova has used EU-backed initiatives to diversify its economy through digital transformation. Considering together, these studies illustrate the complex relationship between telecommunications infrastructure and growth. The experiences of Serbia, Georgia, and Moldova aptly bring out the transformational potential of targeted telecommunications investments for economic modernization, as well as regional integration. Their advancement shows how digital strategies, along infrastructure development, can drive inclusive growth and enhance resilience in such a rapidly evolving digital landscape.

3. METHODOLOGY

This research uses a quantitative methodology to investigate the relationship between Gross Domestic Product (GDP) and Fixed broadband subscriptions in three emergent economies (Serbia, Georgia and Moldova).

The technique is based on the application of a simple linear regression analysis with one predictor, which will explore the relationship between a country's Gross Domestic Product and fixed broadband subscriptions. The goal here is to examine how variations in fixed broadband connections affect the GDP of various economies, with specific reference to Serbia, Georgia, and Moldova.

Accordingly, we will note here the equation of the linear regression model:

$$Y = a + bx + u \quad (1)$$

Y assumes the real values of the dependent variable, respectively of the gross domestic product; x assumes the real values of the independent variables, for one of the analyzes it will be high-tech exports; a and b represent parameters of the model; and u assumes the residual variable that signifies the influence of other factors on Y .

The parameter b is estimated by the following formula:

$$\hat{b} = \frac{n \cdot \sum y_t x_t - \sum x_t \cdot \sum y_t}{n \cdot \sum x_t^2 - \sum x_t \cdot \sum x_t} \quad (2)$$

In the formula (2), n implies the number of observations. The analysis we propose has 10 observations because the data collected covers a period of 10 years, namely 2014-2023.

Data for the study was predominantly sourced from the World Bank Database with the span of the comprehensive time frame covered 2014-2023. The data Gathering specifically focused on two main economic indicators – Gross Domestic Product (GDP), reported in US dollars using the current value, and Fixed broadband subscriptions; both were measured in integers. These were selected to provide a more comprehensive view of the global economic picture by looking into the progression of individual country economies and the role of high broadband connectivity in promoting economic growth and development.

Having collected the required data, it was determined to apply eViews in carrying out the linear regression analysis. This recommended use of eViews results from its effectiveness in processing time-series data together with an easy-to-use econometrics-oriented user interface. The software enhances the analysis and helps in solving the problems under consideration effectively.

Regression analysis can be simplified as a unifactorial linear regression model to create the analytical framework. This will help address the specific concerns relating to how the GDP of a given country at a specific time informs the fixed broadband subscriptions for that period. Such a model includes variables for the intercept, the slope coefficient, as well as the error term and in so doing, formulates what should be the expected relationship between GDP and fixed broadband subscriptions.

The estimation in this model involves using the OLS approach. This step is very important because it helps us to determine the magnitude and characteristics of the relationship between the dependent (GDP) and independent (fixed broadband subscriptions) variables. To look deep into this, the significance of the regression coefficients was subjected to t-tests, specifically shedding more light on the effects of fixed broadband subscriptions on GDP. The overall adequacy of the model is also evaluated by R-squared and F-statistics. These give a measure of how much of the data the model can account for.

4. RESULTS AND DISCUSSION

The following table (Table 1) includes data regarding the evolution of the gross domestic product and the evolution of fixed broadband subscriptions in Serbia, Moldova, and Georgia in the period 2014-2024.

Table 1. Evolution of GDP and Fixed broadband subscriptions in Moldova, Serbia and Georgia

Year	Moldova		Serbia		Georgia	
	GDP (current mil. \$)	Fixed broadband subscriptions (no.)	GDP (current mil. \$)	Fixed broadband subscriptions (no.)	GDP (current mil. \$)	Fixed broadband subscriptions (no.)
2014	9.402,09	509.000,00	47.062,20	1.190.000,00	17.966,02	601.000,00
2015	7.797,67	534.000,00	39.655,95	1.320.000,00	15.223,80	636.000,00
2016	7.980,92	557.000,00	40.692,66	1.450.000,00	15.444,55	681.000,00
2017	9.514,40	584.000,00	44.179,08	1.480.000,00	16.473,13	776.000,00
2018	11.252,35	623.000,00	50.640,66	1.550.000,00	17.902,54	857.000,00
2019	11.736,80	671.000,00	51.514,24	1.620.000,00	17.638,34	937.000,00
2020	11.530,75	719.000,00	53.356,48	1.730.000,00	16.010,87	968.000,00
2021	13.691,87	762.000,00	63.101,04	1.800.000,00	18.853,12	1.010.000,00
2022	14.510,49	800.000,00	63.563,41	1.950.000,00	24.984,57	1.080.000,00
2023	16.539,44	841.000,00	75.187,13	2.080.000,00	30.535,53	1.100.000,00

Source: The World Bank, World Development Indicators

The estimated results (Table 2) are of the view that during the sample period (2014–2023), there was a strong relationship between fixed broadband subscriptions and GDP for Moldova. Judging by the coefficient for fixed broadband subscriptions, which stands at 23,350.61, it is average that each extra subscription has an associated GDP increase of 23,350.61 USD for Moldova. This result bears high statistical significance, as represented by an 8.91 t-statistic and a corresponding p-value of 0.0000 well below the 1% level. This would reiterate the very important role of the digital infrastructure in determining economic growth in Moldova for this duration.

Table 2. Estimation of the fixed broadband subscriptions on GDP in Moldova

Dependent Variable: Gross domestic Product (Moldova)
Method: Least Squares
Sample: 2014 2023
Included observations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-4.02E+09	1.75E+09	-2.288786	0.0514
Fixed broadband subscriptions (Moldova)	23350.61	2621.670	8.906769	0.0000
R-squared	0.908394	Mean dependent var		1.14E+10
Adjusted R-squared	0.896943	S.D. dependent var		2.86E+09
S.E. of regression	9.19E+08	Akaike info criterion		44.29167
Sum squared resid	6.75E+18	Schwarz criterion		44.35219
Log likelihood	-219.4584	Hannan-Quinn criter.		44.22529
F-statistic	79.33053	Durbin-Watson stat		1.639573
Prob(F-statistic)	0.000020			

Source: Authors' own data processing in eViews, based on the data from Table 1

The statistical measurements further enhance the trustworthiness of the model. As high as 0.91, the R-squared value represents that 91% of variability in GDP is going to be clarified by variations in fixed broadband subscriptions; hence, a highly descriptive model. The adjusted R-squared, an improvement for the number of predictors present in the model, is a little lower

at 0.90 and assures the robustness of the description. . Furthermore, there is also a statistically significant relationship between dependent and independent variables since F-ratio with its very low associated probability level($0.000020 < 0.05$) is less than $0.05 < 0.01 < \alpha$.

The constant term (C) is negative and marginally significant (p-value = 0.0514). Thus, it indicates some baseline effects that are unrelated to fixed broadband subscriptions. In plain terms, the results bring out the ‘real’ contribution of high-speed internet connectivity to Moldova’s economic performance and underscore the imperative nature of continued investments in broadband infrastructure for sustainable economic growth.

Table 3. Estimation of the fixed broadband subscriptions on GDP in Serbia

Dependent Variable: Gross domestic Product (Serbia)

Method: Least Squares

Sample: 2014 2023

Included observations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-6.81E+09	1.01E+10	-0.673351	0.5197
Fixed broadband subscriptions (Serbia)	36922.52	6171.824	5.982432	0.0003
R-squared	0.817308	Mean dependent var		5.29E+10
Adjusted R-squared	0.794471	S.D. dependent var		1.13E+10
S.E. of regression	5.14E+09	Akaike info criterion		47.73483
Sum squared resid	2.11E+20	Schwarz criterion		47.79535
Log likelihood	-236.6742	Hannan-Quinn criter.		47.66844
F-statistic	35.78950	Durbin-Watson stat		1.492548
Prob(F-statistic)	0.000330			

Source: Authors' own data processing in eViews, based on the data from Table 1

The relationship between GDP and fixed broadband subscriptions was quite strong and statistically considerable in Serbia by the period 2014–2023 (Table 3). The subscription for fixed broadband is associated with an average increase of 36,922.52 units in the GDP of Serbia. This is highly considerable, with t-statistics standing at 5.98 and p-value at 0.0003 against a 1% level of significance.

The model has a strong explanatory power, 0.82 of Serbia’s GDP variations are explained by changes in fixed broadband subscriptions. The adjusted R-squared of 0.79 also shows a great explanatory capability after being adjusted for predictors. Besides that, the F-statistic of 35.79, and extremely low p-value of 0.00033 indicate the model being highly significant.

The constant term (C) is negative and is not statistically significant (p-value = 0.5197) implying no substantial baseline impact on GDP that is not related to broadband subscriptions. These findings overall underline the very critical supportive role of broadband connectivity to Serbia’s economic development and the further good investment in developing digital infrastructure that could accelerate growth.

Table 4. Estimation of the fixed broadband subscriptions on GDP in Georgia

Dependent Variable: Gross domestic Product (Georgia)

Method: Least Squares

Sample: 2014 2023

Included observations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.09E+09	5.99E+09	0.516644	0.6194
Fixed broadband subscriptions (Georgia)	18515.89	6791.479	2.726341	0.0260
R-squared	0.481628	Mean dependent var		1.91E+10
Adjusted R-squared	0.416832	S.D. dependent var		4.89E+09
S.E. of regression	3.73E+09	Akaike info criterion		47.09608
Sum squared resid	1.12E+20	Schwarz criterion		47.15660
Log likelihood	-233.4804	Hannan-Quinn criter.		47.02970
F-statistic	7.432937	Durbin-Watson stat		0.670540
Prob(F-statistic)	0.025992			

Source: Authors' own data processing in eViews, based on the data from Table 1

Regression analysis results in Table 4 show a weak but statistically significant positive association between fixed broadband subscriptions and the GDP of Georgia between 2014 and 2023. The coefficient on fixed broadband subscriptions is 18,515.89, meaning that each additional subscription is associated with an increase in GDP of about \$18,515.89, all other things held constant. The t-statistic of 2.726 and p-value of 0.026 show that this relationship is statistically significantly different from zero at the 5% level. However, the constant term is not significant. Its p-value is quite high (0.6194), so other hidden factors might be at work affecting variations in GDP other than the broadband variable.

The model's explanatory power is quite enough since 48.16% of the variance in GDP can be explained by changes in fixed broadband subscriptions. Model complexities are also accounted for it, suggesting a moderately good fit though room for improvement. The Durbin-Watson statistic further points out that there may be positive serial correlation present in the disturbances of the expanded model. That is, the economic importance of broadband infrastructure in the facilities mentioned earlier GDP growth has been well reiterated in Georgia, perhaps reflective of most developing countries where importance on economic development has shifted to infrastructure that is digital in nature.

5. CONCLUSIONS AND RECOMMENDATIONS

Moldova exhibits the strongest relationship, with each additional broadband subscription associated with a GDP increase of \$23,350.61. The model explains 91% of the GDP variance, highlighting the critical role of broadband in economic modernization in the country. The findings underscore the need for Moldova to maintain strategic investments in digital infrastructure, which in turn would help sustain this trajectory of growth.

At the same time, broadband subscriptions are also important to Serbia by each subscription contributing \$36,922.52 to the increase in Gross Domestic Product. This substantial effect shows the progress of Serbia in digital infrastructure and alignment with EU digital policies. The results show that broadband development enhanced the IT sector of Serbia and its

industrial competitiveness. The concentration on expanding broadband services, especially in underserved areas, would further enhance Serbia's economic integration into global markets.

Georgia exhibits a weaker but statistically significant relationship, as broadband subscriptions add \$18,515.89 to GDP. The R-squared of 0.4816 implies that broadband is important, but there are other factors at play in fostering economic development. Such investments in Georgia included the Open Net projects, which improved connectivity in rural areas and hence boosted e-commerce as well as digital services. Such results, however, reveal that there may still be some room for policy tweaking to enhance the effect of broadband on GDP and close any residual gaps in 'remaining' digital divides.

Comparative analysis reveals that there are still considerable regional disparities in broadband development and its economic impacts. The results for Moldova are so impressive that they may provide a good case for strategic investment in broadband for economic resilience; larger-scale implementation by Serbia indicates the transformative potential of the integration of digital infrastructure with EU frameworks, whereas moderate performance by Georgia shows the importance of such policy tailorings targeting specific regional needs.

The interplay between GDP growth and the proliferation of broadband connectivity in these countries is reflective of the general trends in digital transformation as a driver for economic modernization. Productivity gets a boost through digital infrastructure, along with opportunities for fostering innovation and being competitive in global markets. However, the varying strengths of these relationships speak to the need for context-specific strategies aimed at maximizing the economic benefits going hand in hand with broadband.

Future directions for these countries must involve placing rural connectivity at the top of the agenda for inclusive growth and the fostering of innovation through broadband-enabled technologies and international partnerships for technological upgrades. Policymakers should further look into ways to enhance digital literacy programs and align national strategies with international digital agendas for accelerated economic development and regional integration. These measures will allow Moldova, Serbia, and Georgia to further harness the transformative power of digital connectivity.

REFERENCES

- Atasoy, H. (2013). The effects of broadband internet expansion on labor market outcomes. *Industrial and Labor Relations Review*, 66(2), 315-345. <https://doi.org/10.1177/001979391306600203>
- Crandall, R., & Jackson, C. (2001). The \$500 billion opportunity: The potential economic benefit of widespread diffusion of broadband Internet access. *Brookings Policy Brief*, 84, 1-8.
- Cronin, F. J., Parker, B. E., Colleran, K. E., & Gold, A. M. (1991). Telecommunications infrastructure and economic growth: An analysis of causality. *Telecommunications Policy*, 15, 529–535.
- Czernich, N., Falck, O., Kretschmer, T., & Woessmann, L. (2011). Broadband infrastructure and economic growth. *The Economic Journal*, 121(552), 505-532. <https://doi.org/10.1111/j.1468-0297.2011.02420.x>
- Dutta, A. (2001). Telecommunications and economic activity: An analysis of Granger causality. *Journal of Management Information Systems*, 17, 71–95.

- European Commission. (2010). *A digital agenda for Europe*. European Union. <https://doi.org/10.2759/20409>
- Federal Communications Commission (FCC). (2010). *Connecting America: The National Broadband Plan*. FCC. <https://www.fcc.gov/national-broadband-plan>
- Grace, J., Kenny, C., & Qiang, C. (2001). Information and communication technologies and broad-based development: A partial review of the evidence.
- Gruber, H., & Koutroumpis, P. (2011). Mobile telecommunications and the impact on economic development. *Economic Policy*, 26(67), 387–426.
- Katz, R., & Callorda, F. (2018). The economic contribution of broadband, digitization, and ICT regulation. *International Telecommunication Union*. <https://www.itu.int/pub/D-PREF-EF.BDR-2018>
- Koutroumpis, P. (2009). The economic impact of broadband on growth: A simultaneous approach. *Telecommunications Policy*, 33(9), 471-485.
- Lee, S., Marcu, M., & Lee, S. (2011). An empirical analysis of fixed and mobile broadband diffusion. *Information Economics and Policy*, 23(3–4), 227–233. <https://doi.org/10.1016/j.infoecopol.2011.05.001>
- Madden, G., & Savage, S. J. (1998). CEE telecommunications investment and economic growth. *Information Economics and Policy*, 10(2), 173–195. <https://ideas.repec.org/a/eee/iepoli/v10y1998i2p173-195.html>
- OECD. (2020). *Broadband networks and their impact on economic growth*. OECD Digital Economy Papers. <https://doi.org/10.1787/5kmh79jrntd5-en>
- Qiang, C. Z. W., Rossotto, C. M., & Kimura, K. (2009). Economic impacts of broadband. *Information and Communications for Development 2009: Extending Reach and Increasing Impact*, 35-50.
- Röller, L. H., & Waverman, L. (2001). Telecommunications infrastructure and economic development: A simultaneous approach. *American Economic Review*, 91(4), 909–923. <https://doi.org/10.1257/aer.91.4.909>
- Yilmaz, S., Haynes, K., & Dinc, M. (2001). The impact of telecommunications infrastructure investment on sectoral growth. *Australasian Journal of Regional Studies*, 7, 383–397.

ACKNOWLEDGEMENT

This paper was co-financed by The Bucharest University of Economic Studies during the PhD program.

SOCIO-ECONOMIC AND CULTURAL INFLUENCES ON THE HOUSEHOLD TRANSITION TO RENEWABLE ENERGY SOURCES: A RESEARCH DESIGN

Dušan Mojić*

University of Belgrade, Faculty of Philosophy, dmojic@f.bg.ac.rs

Abstract: *Energy production and consumption patterns represent one of the greatest political, economic and social challenges the world has faced in recent decades. Although measures to address these challenges have been planned and implemented at global, regional, national and local levels, households remain one of the most important actors in tackling these challenges. In 2022, for example, households accounted for 25.8% of final energy consumption in the EU (with 63.5% of final energy consumption used for heating purposes in the residential sector). In Serbia, the share of household energy consumption in final energy consumption is even higher (40% in 2020). This situation offers a great opportunity to reduce energy intensity, pollutant and greenhouse gas emissions, switch to renewable energy sources (RES) and increase energy self-sufficiency. However, one of the most important questions in this context is how households make the decision to switch to more sustainable heating systems. The term “sustainable heating system” implies an increase in the share of renewable energy sources (RES), more efficient energy use, a reduction in primary energy demand, a lower environmental impact and the promotion of economic feasibility. Although empirical studies on residential heating (as one of the dominant forms of energy use in households) are widespread in the literature, these models have mainly neglected deeper socio-economic and especially cultural factors that influence energy consumption in households. With this in mind, the aim of the paper is to develop a more comprehensive research design to understand the socio-economic and cultural impacts on the process of household transition to renewable energy sources.*

Keywords: *Economic Development, Energy Transition, Households*

JEL Classification: *O13, D10*

* Corresponding author

1. INTRODUCTION

Environmental pollution and global warming are among the most important indicators (from a sociological perspective) of the risk society of recent decades. The concept of the (global) risk society was proposed by the German sociologist Ulrich Beck (Beck, 2009) and has gained increasing attention in sociology and the social sciences in general. In Beck's view, uncertainty and risk have become the dominant characteristics of contemporary (modern and postmodern) societies. In addition to natural or external risks (such as drought, earthquakes, famines and storms), man-made or manufactured risks are also among the most important characteristics of the global risk society.

Global warming is one of the most threatening problems in this respect (Giddens and Sutton, 2017), because never before has a problem affected every single person on this planet and never before has the window of opportunity for action been so short (Alexander et al. 2018, 587-588). In addition, the far-reaching problem of environmental pollution significantly jeopardises the quality of life of the majority of the Earth's inhabitants and poses considerable problems (and even threats) to the social organisation of almost every modern society.

Manufactured risks are primarily the result of human economic activity, particularly in the last two centuries (especially industrial development and intensive large-scale agricultural production). Air pollution is a manufactured risk with serious consequences for human health, such as respiratory problems, cancers and lung diseases. A distinction is usually made between two types of air pollution: 'outdoor air pollution', which is mainly caused by industrial pollutants and car exhausts, and 'indoor air pollution', which is caused by the combustion of fuels for heating and cooking in households. "Traditionally, air pollution has been seen as a problem that afflicts mainly the industrialized countries as a result of mass production and large numbers of motorized vehicles. However, in recent years attention has been drawn to the dangers of 'indoor pollution' in the developing world, where many of the fuels used, such as wood and dung, are not as clean-burning as modern fuels such as kerosene and propane" (Giddens and Sutton, 2013, 162).

Global warming and pollution are the result of human activity and therefore require institutional responses. However, such institutional responses are largely dependent on the existing structures in society. Anthony Giddens' structuration theory (Giddens, 1984) states that individuals and groups actively shape and change the social structure through their daily actions. Nevertheless, it is questionable whether humanity today is able to collectively find sufficient institutional responses to global risks of this scale and urgency? Can global warming, climate change and environmental pollution be slowed down and even reversed in - the longer term?

So far, the prospects for global agreements, such as those reached at the 2015 UN Climate Change Conference in Paris, are not very promising. However, regional initiatives seem more promising (such as a European Green Deal to make Europe the first climate-neutral continent). Nevertheless, nation states are likely to remain the strongest institutional actors in this regard. Transnational and supranational agreements of this kind still need to be translated into action by the national and local governments of individual states in the form of legal documents, strategies and action plans. Furthermore, these measures need to be adapted to the specific circumstances in each state (even in each region or local community of the state in question).

A large part of these measures should address energy consumption patterns, particularly in the household sector. Due to its complexity and heterogeneity, the household sector is a key issue in energy transition policy. In the European Union, household energy consumption accounts for about 26% of final energy consumption, while in Serbia this sector has the largest share of final consumption, accounting for about one third of final consumption. By implementing energy efficiency measures, significant energy savings can be achieved, which, together with the reduction and substitution of fossil fuel consumption, contribute to a lower impact on climate change and a significant reduction in air pollution (Pavlović et al. 2024, 51).

However, the most important social actors or decision-makers in the transition of households to renewable energy sources are (of course) the households, i.e. their members. In this paper, we will primarily address the socio-economic and cultural factors that could have a significant impact on such a decision, focussing particularly on Serbia. To this end, we will review the relevant literature, present the socio-economic and cultural context and finally offer a possible research design for an empirical study that would shed some light on this process.

2. CONCEPTUAL AND CONTEXTUAL FRAMEWORK

As already mentioned in the introduction, pollution represents an existential threat to human health and planetary health, and jeopardises the sustainability of modern societies, with immediate and severe consequences to human health. “In 2019, pollution was responsible for approximately 9 million premature deaths. Air pollution (both household and ambient air pollution) remains responsible for the greatest number of deaths, causing 6.7 million deaths in 2019. Water pollution was responsible for 1.4 million premature deaths. Lead was responsible 900,000 premature deaths. Toxic occupational hazards, excluding workplace fatalities due to safety hazards, were responsible for 870,000 deaths” (Fuller et al. 2022, e536).

For the purposes of this paper, it is worth noting that according to a study by the Global Alliance in Health and Pollution (GAHP), an international body of experts and observers advocating for resources and solutions to environmental problems, Serbia ranks first in Europe and ninth in the world in terms of environmentally-related deaths. According to the GAHP study *2019 Pollution and Health Metrics: Global, Regional and Country Analysis*, Serbia is among the ten countries with the highest number of premature deaths due to pollution, with 175 deaths per 100,000 people in 2017, the most recent data set. Chad tops the list with 287 deaths per 100,000 inhabitants, followed by the Central African Republic (251), North Korea (202), Niger (192), Madagascar (183), Papua New Guinea (183), South Sudan (180), Somalia (175), while India ranks 10th with 174 deaths/100,000 inhabitants. Serbia is also in first place in the ranking, which includes the countries of the WHO European Region. Serbia is followed by Georgia (140 deaths per 100,000 inhabitants), Bulgaria (137), Ukraine (128), Bosnia and Herzegovina (125), Armenia (117), Croatia (108), Romania (106), Belarus and Hungary (both 105) (Giantin, 2020).

As already mentioned, there is no real doubt that these are the consequences of human activity, especially in modern times. Modern industrial societies (followed by technological development, industrial production, urbanisation, etc.) have brought about unprecedented changes in economic production and, consequently, in social organisation. Never before in the history of human societies had technological progress brought about such a change in institutions and relationships between individuals and social groups. In just two or three centuries (a fraction of the time since the dawn of humanity), human social life was

“uprooted” from the social order in which people had lived thousands of years before (Giddens and Sutton, 2017, 120). The industrial and political revolutions of the 18th and 19th centuries destroyed the old traditional structures and societies, which subsequently accelerated exponentially (until today).

These processes were strong evidence in favour of Anthony Giddens’ structuration theory (Giddens, 1984), which states that people (individuals and social groups) actively shape and change the social structure through their daily actions. “Structure” and “agency” are necessarily linked. “Societies, communities and groups have a ‘structure’ to the extent which people behave in the right and relatively predictable way. On the other hand, only ‘agency’ is possible because each individual has a large amount of structured knowledge that precedes them” (Giddens and Sutton, 2017, 89). Are today’s structures too powerful for human agency when it comes to the fight against environmental degradation? If not, which level of action has the best chance of achieving even satisfactory results? The global geopolitical situation gives no cause for optimism in this respect, as the political, economic, social and cultural divides are perhaps wider today than in many other decades. Does the European Union have the strength to realise its bold plans (such as the European Green Deal)?

The objectives of the European Green Deal are to transform the EU into a modern, resource-efficient and competitive economy that ensures

- Zero net emissions of greenhouse gases by 2050.
- Economic growth that is decoupled from resource consumption.
- No people and no place left behind (The European Commission, 2023).

To achieve the above targets, the European Commission has adopted a series of proposals to shape the EU’s climate, energy, transport and tax policies to reduce net greenhouse gas emissions by at least 55% by 2030 compared to 1990 levels (The European Commission, 2023). One third of the €1.8 trillion investment from the NextGenerationEU recovery plan and the EU’s seven-year budget will be used to finance the European Green Deal. This document provides for further EU legislation to achieve the climate targets, in particular by promoting energy efficiency and renewable energy, as set out in the ‘Fit for 55’ package (The European Commission, 2023).

The ‘Fit for 55’ package proposed by the European Commission in July 2021 is a set of interlinked proposals aimed at achieving the EU’s 2030 climate target as part of the European Green Deal (The European Council, 2023). The package strengthens eight existing pieces of legislation and introduces five new initiatives covering a range of policy areas and economic sectors: climate, energy and fuels, transport, buildings, land use and forestry. These measures are necessary steps for a fundamental transformation of the energy system with a profound impact on European economies, societies, territories and people’s lives in general.

The “Clean Energy for All Europeans” legislative package is a comprehensive set of legal documents that define European climate and energy policy post-2020. This package includes and links a number of issues related to the household sector. Through this package, Member States are obliged to set high targets for energy efficiency and decarbonisation in the construction and renovation of residential buildings, while implementing measures for households affected by energy poverty. The Energy Performance of Buildings Directive, the Energy Efficiency Directive, the Renewable Energy Directive, the Regulation on the Governance of the Energy Union and Climate Action and the Regulation on the establishment

of a framework for achieving climate neutrality cover the main issues related to the energy transition in European Union households (Pavlović et al. 2024, 51).

What are the prospects for Serbia in this respect? The European Green Deal is a basis for the Green Agenda for the Western Balkans, which sets very ambitious targets in terms of reducing greenhouse gas emissions, renewable energy, energy efficiency and biodiversity. In October 2020, the European Commission published guidelines for the implementation of the Green Agenda for the Western Balkans and an Economic and Investment Plan for the Western Balkans. Funds totalling EUR 9 billion from IPA III are earmarked for the period 2021-2027 (European Commission, 2020). As a member of the Energy Community and a candidate for membership of the European Union, Serbia has committed to harmonising its energy policy and legislation and accepting technical assistance and support in implementing reforms to bring the national energy system in line with European standards.

Serbia has significantly improved its legal framework in relation to energy consumption and climate change (for a detailed account of these changes, see Pavlović et al. 2024). The most important laws for the topic of this article will be briefly discussed here. The main objectives of the Law on Energy Efficiency and Rational Use of Energy (Official Gazette of the RS, No. 40/2021) are to save energy, reduce the impact of the energy sector on the environment and climate change, and contribute to the sustainable use of natural and other resources. In order to promote the efficient use of energy and the implementation of energy efficiency measures, it is planned to set up an administration for the financing and promotion of energy efficiency within the Ministry of Mining and Energy, which will make it easier for citizens to obtain grants for the replacement of windows, doors, façade insulation and heating systems (Energetski portal, 2024).

The aim of the new Law on the Use of Renewable Energy Sources RES (Official Gazette of the RS, No. 40/2021) is to enable new investments in renewable energy and to increase the share of renewable energy in total energy production. As an important innovation, the new law brings greater citizen participation in the energy transition by introducing the institute of the customer-producer, which means that electricity customers can generate electricity for their own use by installing solar panels on the roofs of buildings and thus reduce their electricity bills. Amendments to the Law on Renewable Energy in Serbia (Official Gazette of the RS, No. 35/2023) created the legal framework for the inclusion of sustainability and greenhouse gas emissions criteria. In order to achieve full alignment with the REDII requirements, the Decree on Sustainability and Greenhouse Gas Emissions Criteria for Biofuels, Liquid Biofuels and Biomass was adopted in October 2023 (Energetski portal, 2024).

New programmes and activities have been introduced on the basis of these legislative changes. For example, the public ESCO project includes subsidies for the energy-efficient refurbishment of residential buildings in 15 Serbian municipalities. The Serbian government provides 50% of the funds for the investments, which are intended to reduce heating and cooling costs as well as maintenance costs and increase the value of the properties. According to officials from the Ministry of Mining and Energy of the Republic of Serbia, the implementation of the project should enable energy savings of more than 35% or 81,000 MWh per year and a reduction in CO₂ emissions of 20,000 tonnes per year (Spasić, 2023).

3. A POSSIBLE RESEARCH DESIGN FOR ANALYSIS OF SOCIO-ECONOMIC AND CULTURAL FACTORS OF THE HOUSEHOLD TRANSITION TO RENEWABLE ENERGY SOURCES

After presenting the conceptual and contextual framework of household transition to RES in Serbia, we will look at the socio-economic and cultural determinants of such a decision. Decision-making is a very complex process that is the subject of various scientific disciplines and theories. In general, decision-making is about purposeful behaviour in the presence of alternatives (Azdejković, 2020, 1). Many decisions made by household members can be categorised as economic decisions, but not all.

Sociology (as already mentioned) primarily sheds light on the complex interplay between existing structures and human action (or, in sociological terms, agency). As Rojek suggests, individuals are free to make choices, but the choices they make are contextualised by how they relate to scarcity. Scarcity refers to the unequal distribution of economic, cultural, social and political resources and the individual's position in relation to these resources (Rojek, 2010, 6). Although individual actions can bring about significant changes in a society, social structures are long-lasting and powerful determinants of said unequal distribution of resources and opportunities.

Economic position of households can be considered one of the strongest predictors of the willingness to switch to renewable energy sources in Serbia. Studies on the economic aspect of changes in the basic social structures in Serbia during the first two decades of the 21st century show that the economic situation of households in Serbia has improved in the period of capitalist consolidation (since 2010) compared to the period of economic crisis (2008-2009), but is still lower than in the first years of accelerated post-socialist transformation (2000-2007). Economic differentiation between social classes increased during the recession and decreased slightly during the period of economic recovery (Manić and Mirkov, 2019, 305). These differences have a clear spatial dimension in Serbia, which should also be taken into account (Petrović et al. 2019).

Culture is another powerful determinant of human decision-making (including the process of decision-making analysed in this paper). In its broadest sense, culture refers to the entire way of life of a people or group. In a narrower way, culture can be defined as the specific systems of meaning that we use to weigh and consider our social world (Alexander et al. 2018, 78). Value orientations and trust are the most relevant aspects of culture for the purpose of our analysis.

Value orientations are defined as general principles of behaviour and action in relation to certain desired goals, which manifest themselves in numerous and different forms of action (Rot and Havelka, 1973, in Pavlović, 2021, 105). They are primarily associated with social actors (i.e. their social actions) at the individual or collective level (Pešić, 2017, 23). In our opinion, two (general) value orientations are most important in relation to our topic – future orientation and individualism/collectivism.

Another (specific) form of value orientation is also of the utmost importance – the attitude towards the protection of the environment. The roots of this orientation can be found in the famous Kluckhohn-Strodtbeck theory of value orientations (Kluckhohn and Strodtbeck, 1961). According to this theory, there are three ways in which a person can relate to the

physical environment – subordination, mastery and harmony. Naturally, the third way (harmony with the environment) is expected to correlate positively with a favourable attitude towards environmental protection.

“Trust is a complex, multidimensional construct and two types of trust are usually distinguished and included in the measurement of social capital: interpersonal and institutional. Interpersonal trust refers to the belief that most people can be trusted, whereas institutional trust captures the confidence in various institutions, such as the government, the justice system, the health system, the education system, the media, etc.” (Jovanović, 2016, 284). Since the transition to renewable energy involves significant subsidies for households (and other forms of institutional activity), trust in the relevant institutions (ministries, local authorities and public companies) is very important in this regard. All mentioned factors would be analysed through a regression analysis and the expected outcome would be a model that could improve our understanding of the socio-economic and cultural determinants of household transition to renewable energy sources in Serbia.

The institutional framework conditions for economic and social development in Serbia over the last decade are predominantly viewed as unfavourable (Petrović et al. 2019). However, as mentioned above, Serbia has improved its legal framework in terms of energy consumption. According to the European Commission’s Serbia 2024 report, Serbia has continued to harmonise with the EU *acquis* in the area of energy efficiency. In the field of renewable energy sources (RES), Serbia has made good progress in the implementation of support programmes for RES. On the other hand, the country has not achieved the Energy Community’s target for renewable energy by 2030 in its NECP (National Energy and Climate Plan to 2030). Institutional capacities for the implementation of energy efficiency measures also need to be improved, especially the administrative and institutional capacities of the Ministry of Mining and Energy and the regulatory agency responsible for renewable energy (Energy Agency of the Republic of Serbia) (The European Commission, 2024, 86).

Such a contradictory development can also be observed in the implementation of the relevant documents and plans. For example, in May 2024 there are more than 3,000 so-called prosumers of electrical energy in Serbia (Peljto, 2024). Prosumers are both producers (through installed solar panels) and consumers of electrical energy. The vast majority of them are households. However, there are problems with the implementation of the relevant documents that regulate the mutual rights and obligations of prosumers and the Joint-stock Company Elektroprivreda Srbije. Contrary to the relevant regulations (Government of the Republic of Serbia, 2021; Government of the Republic of Serbia, 2022), prosumers pay VAT and excise tax on all planned consumption (although in reality they do not spend it all). In addition, they even pay a fee for (larger) producers of RES to Elektroprivreda Srbije (Savković, 2022).

4. CONCLUSIONS

Decision-making is a very complex process of choosing between different alternatives in societies. Individuals and households are free to choose, but the choices they make are largely determined by existing structures at local, national, regional and global levels. The decision on how to heat the household is primarily an economic decision, but is also largely influenced by social and cultural factors. In addition to the technical availability of different heating

alternatives, the socio-economic status of the household and the culture are of the utmost importance.

A favourable economic situation for households is a basic prerequisite for investment in the transition to renewable energy sources. In the long term, this decision will in most cases pay off economically for households, local communities and society as a whole, but the non-economic benefits are even more valuable, namely a cleaner (or less polluted) physical environment. Both categories of these choices are, in our view, largely determined by two important aspects of culture – value orientations and trust (especially institutional trust). Long-term orientation, individualism/collectivism and attitudes towards protecting the environment are important predictors of investment in renewable energy. Trust in the responsible institutions (ministries, local authorities and public companies) is also very important in this context, as the transition to renewable energies requires a high level of institutional measures and support for households. However, the strength and significance of the influence of these explanatory variables on the response variable (transition to RES) will be determined in an empirical study conducted on a representative sample of Serbian households.

REFERENCES

- Alexander, J. C., K. Thompson, L. Desfor Edles and M. Capous-Desyllas. (2018). *Contemporary Introduction to Sociology: Culture and Society in Transition*. New York and London: Routledge.
- Amendments to the Law on Renewable Energy in Serbia. (2023). *Official Gazette of the RS*, No. 35/2023.
- Azdejković, D. (2020). *Teorija odlučivanja*. Beograd: Univerzitet, Ekonomski fakultet.
- Beck, U. (2009). *World at Risk*. Cambridge: Polity.
- Energetski portal. (2024). *Laws*. <https://www.energetskiportal.com/regulations/legislation/laws/>
- Energy Community. (2023). *Serbia: Annual Implementation Report*. https://www.energy-community.org/dam/jcr:a2ee5af3-ab4d-4573-9e08-7702ffd810c8/EnC_IR2023_Serbia.pdf
- Fuller, R. et al. (2022). Pollution and Health: A Progress Update. *The Lancet Planetary Health*, 6 (6), e535-e547.
- Giantin, S. (2020). *Serbia Ranks First in Europe for Pollution-Related Deaths*. <https://www.cei.int/ansa/76693>
- Giddens A. and P. W. Sutton. (2013). *Sociology*. Seventh revised edition. Cambridge: Polity Press.
- Giddens, A. and P. W. Sutton. (2017). *Sociology*. Eight edition. Cambridge: Polity Press.
- Giddens, A. (1984). *The Constitution of Society: Towards a Theory of Structuration*. Cambridge: Polity Press.
- Government of the Republic of Serbia. (2021). Decree on Criteria, Conditions and Method of Calculation of Claims and Obligations between Buyers – Producers and Suppliers. *Official Gazette of the RS*, No. 83/2021.
- Government of the Republic of Serbia. (2022). Decree on Amendments and Supplements to the Decree on Criteria, Conditions and Method of Calculation of Claims and Obligations between Buyers – Producers and Suppliers. *Official Gazette of the RS*, No. 74/2022.

- Jovanović, V. (2016). Trust and Subjective Well-being: The Case of Serbia. *Personality and Individual Differences*, 98, 284-288.
- Kluckhohn F. and F. Strodtbeck. (1961). *Variations in Value Orientations*. Evanston, IL: Row, Peterson.
- Law on Energy Efficiency and Rational Use of Energy. (2021). *Official Gazette of the RS*, No. 40/2021.
- Law on the Use of Renewable Energy Sources RES. (2021). *Official Gazette of the RS*, No. 40/2021.
- Manić, Ž. and A. Mirkov. (2019). Materijalni položaj domaćinstava u Srbiji u periodu konsolidacije kapitalističkog poretka. In: Lazić, M. and S. Cvejić (Eds.). *Stratifikacijske promene u periodu konsolidacije kapitalizma u Srbiji*, 49-70. Beograd: Filozofski fakultet, Institut za sociološka istraživanja.
- Pavlović, B., A. Madžarević, D. Ivezić, M. Živković and D. Mojić. (2024). Energetska tranzicija u domaćinstvima: analiza usaglašenosti Srbije sa paketom „Čista energija za sve Evropljane“. *Energija, ekonomija, ekologija*, 26 (1), 51-58.
- Peljto, S. (2024). *Instalisana snaga svih prozjumeru u Srbiji dostigla 50 megavata*. <https://rs.bloombergdria.com/ekonomija/srbija/58021/instalisana-snaga-svih-prozjumeru-u-srbiji-dostigla-50-megavata/news/>
- Petrović, M., V. Backović and I. Petrović. (2019). Prostorna dimenzija klasno-slojnih razlika u Srbiji: analiza materijalnog položaja i potrošnje. In: Lazić, M. and S. Cvejić (Eds.). *Stratifikacijske promene u periodu konsolidacije kapitalizma u Srbiji*, 71-98. Beograd: Filozofski fakultet, Institut za sociološka istraživanja.
- Petrović, P., D. Brčerević and M. Gligorić. (2019). Why is Serbia an Economic Growth Underachiever? *Ekonomika preduzeća*, 67 (1-2), 17-33.
- Rojek, C. (2010). *The Labour of Leisure: The Culture of Free Time*. London: SAGE.
- Savković, Č. (2022). *Iskustva građana koji su ugradili solarne panele i postali „prozjumeri“*. <https://novaekonomija.rs/vesti-iz-zemlje/iskustva-gradjana-koji-su-ugradili-solarne-panele-i-postali-prozjumeri>
- Spasić, V. (2023). *Serbia kicks-off Public ESCO project – subsidies for energy renovation of residential buildings*. <https://balkangreenenergynews.com/serbia-kicks-off-public-esco-project-subsidies-for-energy-renovation-of-residential-buildings/>
- The European Commission. (2020). *Guidelines for the Implementation of the Green Agenda for the Western Balkans*. https://neighbourhood-enlargement.ec.europa.eu/system/files/2020-10/green_agenda_for_the_western_balkans_en.pdf
- The European Commission. (2023). *The European Green Deal: Striving to be the first climate-neutral continent*. https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en
- The European Commission. (2024). *Serbia 2024 Report*. https://neighbourhood-enlargement.ec.europa.eu/document/download/3c8c2d7f-bff7-44eb-b868-414730cc5902_en?filename=Serbia%20Report%202024.pdf
- The European Council. (2023). *Fit for 55*. <https://www.consilium.europa.eu/en/policies/green-deal/fit-for-55-the-eu-plan-for-a-green-transition/>

ACKNOWLEDGEMENT

This research was supported by the Science Fund of the Republic of Serbia, #GRANT No 4344, Forward-Looking Framework for Accelerating Households' Green Energy Transition - FF GreEN.

IS THERE AN ENVIRONMENTAL KUZNETS CURVE IN WESTERN BALKANS: EXAMINING EDUCATION-TECHNOLOGICAL INNOVATION-CO₂ EMISSIONS

Marija Petrović-Randelović*

Faculty of Economics, University of Niš, marija.petrovic@eknfak.ni.ac.rs,
ORCID number 0000-0003-2905-1023

Snežana Radukić

Faculty of Economics, University of Niš, snezana.radukic@eknfak.ni.ac.rs,
ORCID number 0000-0001-5636-2893

Žarko Popović

Faculty of Economics, University of Niš, zarko.popovic@eknfak.ni.ac.rs,
ORCID number 0000-0002-4347-6960

Abstract: *In the period after 2000, the Western Balkans countries significantly improved their development performance and realized benefits from the increase in per capita income. However, the region today faces complex environmental challenges, because of the fact that economic development in these countries is associated with a growing environmental impact. Raising concerns about the growth patterns sustainability in the context of global environmental challenge require coordinated regional efforts and significant investment in adapting and mitigating the impact of harmful environmental practices in order to build resilient and sustainable economies. In this context, the question of the existence of an Environmental Kuznets curve (EKC) in the countries of the Western Balkan region, that is, the existence of an inverted U-shaped relationship between per capita income and environmental quality, arises. Increasing awareness of climate change and the need for sustainable development give the importance of education and technological innovation in reducing CO₂ emissions. For this reason, this study examines the relationship between the education and technological innovation and CO₂ emissions in the Western Balkan countries over the period 2002-2022 employing an econometric model based on the panel data for these countries. The findings revealed a positive correlation between education and the reduction of CO₂ emissions, while the impact of technological innovations varies depending on the type of technologies used, suggesting that EKC hypothesis is valid in the countries in region. In order to achieve environmental objectives and achieving green economic growth, the authorities of the Western Balkan countries must pursue the strategies for mitigating the CO₂ emissions through educational and technological investments.*

Keywords: *Education, Technological innovations, CO₂ emissions, Environmental Kuznets curve, Western Balkan countries.*

JEL Classification: *F 64, O 13, O 44.*

* Corresponding author

1. INTRODUCTION

The beginning of the twenty-first century has brought about a significant change in the environment. The general condition of the world environment is getting worse and has become one of the biggest problems facing countries today.

The growing rate of environmental degradation has made the global environmental crisis one of the most urgent challenges of our day, endangering human civilization's long-term existence. The world's fast-growing population appears to be threatened by a number of serious environmental issues, including the effects of global warming, the ozone layer hole, pollution of the water, soil, atmosphere, deteriorating biodiversity, land and soil quality. Human health, material necessities, physical security, and social cohesiveness are all seriously threatened by them. At the same time, it was shown that the current models of production and consumption are unsustainable and that the creators of economic policy of all countries should direct their focus towards improving the sustainability of economic systems by applying appropriate sustainable policies. The belief that the world's population may have a higher standard of life without needlessly draining the planet's limited resources and further harming the environment is the foundation of the notion of sustainable development.

Environmental stability and environmentally friendly business practices have sparked much debate at the global level. The efforts of developed, developing countries and countries in transition are increasingly directed towards finding optimal solutions to the problem of sustainability of their economic systems. The development of ecologically sustainable technology has an important role in achieving the goals of protecting and improving the state of the environment.

Many academics and environmentalists criticize technology for environmental issues because they believe that human activity is the root cause of these issues. Technology has a negative impact on the environment by causing global warming, affecting water quality, pollution, waste, power consumption, deforestation, and radiation. In other words, technology can lead to increased environmental exploitation by humans; vehicles are a major source of carbon emissions thanks to technology; though they facilitate and speed up communication, communication technologies have also made the atmosphere more radioactive; every day, technology and its byproducts harm the ecology in countless ways.

However, humans' quality of life improved as a result of technological advancements that eventually sparked the Industrial Revolution. In addition to improving access to clean water, food, and pleasant housing, technology has also improved and enhanced communication, transportation, health, and other aspects of the human life. Therefore, it may be claimed that technology has transformed practically every facet of human existence. Also, technology has the potential to enable more effective and reasonable use of the world's limited resources, as well as to contribute to sustainable development goals. So, one important factor in determining the pattern and rate of development of human societies worldwide is the advancement of science and technology. It is widely accepted that approaches for establishing a balance between the demands of environmental preservation and development require the support of science and technology. Technological innovations are essential for developing new, effective, and eco-friendly solutions as societies strive to transition to cleaner and more sustainable systems.

In discussions about a sustainable future and ways of sustainable development, one of the issues that what arouses the greatest interest, but also concern, is whether we have enough

readiness to support that development. How the times we live in demand new knowledge in all areas of life and work, so education for sustainable development is one of the most important aspects of one's progress society in the spirit of the idea of sustainable development (Đukić et al., 2019).

Because it raises awareness, encourages critical thinking, and supports sustainable habits, education, formal and informal, is essential to mitigating the effects of negative human-environment impacts. It gives people the information and abilities needed to comprehend the complex environmental problems and participate in well-informed decision-making. Additionally, education fosters advocacy and policy, empowers disadvantaged groups, fosters innovation and solutions, and increases resilience.

The link between education and technological innovation becomes more significant in the context of global environmental challenges. Education is one of the most important factors in the development of human capital, which is crucial for the improvement of innovation and sustainable economic development. In this sense, technological innovations become not only drivers of economic growth, but also means of reducing the negative impact on the environment.

With a total area of around 200,000 km², the Western Balkan region, Albania, Bosnia and Herzegovina, Montenegro, North Macedonia, and Serbia, home to almost 18 million people. The main economic activity in the area is focused on sectors that are weather and climate-related, such as tourism, forestry, agriculture, and their connected services. These economies are striving for EU accession and are dedicated to upholding the Paris Agreement and reaching the EU2020 and EU2030 targets for lowering greenhouse gas (GHG) emissions, improving energy efficiency, and increasing the production of renewable energy. Their shared goal of raising per capita income while lowering unemployment rates is at the top of the economic policy agenda. With their limited financial and human resources, the Western Balkan economies, which are particularly affected by global warming and vulnerable to climate change, analyse and report on adaptation techniques while working to prioritize mitigation efforts. The necessity of fresh regional cooperation and growth is highlighted by this shortage.

Since 2000, the five Western Balkan (WB5) countries, Albania, Bosnia and Herzegovina, Montenegro, North Macedonia, and Serbia, have developed considerably when it comes to the state of their economies (World bank, 2024). Per capita incomes increased as a result of output growth in these economies; by 2022, they varied from US\$15,329 in Albania to US\$22,081 in Montenegro (in constant 2017 international currencies). Between 2012 and 2022, the average annual GDP growth was almost 2.7 percent, while the EU average for the same time period was 1.4 percent. The GDP increased from 14.2 percent to 26.6 percent as a result of exports growth from the WB5 to the EU (from US\$25.4 million in 2010 to around US\$72.5 million in 2022). The region's growth and poverty reduction were bolstered by market liberalization, trade and financial access, and a dedication to structural reforms. Between 2016 and 2019, the percentage of the population living below the middle-class poverty line, which is US\$6.85 per day in 2017 purchasing power parity (PPP), decreased by an average of almost 10 percentage points, followed by an increase in life expectancy at birth, (from 72 years in 2000 to 77 years in 2021).

However, despite improving development performance, the countries of the Western Balkans face a number of environmental problems that include: air pollution, induced by the use of fossil fuels, outdated industrial plants and poor heating systems; water degradation induced by

the absence of industrial waste treatment systems, which has a negative effect on the provision of ecosystem services and the supply of clean drinking water; uncontrolled waste disposal, caused by the absence of adequate waste management systems; deforestation and land degradation due to unplanned forest cutting and unsustainable agricultural practices; climate change causes extreme weather conditions, such as droughts and floods, which negatively affects agriculture and the living conditions of the population, energy inefficiency, due to the predominant use of coal in the energy sector, which contributes to greenhouse gas emissions and environmental pollution. Solving these problems implies undertaking joint activities in the direction of promoting the transition to a green economy, which implies the transition to renewable energy sources and raising the technological performance of the economies of the Western Balkans, strengthening legal regulations, but raising the environmental awareness of citizens through education for sustainable development.

One of the most often used techniques for analysing environmental performance is the Environmental Kuznets Curve (EKC). An inverted U-shaped curve developed by Kuznets in 1955 serves as the foundation for the EKC. Its original purpose was to investigate the connection between income disparity and per capita income. When the inverted U-shape began to be used in environmental research, the EKC gained popularity. It has since been extensively and intensively employed as a theoretical framework to investigate the connection between economic growth and CO₂ emissions.

The relevance of education and technical innovation in influencing CO₂ emissions is indicated by recent studies. Given the fact that most of the previous literature on this issue not taking into the account Western Balkans, this study is trying to fill this gap.

Therefore, the goal of this paper is to determine the existence of the EKC hypothesis in the countries in the region, by examining the relationship between the education and technological innovation and CO₂ emissions. After the introductory remarks, a review of the literature on the relationship between these variables is given. The research methodology is presented in the main part of the paper, and the research results are discussed in the fourth part of the paper. In the conclusion, a synthesis of the research results and concluding considerations of the given problem were made.

2. LITERATURE REVIEW

Although more or less ecologically friendly technologies might be selected, conventional environmental philosophy up to the 1980s maintained that environmental effect rose with economic activity. Ehrlich and Holdren's (1971) IPAT model (Population * Affluence * Technology = Impact) serves as a representation of this strategy. If income per capita is a measure of prosperity, then effect or emissions per dollar of income is a measure of technology. The idea of sustainable development was first proposed in the 1980s, contending that poverty alleviation was crucial for environmental protection and that development was not always harmful to the environment.

In their groundbreaking analysis of the possible effects of the North American Free Trade Agreement (NAFTA), Grossman & Krueger (1991a) presented the EKC concept in keeping with this sustainable development theory. Environmentalists who opposed NAFTA argued that Mexico's ecology would suffer from the economic expansion that would come with free trade. Instead, Grossman & Krueger contended that rather than worsening Mexico's environmental quality, increased growth actually improves it. They conducted an empirical

examination of the correlation between income per capita and ambient pollution levels in numerous cities worldwide using data from the GEMS database in order to bolster this claim. They found that when a nation's per capita income approached that of Mexico at the time, the concentrations of several pollutants peaked.

EKC hypothesis developed by Grossman and Krueger predicts an inverted U-shaped link between income growth and pollution emissions. Scale effects are thought to be the cause of pollution emissions since economic expansion necessitates high energy consumption in the early stages of development to support the expanding economic activity. At the second stage of growth, a clean environment might also be sought. This can be achieved by diversifying the economy from polluted to clean industries, which is known as a composition effects by implementing clean technology. Here, the EKC is significantly shaped by energy use.

Many academics have used a variety of approaches to examine the EKC hypothesis in various nations and locations since the seminal publication by Grossman and Krueger (1991). Additionally, these studies differ due to the model assumptions, time periods, various EKC forms, and explanatory factors. As a result, some studies may find support for the EKC for any given nation or region, while others may find none.

Among the empirical studies that support EKC hypothesis, the study of Thompson (2012) on the sample of 38 developed and developing countries expands to the body of knowledge on the EKC by analyzing how water quantity affects an EKC for water pollution. The findings show that the turning point of an EKC is significantly impacted by water quantity. To estimate an EKC enhanced by neighboring per capita income and energy intensity, Balado-Naves et al. (2018) used a panel data set comprising 173 nations from 1990 to 2014. The empirical findings revealed that the majority of regions support the standard EKC, the relationship between observed variables appears to be inverted U-shaped in Europe, Asia, and the entire world, neighboring energy intensity raises national per capita emissions, and economic growth is predicted to accelerate climate change.

The study of Pham et al. (2020) focuses at the immediate and long-term impacts of sociological, economic, and energy factors on environmental deterioration in 28 European nations. Empirical findings suggest that while these elements may have short-term positive effects on the environment, they have long-term negative effects. These results support the issues that Thomas Robert Malthus brought up in his *Essay on the Principle of Population*. Regarding the energy elements, it shows that while greater energy intensity poses an ecological concern, renewable energies benefit the European environment by lowering carbon dioxide emissions.

The findings of Xie et al. (2019), Ahmad et al. (2021), Jiang et al. (2021) studies further support the EKC hypothesis by indicating a strong inverted U-shaped association between economic growth and emissions of pollutants in China. Alola & Ozturk (2021) examine the viability of the EKC theory, which links wealth to environmental degradation, particularly in light of investment risk in the US from 1984 to 2017. Crucially, the analysis concluded that the EKC hypothesis holds true in the US, but with a negligible risk-to-investment trade-off. Furthermore, the production of renewable energy has a positive and statistically significant short- and long-term effect on environmental quality. The study's general hypothesis was that, although environmental sustainability can be attained at the highest income level, doing so is probably at the expense of investment risk.

However, some recent empirical studies disagree against the EKC's central thesis, which supports an inverted U-shaped link between economic growth and CO₂ emissions.

In their study, Yang et al. (2015) found that there isn't a single model that works for all economies worldwide. The relationship between income and the emissions of pollutants can be represented by inverted-N and M shapes in addition to an inverted U-shape. These outcomes may differ according to a nation's level of economic development and how it differs according to the region of the world in which the nation is located. The relationship between economic growth and CO₂ emissions is inconsistent, according to Li et al. (2019), who also noted that it is evolutionary in nature and can be influenced by a nation's socioeconomic characteristics, time, and location. Both inverted N and M-shaped relationships can differ from an inverted U-shaped curve.

The existence of EKC in the Portuguese and Spanish economies was examined by Moutinho et al. (2017), who also presented evidence of an inverted N-shaped EKC on the sample of six nuclear-producing nations. It was explained that encouraging renewable energy in economies can help achieve pressing objectives and have significant positive effects. It was noted that while rising income can occasionally be advantageous for the environment, nuclear energy has been shown to be environmentally beneficial. Investigating the impact of determinants of environmental degradation, such as economic growth, trade openness, industrialization, energy consumption, on CO₂ emissions in the period 1980–2014 in Australia, Nasir et al. (2021) did not confirm the validity of the EKC hypothesis. There is a short-term, two-way causal relationship CO₂ emissions and economic growth, energy consumption, industrialization, and stock market development. On the other hand, no solid proof of EKC was discovered, because trade openness, energy consumption, and financial development have long-term favorable effects on CO₂ emissions.

Increasing awareness, promoting behavioral changes, and equipping people with the knowledge and abilities necessary to handle the complex challenges presented by climate change largely rely on education. While the literature mainly discusses the impact of human capital on CO₂ emissions, research on the impact of education on CO₂ emissions is very scarce. According to Alkhateeb et al. (2020), “education can play an effective role in building social responsibility in a community which can help to reduce pollution emissions” (p. 195). The findings of their study of the relationship between Saudi Arabia's CO₂ emissions and economic growth, energy use, and education using data from 1971 to 2014, indicate that whereas energy consumption has a beneficial impact on CO₂ emissions, secondary education has a negative impact, while primary education has no effect. CO₂ emissions and economic growth have an inverted U-shaped connection over the long term, at the early stage of development. Therefore, environmental deterioration is caused by economic expansion. They recommend using cleaner energy sources to prevent the adverse environmental effects of economic expansion and improving secondary education to improve the country's environment. Through the promotion of sustainable practices and environmental awareness, education can aid in reducing the adverse effects of CO₂ emissions.

Shields (2019) study offers a model of greenhouse gas emissions related to international student mobility by combining many datasets. According to estimates, these emissions are significant and increasing more quickly than world emissions generally, yet emissions per student are gradually declining, mostly as a result of shifting mobility patterns. The findings revealed that while global interchange is becoming more and more significant, higher education for sustainable development should also take into account the environmental costs

of international mobility in addition to its advantages. Because it fosters advanced knowledge and abilities that result in creative solutions to environmental issues, higher education in particular is associated with lower CO₂ emissions (Eyuboglu & Uzar, 2021).

Li & Ullah (2022) indicate that whereas a negative change in education has eventually led to higher CO₂ emissions in the BRICS, a positive change in education has decreased CO₂ emissions. In terms of economic analysis, improved education eventually lowers CO₂ emissions in South Africa, China, and Russia, while poorer education has a greater effect on CO₂ emissions in China and Brazil.

A strong estimate of education's role as a catalyst for environmental deterioration is also found in the study of Zafar et al. (2022). Xin et al. (2023) examining how education affects CO₂ emissions in China, and found that the average year of education and the literacy rate as the measures of human capital have a long-term moderating influence on CO₂ emissions. Education has far-reaching economic implications, and a country's human capital and educational institutions have a significant impact on how it uses its energy resources and its overall economic health. Gaining more knowledge increases people's wealth and purchasing power, which opens up access to highly energy-intensive technologies (Balaguer & Cantavella, 2018). In opposite, Zhang et al. (2022) revealed that education, among other factors (income, financial development, and globalization) decrease environmental quality by increasing emissions level.

Such inconsistent results suggest that there is still disagreement over findings about the connection between education and CO₂ emissions, which poses new challenges for further research. Numerous studies have been conducted on the relationship between technological innovations and CO₂ emissions. Energy efficiency gains, the creation of low-carbon technology, and modifications to industrial processes are all examples of the intricate link between technological advancement and environmental effect. Grossman & Krueger (1995b) claim that technological innovation is the main factor reducing emissions, particularly in the form of environmental technology that has a significant impact on the economy, society, and environment.

Carrion-Flores & Innes (2010) estimate the connection between environmental innovation and toxic air pollution on 127 manufacturing industries over the period 1989–2004 in the US, and found that environmental innovation contribute to US toxic emissions reduction. If the time horizon is constrained, however, the application of environmental innovation might not result in a meaningful reduction in CO₂ emissions. Thus, the benefits of putting environmental innovation into practice depend on how long it is implemented (Mongo et al., 2021). Wang & Zu (2020) attempts to investigate the advantages of energy technology innovation for reducing CO₂ emissions in China. The findings show that while fossil energy technology innovation is ineffectual at lowering CO₂, renewable energy technology innovation helps reduce CO₂, which has been also confirmed by research of Dauda et al. (2021). There may be an inverted U-shaped EKC between environmental innovation and CO₂ emissions, with an initial rise in CO₂ emissions followed by decreases. However, according Chen & Lee (2020), despite the adoption of environmental innovation, CO₂ emissions are expected to increase in low-, middle-, and middle-income nations with low technology and low CO₂ emissions. So, it's possible that environmental innovation won't have an immediate impact on lowering CO₂ emissions.

3. METHODOLOGY

The research subject of this paper is the relationship between the variables, education and technological innovation, on the one hand, and the CO₂ emissions, on the other hand on the sample of Western Balkan countries. The countries of the Western Balkans were selected for analysis because of their specific socioeconomic situation, which combines the characteristics of transition economies and the challenges of sustainable development and environmental protection. This region is facing intensive reform processes in the educational and technological sectors, while at the same time recording significant CO₂ emissions as a result of outdated infrastructure, energy inefficiency and industrial heritage. Studying the links between education, technological innovation and CO₂ emissions in these countries provides the opportunity to identify specific factors that can contribute to the sustainable development of the region and facilitate the transition to a greener economy. In addition, the results of the analysis can serve as a valuable framework for policy making in similar developing economies.

The starting hypothesis in the research is: *There is a significant relationship between education and technological innovation and CO₂ emissions in the Western Balkan countries.* In order to test the hypothesis, correlation analysis was first applied. More precisely, Spearman's rank correlation coefficient was calculated, as a non-parametric indicator of the relationship between the variables of interest, and its significance was tested. For data analysis in this work, regression analysis of panel data was also used, which enables simultaneous monitoring of variations over time and among entities (countries, regions or sectors). This method was applied to investigate the relationship between education, technological innovation and CO₂ emissions. Panel data provided a more detailed insight into the interdependencies of these factors and their dynamics over time, thus providing a more robust analysis compared to traditional methods.

The information basis of this research is related to World Bank Development Indicators, Our World in Data, and UNDP Human Development Reports. Data set covers the period of 2002 to 2022 for the five Western Balkans countries, namely, Albania, Bosnia and Herzegovina, Montenegro, North Macedonia and Serbia.

In the data analysis, a regression analysis of panel data was applied, which refer to the period 2002-2022. year. In the regression model, the dependent variable in this study is the Annual total emissions of carbon dioxide (CO₂), excluding land-use change, measured in tones. For the purpose of this study several independent variables are included to represent: national education level – Mean years of schooling; and technological innovation – Research and development expenditure in % of GDP, so that the model can display as follows:

$$CO_{2it} = \beta_0 + \beta_1 \text{MeanYearsSchooling}_{it} + \beta_2 \text{RDExpenditure}_{it} + \varepsilon_{it}$$

Where:

- CO_{2it}, CO₂ emissions for country *i* in the time period *t* (dependent variable),
- MeanYearsSchooling_{it}, mean years of schooling for country *i* in the time period *t* (independent variable),
- RDExpenditure_{it}, research and development expenditure in % of GDP for country *i* in the time period *t* (independent variable),
- β₀, constant,
- β₁, β₂, coefficients that measure the impact of independent variables,
- ε_{it}, standard error.

Also, the following are included as control variables. Renewable energy consumption (% of total final energy consumption) is an independent variable that is included in the analysis because the consumption of renewable energy directly affects the reduction of CO₂ emissions, because it replaces fossil fuels, which are the main source of gases with the greenhouse effect. In addition, the development and use of renewable energy sources are often linked to technological innovation, but a high level of education can also contribute to greater acceptance of renewable energy sources through raising awareness of climate change, developing new technologies and forming policies that favor sustainability. In the context of the Western Balkans, the transition to renewable energy sources is a priority due to energy dependence on coal and high levels of pollution. Renewable energy consumption is a key indicator within the Sustainable Development Goals (SDGs), especially for goals related to clean energy (SDG 7) and climate action (SDG 13). By including this variable, the analysis becomes richer and allows a deeper understanding of the complex interdependencies between education, innovation and CO₂ emissions, while simultaneously considering key factors for sustainable development.

In order to gain a clearer insight into the achieved level of development, which determines the opportunities for investing in education and technological development, the GDP per capita indicator, PPP (current international \$), was introduced into the analysis. It is certain that economic growth has a double effect on CO₂ emissions. In the initial stages of development, emissions often increase due to industrialization and the use of fossil fuels (EKC hypothesis). As higher stages of development are reached, emissions can be reduced due to the transition to sustainable technologies and greater environmental awareness. Countries with higher GDP per capita tend to have better education systems and a higher rate of investment in research and development. This can directly affect the level of technological innovation and, indirectly, CO₂ emissions.

Employment to population ratio, ages 15-24, total (%) (modeled ILO estimate) is an independent variable introduced to gain insight into the impact of economic inclusion of young people on education, innovation and sustainable development. Low youth employment may indicate that a larger part of the population stays longer in the education system, while high youth employment is often associated with lower educational qualifications, which may affect the level of technological innovation and environmental awareness. The inclusion of this indicator can contribute to a clearer insight into how the structure of the workforce affects total CO₂ emissions. For example, higher employment in technology-intensive sectors can contribute to reducing emissions through sustainable practices.

Finally, urban population (% of total population) as independent variable is chosen because economic growth serves as a spur for both industrialization and urbanization since it promotes migration from rural to urban areas and the movement of jobs from the agricultural to the industrial sectors. Since energy consumption is the primary contributor to CO₂ emissions, industrialization and urbanization processes are directly related to energy use and CO₂ emissions (Zi et al. 2016).

4. RESULTS AND DISCUSSION

Table 1 shows the values of the correlation coefficients that show the interdependence of the selected variables and CO₂ emissions.

Table 1. *Correlation Coefficients*

		WB	Albania	BiH	Montenegro	Macedonia	Serbia
Mean years of schooling	Correlation	-.095	.796**	.633**	.582**	-.650**	-.095
	Sig. (2-tailed)	.333	.000	.002	.006	.001	.333
	N	105	21	21	21	21	105
R&D expenditure	Correlation	.413**	-.217	.641**	-.258	-.840**	.413**
	Sig. (2-tailed)	.000	.344	.002	.260	.000	.000
	N	105	21	21	21	21	105
Renewable energy consumption	Correlation	-.577**	.549*	.174	-.576*	-.561*	-.577**
	Sig. (2-tailed)	.000	.012	.464	.015	.010	.000
	N	97	20	20	17	20	97
GDP	Correlation	.027	.663**	.661**	.643**	-.731**	.027
	Sig. (2-tailed)	.784	.001	.001	.002	.000	.784
	N	105	21	21	21	21	105
Employment	Correlation	.016	-.579**	.271	.529*	-.631**	.016
	Sig. (2-tailed)	.875	.006	.234	.014	.002	.875
	N	105	21	21	21	21	105
Urban population	Correlation	-.298**	.693**	.718**	.619**	-.548*	-.298**
	Sig. (2-tailed)	.002	.000	.000	.003	.010	.002
	N	105	21	21	21	21	105

Source: Author's own presentation

Pearson's correlation coefficient was calculated for the countries of the Western Balkans region, and Spearman's correlation coefficient (non-parametric) for these countries.

Education (Mean years of schooling) is negatively correlated with CO₂ emissions at the WB level, in Macedonia and Serbia, with the correlation being significant only in Macedonia. Expenditures for research and development are negatively correlated with CO₂ in Albania, Montenegro and Macedonia, with this correlation being significant only in Macedonia.

Table 2. *Regression analysis of panel data, I model*

Dependent variable: CO₂ Emissions				
Method: Panel Least Squares				
Periods included: 21				
Cross-sections included: 5				
Total panel (balanced) observations: 105				
Variable	Coefficient	Standard Error	t-Statistic	Probability
C	9.682.016	5.976.054	1,620	0,109
Mean years of schooling	954.148,4	626.556,4	1,523	0,132
R&D Expenditures	-7.108.666	1.935.741	-3,672	0,0004
<i>Cross-section fixed</i>				
R-squared:0,975				
Adjusted R-squared: 0,967				
S.E. of regression: 3.101.277				
F-statistic (probability): 121,694 (0,000)				
<i>Durbin-Watson statistic: 0,487</i>				

Source: Author's own presentation

Table 3. Regression analysis of panel data, II model

Dependent variable: Carbon Dioxide CO₂ Emissions Total EXCLUDING LLUCF MT CO₂E				
Method: Panel Least Squares				
Sample (adjusted): 2003 2022				
Periods included: 20				
Cross-sections included: 5				
Total panel (balanced) observations: 100				
Variable	Coefficient	Standard Error	t-Statistic	Probability
C	4765754.	4268611.	1.116465	0.2679
LAG CO2	0.7266286	0.076027	9.552981	0.0000
Mean years of schooling	75167.12	464334.7	0.161881	0.8718
R&D Expenditures	-2690986.	1419295	-1.896002	0.0619
Effects Specification				
<i>Cross-section fixed (dummy variables)</i>				
<i>Period fixed (dummy variables)</i>				
R-squared	0.989685	Mean dependent var	16545178	
Adjusted R-squared	0.986011	S.D. dependent var	17245951	
S.E. of regression	2039755.	Akaike info criterion	32.11985	
Sum squared resid	3.04E+14	Schwartz criter.	32.82324	
Log likelihood	-1578.992	Hannan-Quinn criter.	32.40452	
F-statistic	269.3874	Durbin-Watson stat		
<i>Prob(F-statistic)</i>	<i>0.000000</i>			

Source: Author's own presentation

The regression coefficients given in Table 2 showed that R&D expenditures have a significant negative impact on CO₂ emissions, which means that an increase in R&D expenditures affects a decrease in CO₂ emissions. Mean years of schooling has no significant effect on CO₂ emissions. However, here one of the statistics (Durbin-Watson) shows that there is also an autocorrelation problem in the model, which means that CO₂ emissions in the current year largely depend on emissions in the previous year, which model II showed (Table 3).

The impact of R&D expenditure is still negative, but its significance has decreased. It is significant now with a risk of error of 10% (in the first model it was significant with a risk of error of 5%). The consumption of renewable energy is also included in the third model. This variable has a negative but not significant impact on CO₂ emissions.

Table 4. Regression analysis of panel data, III model

Dependent variable: Carbon Dioxide CO₂ Emissions Total EXCLUDING LLUCF MT CO₂E				
Method: Panel Least Squares				
Sample (adjusted): 2003 2022				
Periods included: 20				
Cross-sections included: 5				
Total panel (balanced) observations: 97				
Variable	Coefficient	Standard Error	t-Statistic	Probability
C	9397528	6646780.	1.413847	0.1618
LAG CO2	1182531.	754785.5	1.566711	0.1217
Mean years of schooling	-7560310.	2292577.	-3.297735	0.0015
R&D Expenditures	-46960.10	104913.3	-0.447480	0.6559
Effects Specification				
<i>Cross-section fixed (dummy variables)</i>				
<i>Period fixed (dummy variables)</i>				
R-squared	0.975228	Mean dependent var	17004128	
Adjusted R-squared	0.966027	S.D. dependent var	17485884	
S.E. of regression	3222975.	Akaike info criterion	33.03999	
Sum squared resid	7.27E+14	Schwartz criter.	33.75667	
Log likelihood	-1575.440	Hannan-Quinn criter.	33.32978	
F-statistic	105.901	Durbin-Watson stat	0.480648	
<i>Prob(F-statistic)</i>	<i>0.000000</i>			

Source: Author's own presentation

5. CONCLUSIONS AND RECOMMENDATIONS

The results of the analysis provide an opportunity to draw some conclusions regarding the interdependence between education, technological innovation and CO₂ emissions in the countries of the Western Balkans, in the context of the EKC Hypothesis.

Correlation coefficients, calculated for the countries of the Western Balkans, show that education (Mean years of schooling) has a negative correlation with CO₂ emissions at the regional level, while this correlation is significant only in Macedonia. A similar negative correlation with CO₂ emissions was also recorded for research and development expenditures, but only in Macedonia the correlation is statistically significant. These results suggest that education and investment in research and development can have a potentially positive impact on reducing emissions, which is consistent with the EKC theory, which postulates that CO₂ emissions first increase with economic development and then decrease when a certain level of technological and economic development is reached. economic maturity.

Regression models indicate that R&D expenditures have a significant negative impact on CO₂ emissions, which means that an increase in R&D investment can contribute to a reduction in emissions. This result is consistent with the EKC, which predicts that technological innovation and development can be key to reducing CO₂ emissions in stages when the economy reaches a higher level of development. However, education (Mean years of schooling) did not have a significant impact on CO₂ emissions, which may suggest that educational factors are still not sufficiently integrated into economic and technological policies that directly affect CO₂ emissions in this region.

Also, the analysis revealed the problem of autocorrelation in the model, which indicates that CO₂ emissions from the previous year significantly affect emissions in the current year. Although the negative impact of R&D expenditure on CO₂ emissions was maintained, the significance was reduced in the second model, while in the third model, which includes renewable energy consumption, the impact of renewable energy consumption was negative but not statistically significant. These results indicate that renewable energy consumption, although positive, is still not sufficiently developed or implemented in the Western Balkan region to have a significant impact on reducing CO₂ emissions.

It could be concluded that the results of the research partially confirm the existence of the Ecological Kuznets Curve for the countries of the Western Balkans region, since they indicate that technological innovations (through increased R&D expenditures) can have a negative impact on CO₂ emissions. However, education and renewable energy sources still do not show a strong enough impact on emissions in this region, which implies that additional efforts are needed in the integration of education and energy policies that can contribute to reducing emissions in the future.

In order to reduce CO₂ emissions and encourage sustainable development, the governments of the countries of the region should undertake the following activities. First, bearing in mind that the results of the analysis show a significant negative impact of R&D expenditures on CO₂ emissions, which means that investing in new technologies and energy-efficient processes can have a long-term positive effect on reducing emissions, in the following period investments should be increased in R&D. Research confirms that nations with higher R&D expenditures tend to concentrate on creating greener technology and adopting environmentally friendly techniques, which could contribute to reduced CO₂ emissions. Increasing investment in R&D in the energy efficiency and renewable energy sectors is of

great importance for Western Balkans, in order to accelerate technological progress and reduce dependence on fossil fuels.

Second, although education did not have a significant impact on CO₂ emissions in the observed period, investing in improving the education system with a special focus on the green economy and sustainable technologies can contribute to achieving long-term sustainable results.

Third, the governments of the countries of the Western Balkan region should develop and implement policies that would encourage the transition to renewable energy sources, both by providing subsidies and tax breaks for companies and households that invest in green technologies, and by building adequate infrastructure for renewable sources.

Fourth, the governments of countries in the region should create policies that will support the development of sustainable industries, since, by encouraging green innovations in industry, it is possible to reduce the negative environmental impact of traditional industrial sectors.

Fifth, it is necessary to introduce more effective environmental protection policies, by strengthening the legislative framework in the field of environmental protection, including the introduction of more rigorous standards for CO₂ emissions and increased inspection supervision and control of industrial sectors. It is also important to improve the system for monitoring and reporting on emissions, in order to encourage transparency and responsibility in connection with the achievement of emission reduction goals. By integrating the principles of sustainability into all sectoral policies, in order to create conditions for a long-term reduction of CO₂ emissions, by investing in infrastructure, technology and education, the governments of the countries of the region will create a sustainable economic environment that will simultaneously ensure ecological and economic balance.

REFERENCES

- Ahmad, M., Işık, C., Jabeen, G., Ali, T., Ozturk, I., & Atchike, D. W. (2021). Heterogeneous links among urban concentration, non-renewable energy use intensity, economic development, and environmental emissions across regional development levels. *Science of the Total Environment*, 765, 144527. <https://pubmed.ncbi.nlm.nih.gov/33412378/>
- Alkhateeb, T. T. Y., Mahmood, H., Altamimi, N. N., & Furqan, M. (2020) Role of education and economic growth on the CO₂ emissions in Saudi Arabia, *Entrepreneurship and Sustainability Issues*, 8(2), 15-209, [http://doi.org/10.9770/jesi.2020.8.2\(12\)](http://doi.org/10.9770/jesi.2020.8.2(12))
- Alola, A. A., & Ozturk, I. (2021). Mirroring risk to investment within the EKC hypothesis in the United States. *Journal of Environmental Management*, 293, 112890. <https://doi.org/10.1016/j.jenvman.2021.112890>
- Balado-Naves, R., Baños-Pino, J. F., & Mayor, M. (2018). Do countries influence neighbouring pollution? A spatial analysis of the EKC for CO₂ emissions. *Energy Policy*, 123, 266–279. <https://ideas.repec.org/a/eee/enepol/v123y2018icp266-279.html>
- Balaguer, J., & Cantavella, M. (2018). The role of education in the Environmental Kuznets Curve. Evidence from Australian data. *Energy Economics*, 70, 289-296. <https://doi.org/10.1016/j.eneco.2018.01.021>

- Carrion-Flores, C. E., & Innes, R. (2010). Environmental innovation and environmental performance. *Journal of Environmental Economics and Management*, 59(1), 27–42. <https://doi.org/10.1016/j.jeem.2009.05.003>.
- Chen, Y., & Lee, C. C. (2020). Does technological innovation reduce CO₂ emissions? Cross country evidence. *Journal of Cleaner Production*, 263, 121550. <https://doi.org/10.1016/j.jclepro.2020.121550>.
- Dauda, L., Long, X., Mensah, C. N., Salman, M., Boamah, K. B., Ampon-Wireko, S., & Kofi Dogbe, C. S. (2021). Innovation, trade openness and CO₂ emissions in selected countries in Africa. *Journal of Cleaner Production*, 281, 125143. <https://doi.org/10.1016/j.jclepro.2020.125143>
- Đukić, V., Đukić, O., & Đukić, B. (2019). Obrazovanje u funkciji održivog razvoja (Education as a function of sustainable development). *Zbornik radova Mediji i ekonomija (Proceedings Media and economy)*, 5. <https://doisrpska.nub.rs/index.php/ZMES/issue/view/753>
- Eyuboglu, K., & Uzar, U. (2021). A new perspective to environmental degradation: The linkages between higher education and CO₂ emissions. *Environmental Science and Pollution Research*, 28(1), 482–493. <https://doi.org/10.1007/s11356-020-09414-8>.
- Grossman, G. M., & Krueger, A. B. (1991a). Environmental impacts of the North American Free Trade Agreement. *NBER Working paper* 3914. <https://doi.org/10.3386/w3914>
- Grossman, G. M., & Krueger, A. B. (1995b). Economic-growth and the environment. *The Quarterly Journal of Economics*. 110(2), 353–377. <https://doi.org/10.2307/2118443>.
- Jiang, Q., Khattak, S. I., & Rahman, Z. U. (2021). Measuring the simultaneous effects of electricity consumption and production on carbon dioxide emissions (CO₂e) in China: new evidence from an EKC-based assessment. *Energy*, 229, 120616. <https://doi.org/10.1016/j.energy.2021.120616>
- Kuznets, S. (1995). Economic growth and income inequality. *American Economic Review*, 45, 1–28. <https://assets.aeaweb.org/asset-server/files/9438.pdf>
- Li, W., Yang, G., & Li, X. (2019). Modeling the evolutionary nexus between carbon dioxide emissions and economic growth. *Journal of Cleaner Production*, 215, 1191-1202. <https://doi.org/10.1016/j.jclepro.2019.01.100>
- Li, X., & Ullah, S. (2022). Caring for the environment: How CO₂ emissions respond to human capital in BRICS economies? *Environmental Science and Pollution Research*, 29(12), 18036–18046. <https://doi.org/10.1007/s11356-021-17025-0>
- Mongo, M., Belaïd, F., & Ramdani, B. (2021). The effects of environmental innovations on CO₂ emissions: Empirical evidence from Europe. *Environmental Science & Policy*, 118, 1–9. <https://doi.org/10.1016/j.envsci.2020.12.004>.
- Moutinho, V., Varum, C., & Madaleno, M. (2017). How economic growth affects emissions? An investigation of the Environmental Kuznets curve in portuguese and spanish economic activity sectors. *Energy Policy*, 106: 326-344. <https://doi.org/10.1016/j.enpol.2017.03.069>
- Nasir, M., A., Canh, N., P., Lan Le, T. N. (2021). Environmental degradation & role of financialisation, economic development, industrialisation and trade liberalization. *Journal of Environmental Management*, 277, 111471. <https://doi.org/10.1016/j.jenvman.2020.111471>
- Pham, N. M., Huynh, T. L. D., & Nasir, M. A. (2020) Environmental consequences of population, affluence and technological progress for European countries: a Malthusian view. *Journal of Environmental Management*, 260, 110143. <https://doi.org/10.1016/j.jenvman.2020.110143>

- Shields, R. (2019). The sustainability of international higher education: Student mobility and global climate change. *Journal of Cleaner Production*, 217: 594-602. <https://doi.org/10.1016/j.jclepro.2019.01.291>
- Thompson, A. (2012). Water abundance and an EKC for water pollution. *Economic Letters*, 117(2), 423–425. <https://doi.org/10.1016/j.econlet.2012.06.014>
- Wang, Z., & Zhu, Y. (2020). Do energy technology innovations contribute to CO₂ emissions abatement? A spatial perspective. *Science of The Total Environment*, 726, 138574. <https://doi.org/10.1016/j.scitotenv.2020.138574>
- World Bank (2024). World Development Indicators. Retrieved 10 November 2024 from: <https://databank.worldbank.org/source/world-development-indicators>
- Xie, Q., Xu, X., & Liu, X. (2019). Is there an EKC between economic growth and smog pollution in China? New evidence from semiparametric spatial autoregressive models. *Journal of Cleaner Production*, 220, 873–883. <https://doi.org/10.1016/j.jclepro.2019.02.166>
- Xin, Y., Yang, S., & Rasheed, M. F. (2023). Exploring the impacts of education and unemployment on CO₂ emissions. *Economic Research-Ekonomska Istraživanja*, 36(2), 2110139. <https://doi.org/10.1080/1331677X.2022.2110139>
- Yang, G., Sun, T., Wang, J., & Li, X. (2015). Modeling the nexus between carbon dioxide emissions and economic growth. *Energy Policy*, 86, 104-117. <https://doi.org/10.1016/j.enpol.2015.06.031>
- Zafar, M. W., Saleem, M. M., Destek, M. A., & Caglar, A. E. (2022). The dynamic linkage between remittances, export diversification, education, renewable energy consumption, economic growth, and CO₂ emissions in top remittance-receiving countries. *Sustainable Development*, 30(1), 165–175. <https://doi.org/10.1002/sd.2236>
- Zhang, C., Khan, I., Dagar, V., Saeed, A., & Zafar, M. W. (2022). Environmental impact of information and communication technology: Unveiling the role of education in developing countries. *Technological Forecasting and Social Change*, 178(C), 121570. <https://doi.org/10.1016/j.techfore.2022.121570>
- Zi, C., Jie, W., & Hong-Bo, C. (2016). CO₂ emissions and urbanization correlation in China based on threshold analysis. *Ecological Indicators*, 61:193–201. <http://dx.doi.org/10.1016/j.ecolind.2015.09.013>

ACKNOWLEDGEMENT

The paper is the result of research in accordance with the Decision of the Ministry of Science, Technological Development and Innovation on the transfer of funds for financing scientific research work in 2024, number 451-03-65/2024-03, dated January 26, 2024.

CHALLENGES OF INDUSTRY 4.0: INNOVATIONS AS KEY DRIVERS OF PROGRESS IN DEFENSE INDUSTRY

Goran Mladenović*

Faculty of Engineering, University of Kragujevac
goran.mladenovic@fink.rs, goran.mladenovicgmd@gmail.com,
ORCID number 0000-0002-0717-9715

Abstract: *This paper investigates the challenges and opportunities associated with the implementation of Industry 4.0 technologies within the defense sector, focusing specifically on Serbia in comparison with global trends. As the demand for military capabilities rises, the integration of artificial intelligence (AI) and machine learning (ML) has become increasingly vital for enhancing the effectiveness and autonomy of modern military systems. Although leading nations such as the USA, China, and EU member states have recognized the transformative potential of these technologies, Serbia faces significant hurdles, including a slow digital transformation process, limited financial resources, and a shortage of skilled workforce necessary for adopting advanced technologies. Despite the existence of essential resources, such as human capital and a national digital strategy, the adoption of Industry 4.0 technologies in Serbia remains insufficient. Through cluster analysis conducted using Python and RapidMiner Studio, this study compares Serbia's readiness against other countries based on the Network Readiness Index 2023. The findings highlight the pressing need for increased investments in research and development, as well as the establishment of robust strategies that can facilitate Serbia's transition toward Industry 4.0. By addressing these challenges, Serbia can better position itself to leverage the benefits of advanced technologies and enhance its competitive edge in the defense sector, ultimately contributing to national security and economic growth.*

Keywords: *Industry 4.0, Artificial Intelligence, Network Readiness Index, Defense sector, Opportunities*

JEL Classification: *C38, F63, O32, H56*

* Corresponding author

1. INTRODUCTION

The concept of Industry 4.0 (4IR) has garnered substantial support and application across all segments of human life since its introduction at the Hanover Fair in 2011 and its endorsement at the World Economic Forum in Davos in 2016. The Fourth Industrial Revolution, unlike its three predecessors, is characterised by an unprecedented exponential pace and a broad scale of change (Dombrowski, 2017). Consequently, it has swiftly become an integral component of national strategies aimed at stimulating economic growth and development in numerous countries. According to estimates by Statista (2024), artificial intelligence (AI) technologies could generate approximately 13 trillion USD in the global economy by 2030, which is nearly equivalent to China's GDP for 2023, estimated at 17.7 trillion USD. At a global level, there is intense competition among the world's most powerful nations to adopt and master advanced technologies in order to secure economic and strategic advantages. The United States, China, Russia, Japan, and members of the European Union (EU) are striving to position their defence sectors at the forefront of generating critical 4IR technologies. They are intensifying collaboration with high-tech companies from the civilian sector to secure global superiority in military, economic, and political realms, thereby further enhancing their national security capacities. According to Dian (2014), the defence sector encompasses the armed forces of a state along with companies from the defence industry. This specific segment of the industry was among the first to recognise the potential of adopting 4IR technologies, particularly as total global military expenditures reached 2.443 trillion USD in 2023, marking a real increase of 6.8% compared to 2022 (SIPRI, 2024). Simultaneously, there is a growing need for coordination, collaboration, and interaction among key stakeholders involved in the development and application of AI within the defence industry, ensuring that these efforts are conducted in a socially responsible and ethically acceptable manner (Raska, 2023).

The aim of this study is to examine the challenges and opportunities associated with the application of 4IR technologies in Serbia's defence industry through an analysis of the experiences, models, and practices of the world's most developed countries. This will identify the factors influencing the country's readiness to adopt new technologies, as well as provide recommendations for increasing investment in research and development (R&D) and establishing strategies that will facilitate the transition to 4IR.

The study employs the definition of innovation provided by the OECD (2005), which describes it as the implementation of a new or significantly improved product (good or service), process, new marketing methods, or new organisational methods in business practices and workplace organisation. From the perspective of the defence industry, Cheung et al. (2011) define innovation as the "transformation of ideas and knowledge into new or improved products, processes, and services for military and dual-use purposes" achieved through collaboration with the "civil-military science, technology, and industrial base" and their application to other problems or domains. Similarly, Wilkinson and Jewell (2017) describe innovations in defence as a means of "deriving value from the exploitation of novelty."

2. LITERATURE REVIEW

Innovations in the defence sector are a crucial factor for maintaining competitive advantage at the global level, with the United States emerging as a leading force in this area. According to the SIPRI database for 2022, **the United States** has the highest number of companies (42)

from the defence industry ranked in the Top 100 within this sector. American companies involved in weapon manufacturing and defence services recorded revenues of approximately 300 billion dollars, accounting for 51% of the total revenues of the top 100 companies. Notably, the top five companies based in the United States generate 32% of the total revenue among the Top 100 (SIPRI, 2022). The success of these U.S. companies is rooted in the integration of the commercial industrial base with the development of the nation's defence capabilities, a relationship acknowledged by the U.S. Department of Defense (DoD) as early as the mid-20th century. This initiative, known as the First Offset Strategy, emerged from the need for accelerated development of defence technologies and strategies in proportion to the economic growth of the U.S. industry. The Second Offset Strategy, developed in the 1970s, spearheaded advancements in precision-guided munitions, the use of stealth technology, and systems for intelligence, surveillance, and reconnaissance (ISR). In 2014, the United States developed the Third Offset Strategy (TOS) as part of the "Defence Innovation Initiative" to monitor advancements in 4IR technologies and facilitate faster and more cost-effective development within the defence industry, ultimately aiming to secure a competitive advantage on a global scale (Walton, 2016; Khan et al., 2021). According to Fiott (2016), this strategy has instigated institutional and structural changes within the DoD, enabling a more effective and cost-efficient utilisation of innovations from the private sector to enhance military capabilities. The implementation process of the TOS in the United States has been driven by the rapid growth and increasing sophistication of the armed forces of China, Russia, and Iran. To monitor the technological advancements of these competitors, the U.S. allocated 3.6 billion dollars for R&D under this strategy in 2017 (Mehta, 2016). By 2024, this amount is projected to reach 100 billion dollars, designated for the U.S. Army Engineer Research and Development Center (ERDC). In 2024, total U.S. expenditures for R&D are projected to amount to 203 billion dollars, with 48.7% allocated for national defence and 51.3% for the civilian sector (Pece, 2024). Knox (2020) finds that DoD is firmly integrated into the national innovation system of the United States, maintaining particularly close relationships with academic research institutions such as Stanford University, the University of California-Berkeley, Carnegie Mellon University and the Massachusetts Institute of Technology. Additionally, it has established and developed partnerships with leading companies in the defence industry, including Raytheon, Boeing, and Lockheed Martin. Knox also highlights that major technology companies in the commercial sector in the U.S. (such as Alphabet, Google, Apple, Amazon, and IBM) are assuming a leading role in R&D compared to defence sector companies, particularly in the fields of AI, 5G, and ML. These changes have resulted in the Pentagon becoming a net consumer of next-generation commercial technologies, rather than the traditional net producer. In other words, DoD is leveraging technologies developed for the civilian market for warfare purposes. This channel, referred to by Stowsky (2005) as "spin-on," is defined as the diffusion of technology from the civilian to the defence sector. Additionally, dozens of innovation entities have been established in the U.S. that form part of the national innovation base for national security purposes. Among the prominent organizations are the Defense Advanced Research Projects Agency (DARPA), the Defense Innovation Unit, the Defense Innovation Board, the Strategic Capabilities Office, Army Futures Command, and NavalX (Naval Expeditions) (Cheung, 2021).

China, alongside the United States, is at the forefront of adopting and implementing AI, although countries such as Russia, Israel, Singapore, and South Korea are also investing heavily in this area as a strategic priority (Horowitz et al., 2022). According to a report by the World Intellectual Property Organization (WIPO, 2021), China has consistently advanced in the Global Innovation Index (GII) rankings since 2013, increasingly approaching the top 10

ranked countries each year. China's performance is notably high, particularly concerning innovation outcomes. The country holds a greater number of patents relative to its GDP than Japan, Germany, and the United States. However, China lags behind the aforementioned economies in the categories of human capital and research, ranking 45th in terms of the number of researchers and 57th regarding the percentage of the population enrolled in some form of higher education. China also falls short of the United States in market and business sophistication, and it is even further behind in the category of institutions, where it ranks 61st. The investment China is making in developing its innovative ecosystem is underscored by data showing that Chinese science and technology clusters (S&T) experienced the largest increase in scientific and technological output in 2021, including scientific publications, patents and inventions, and technological innovations. China boasts the fastest-growing clusters, such as Qingdao (+33.1%) and Suzhou (+21.7%). The highest-ranked Chinese S&T clusters—Shenzhen–Hong Kong–Guangzhou, Beijing, and Shanghai—are among the top ten clusters globally. Furthermore, three Chinese clusters experienced the most significant increases in their rankings: Qingdao (+16 positions), Shenyang (+14), and Dalian (+13) (WIPO, 2021). China's progress in this field is underpinned by a comprehensive Innovation Driven Development (IDD) strategy. This strategy is initiated and led by the Chinese state administration, market-oriented, and globally engaged, yet shaped by technological and national interests. The primary objective of IDD is to support the overall development of the country, with national security and defence as integral components, enabling China to compete for a global leadership position in innovation by 2050. IDD also promotes international scientific and technological cooperation, albeit selectively and under Chinese terms.

An example of this is the Chinese initiative "One Belt, One Road," which aims to connect China with the rest of Eurasia through the construction of infrastructure, trade routes, and economic corridors. This initiative encompasses the establishment of standards, the creation of norms, and the development of international regimes and institutions, particularly in the areas of cybersecurity and 5G technologies (Cheung, 2022). In 2017, China adopted the Next Generation Artificial Intelligence Development Plan, followed by the adoption of the Artificial Intelligence Standardization White Paper in 2018 (Wu et al., 2020).

Unlike the United States and European countries, China has a significant advantage in the integration of the public and private sectors (Metz, 2018), prioritising the development of domestic strategic and key technologies. The current Chinese administration is cultivating the concept of a strategic economy that simultaneously serves both civilian and military needs. The mechanism for achieving this integrated national strategic system is Military-Civil Fusion, where the priorities of the defence sector are aligned with economic objectives. The strategy for the development of military-civil fusion in China was officially approved in 2018, aiming to coordinate national security, economic development, and technological innovation (Cheung, 2022).

According to the results of the NRI for 2023, **Russia** is ranked as the 38th economy, with investment levels for 2022 estimated at only 18.6 million USD (UNCTAD, 2023). Russia's decline on this list is attributed to the absence of current indicators—metrics used to assess economic performance—due to the armed conflict with Ukraine and the economic sanctions imposed by the U.S. and European countries. Russia's potential and strengths in terms of innovation lie in its developed domestic market, the number of utility models (patents, technical innovations, etc.) produced relative to its GDP, and the number of graduates in

natural and technical sciences. Although the Russian innovation ecosystem does not develop as dynamically as those in the U.S. and China, the efforts of the Russian defence industry to enhance the application of AI and robotics for military purposes could have a significant impact on current and future armed conflicts (Horowitz et al., 2022). Unlike the U.S. and China, where the development of AI in the defence sector occurs in collaboration with the commercial sector, in Russia, the driver of technological development is the Ministry of Defence (MoD), which emulates its technological competitors in its innovation management policies. Initial activities in this regard were launched in Russia in 2012 with the establishment of the Advanced Research Foundation (ARF), modelled after DARPA in the U.S. (Bendett, 2018). Subsequently, in 2016, the Russian government adopted the "Strategy for Scientific and Technological Development," aimed at transitioning to advanced digital, intelligent manufacturing technologies, robotic systems, new materials and construction methods, as well as the development of systems for big data processing, machine learning, and AI (Kozyulin, 2019). Finally, Russia has diligently worked on operationalising the goals defined in its Strategy, having established a network of institutions and organisations by 2020 that involve leading Russian research and industrial companies. Among these institutions is the Military Innovative Technopolis ERA, which comprises three clusters: a Research Cluster for laboratory experiments and simulation modelling, an Educational Cluster for military personnel and students, and a Production Cluster for prototype and hardware development.

However, according to Kashin & Raska (2017), a key challenge for Russia in further implementing and developing AI is the sustainable exploitation of limited resources to ensure that innovations find practical application. Notably, in the allocation of budgetary funds, 72% of research and development costs benefit state institutes, which employ around 80% of Russian researchers. This indicates a relatively small share of the private sector in science and research. The share of innovative products in total production is only 8-9%, pointing to cultural barriers regarding the application of new technologies and solutions. Furthermore, investments in intangible assets (patents, software, and research) are 3 to 10 times lower in Russia than in leading countries. Additionally, the share of Russian high-tech products in global exports is only about 0.4%, reflecting Russia's relative technological backwardness.

Based on these factors, it can be concluded that the implementation of AI and advanced 4IR technologies in Russia is under strong state control, which results in challenges regarding the transfer of knowledge and technology between the public and private sectors, complicating the development and use of dual-use technologies for both civilian and military purposes.

Israel and Singapore will be the subject of a comparative analysis due to numerous shared characteristics regarding security, defence and the implementation of AI. These countries are characterised by a relatively small population, territories lacking strategic depth situated amidst potential adversaries, reliance on technologically advanced and modern armies, and a national security concept where all citizens are engaged in defence (Bitzinger, 2021).

According to the NRI 2023, Singapore's economy is ranked 8th, while Israel ranks 12th globally. As noted by Horowitz et al. (2022), countries like Israel and Singapore, which are capital-intensive with developed technological sectors, can gain strategic advantages on a global scale through the implementation and development of AI systems. On the NRI list, Israel excels in indicators related to knowledge and technology, human capital, R&D, and the sophistication of its market and business environment. When considering indicators such as global corporate investment in R&D, received venture capital funding, the quality of

universities, the quality and impact of scientific publications (H-index), and the number of patents by origin, Israel and Singapore rank third. However, in terms of R&D expenditures, Israel and Singapore are at the top. Rubin (2017) notes that Israel invests heavily in AI for both military and commercial purposes, and as a capital-rich country with a relatively small population, it has the potential to disproportionately benefit from 4IR technologies. Israel allocates approximately 4% of its GDP for R&D, which attracts investments and creates conditions for technology transfer from foreign high-tech companies. Additionally, Israel has tailored its national educational policy to support the implementation of high technologies, emphasising the so-called STEM model of education. This refers to an interdisciplinary approach that integrates education in the fields of Science, Technology, Engineering, and Mathematics. The success of this educational model in Israel is evident in the fact that approximately one-third of all degrees awarded at higher education institutions are in the fields of science and engineering (Bitzinger, 2021). The defence industry in Israel serves as a center for national military innovation and is responsible for supplying the armed forces (the Israel Defense Forces - IDF). Parts of the domestic defence industry are state-owned, while private Israeli defence companies are considered an integral part of the national defence system. The Israeli government has established the Directorate for Weapon Development and Technological Infrastructure within the MoD, which coordinates R&D between the IDF and various defence industries (Dyduch & Olszewska, 2018). As a result, the Israeli defence industry (including Israel Aerospace Industries, Rafael Advanced Defense Systems and Elbit Systems Ltd.) has begun transforming into a sector of specialized production. This strategy has allowed it to focus on several specialized areas where it possesses unique core competencies in narrowly focused manufacturing (Owen, 2010). The change in the business model has enabled approximately three-quarters of Israeli military production to be realised abroad. Between 2016 and 2020, Israel achieved arms sales valued at around 4.14 billion USD internationally, with India accounting for 43% of total sales, Azerbaijan for 17%, and Vietnam for 12% (SIPRI, 2024). Evron (2022) notes that the promotion of the development and expansion of a high-tech, specialized business model in the defence sector over the past 30 years has contributed to the explosive growth of Israel's commercial high-tech sector. In this way, Israel has built one of the most advanced S&T sectors in the world and attracted significant foreign direct investment from high-tech commercial companies like IBM and Intel, which are involved in the development and production of next-generation computer chips (Shamah, 2015).

At the same time, Singapore leads Southeast Asia in investments in AI, leveraging its role as a technological hub to attract investments (Chitturu et al., 2017). In this regard, the Singaporean government is dedicated to modernising the country by creating a high-tech society, where, similar to Israel, significant attention is given to the STEM education model (Wong, 2003). Singapore has excelled in the domestic development and production of small-caliber weapons, artillery systems, light armored vehicles, and certain classes of naval vessels. Like Israel, Singapore has adopted a business model focused on core competencies and narrow specialization within its domestic defence industry. The decision to concentrate on weapon production in areas where it holds specific key advantages has created opportunities for greater export potential and the establishment of foreign partnerships for further enhancement of production processes. The Defence Science and Technology Agency is responsible for innovations in Singapore, where the defence industry is primarily concentrated in a single company, Technologies Engineering (STEngg). Additionally, the Singaporean government supports several high-tech incubators, including the Agency for Science, Technology and Research (A*STAR) and Fusionopolis. Their role is to develop key areas where Singapore

has expertise, such as advanced electronics and signal processing, information systems security, advanced guidance systems, communications, electronic warfare, unmanned vehicles, and cryptography (Bitzinger, 2021). Essentially, the Singaporean defence ecosystem promotes an evolutionary approach to innovation, which involves gradual and continuous improvements of existing technologies, systems, or processes rather than sudden or revolutionary changes. Instead of completely replacing or discarding current components, evolutionary innovation focuses on enhancing and upgrading them to achieve better performance, efficiency, or functionality.

3. METHODOLOGY

In order to verify the established hypotheses, the research will employ a combination of quantitative and qualitative methods. This methodology encompasses the following steps:

The collection and analysis of existing data and content regarding digital transformation, investments in research and development, and qualified workforce in Serbia and other countries will be conducted through an analysis of the 2023 Network Readiness Index report (Dutta & Lanvin, 2023). This report evaluates and ranks 134 global economies based on their readiness to harness the benefits of the digital revolution, through four key pillars: Technology, People, Governance, and Impact. The most successful economies according to the NRI demonstrate excellence in all aspects of digital readiness, meaning they possess modern technological infrastructure, a highly skilled and adaptable workforce, efficient management structures capable of overseeing digital transformations, as well as the ability to leverage digital technologies for positive social impacts.

The analysis of Serbia's position has been conducted according to the NRI in relation to leaders in the field of digitalization. This analysis provides insight into Serbia's current status and allows for comparisons with best practices. The data analysis and implementation of machine learning models, particularly K-means cluster analysis, were carried out using tools such as Python and RapidMiner Studio. Cluster analysis is a quantitative form of classification that helps develop decision rules, which are then used to assign a heterogeneous collection of objects to a series of sets. This methodology is primarily applied rather than theoretical. The final result of cluster analysis is a graphical display of classifications and a set of decision rules for assigning new members to these classifications (Gad & Rousseaux, 2002).

Formulating concrete recommendations for improving strategies and policies that would facilitate the adoption of 4IR in Serbia and the development of the defense industry is a key objective of this research.

The following hypotheses will be used in the study:

- Hypothesis 1: Serbia faces significant barriers in the digital transformation process that hinder the adoption of 4IR technologies in the defense industry.
- Hypothesis 2: K-means cluster analysis is an effective tool for gaining a deeper understanding of Serbia's position in the adoption of 4IR technologies, as it highlights key gaps and opportunities for improvement in comparison to other countries.
- Hypothesis 3: Establishing strong national strategies can significantly enhance Serbia's competitive advantage in the defense industry through the adoption of advanced technologies.

4. RESULTS AND DISCUSSION

According to the NRI, Serbia is ranked 55th and falls into the category of medium-developed countries. The weakest results for Serbia are recorded in the technological pillars related to the adoption of critical technologies, investment in critical technologies, expenditures on computer software, and a low number of scientific publications in the field of AI. In terms of human resources, Serbia ranks 58th, facing challenges such as insufficient investments in R&D by companies, a low number of ICT graduates, and a low percentage of budget allocations to support the business sector and promote investment in critical technologies by the government. This situation has a negative impact on the country's innovation and market competitiveness. There is also a noticeable lag in regulating critical technologies, the gig economy, and ensuring standards, among other areas. K-means cluster analysis was conducted using Python and RapidMiner Studio to identify similarities and differences between countries based on their GDP per capita and NRI. In this specific case, this method allows for the segmentation of countries into different clusters, providing deeper insights into their performance and challenges in adopting 4IR technologies. By using this machine learning method, it is possible to identify specific groups of countries facing similar issues, enabling the creation of targeted strategies for informed decision-making and development policies that will support innovation and competitiveness.

This process involved data cleaning, removal of missing values, and data normalization (using StandardScaler) to ensure accuracy and relevance, focusing on key characteristics that influence countries' digital readiness. The number of clusters was manipulated within a range of 2 to 10 to identify the optimal number of clusters, which, in our case, was determined to be 5. Establishing the optimal number of clusters allows for the grouping of countries based on their performance and characteristics. For this purpose, the Elbow and Silhouette techniques were employed. The Elbow method visualizes the within-cluster sum of squares (WCSS) in relation to the number of clusters, while the Silhouette method assesses how well-defined the clusters are. The results of these techniques, illustrated in Figure 1, provided clear indications that 5 clusters are optimal, facilitating a better understanding of Serbia's position in the context of global trends and challenges in adopting critical technologies.

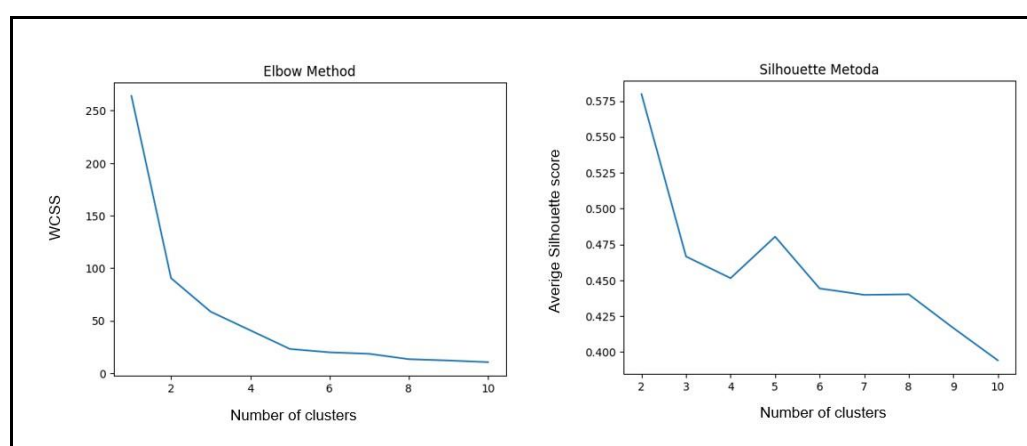


Figure 1. *The comparative review of the results from the Elbow and Silhouette methods in determining the optimal number of clusters*

Source: Author

After determining that the optimal number of clusters is $k=5$, we proceeded to analyze the data on GDP per capita and NRI results. The findings were visualized using a scatter plot, where Serbia and the selected countries are marked in different colors, as shown in Figure 2.

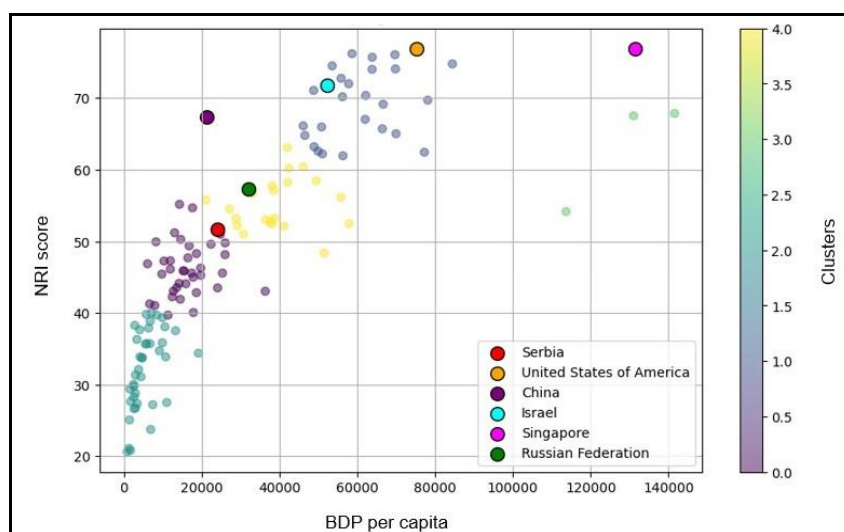


Figure 2. Results of the cluster analysis, $k=5$
Source: Author.

The results of the cluster analysis provide insight into how Serbia positions itself relative to other countries based on economic indicators. Additionally, the distance of Serbia from the analyzed countries was calculated using the "pairwise_distances" function, which is part of the "sklearn.metrics" library in Python. This function calculates the distance between each point in one set and every point in another set, resulting in a distance matrix where each element d_{ij} represents the distance between the i -th point in Serbia's set and the j -th point in the set of other countries. The metric used to calculate the distances was the Euclidean distance. According to the results obtained, Serbia lags most behind China (4.1778), followed by the USA (2.5007), while it is closest to Russia (0.4731). The continuation of the clustering analysis allows for deeper segmentation by filtering data related to the EU to determine Serbia's relative position within this grouping, given the evident significant lag behind global leaders. To make informed decisions and develop strategies for the digitalization of the industry based on the data, further research focused exclusively on the technological pillar and its sub-pillars within the NRI. In this part of the analysis, a comparison was made between Serbia's technological performance and the average values of different clusters, as well as the identification of differences in relation to the best performers within and above the cluster to which Serbia belongs. According to the values of the technological pillars, the top performers in the EU are the Netherlands (71.59), Germany (69.45), and Sweden (67.21), while Serbia falls into the fourth cluster with a score of 36.94. The EU economies that are in the same cluster as Serbia, based on the examined parameters, include Latvia (44.53), Romania (42.76), Bulgaria (42.69), Greece (40.87) and Croatia (38.8). Let's provide mathematical explanations for the results we have obtained from our cluster analysis of technology scores. The K-means clustering algorithm was utilized to group countries based on their technology scores. The algorithm minimizes the within-cluster sum of squares (WCSS), which can be expressed as:

$$WCSS = \sum_{i=1}^k \sum_{x \in C_i} \|x - \mu_i\|^2$$

Where k is the number of clusters, C_i is the i -th cluster, x is a point in the cluster and μ_i is the centroid of cluster.

Serbia's technology score is 36.94. It belongs to cluster 4, which has a mean technology score of 41.93. We can calculate Serbia's deviation from its cluster mean:

$$\text{Deviation} = \text{Cluster Mean} - \text{Serbia's Score}$$

$$\text{Deviation} = 41.93 - 36.94 = 4.99.$$

This indicates that Serbia is below the average of its cluster by 4.99 points.

Serbia's position can be expressed as a percentage of the range within its cluster:

$$\text{Relative Position} = \frac{\text{Serbia's Score} - \text{Minimum Cluster Score}}{\text{Maximum Cluster Score} - \text{Minimum Cluster Score}} \times 100\%$$

$$\text{Relative Position} = \frac{36.94 - 38.8}{44.53 - 38.8} \times 100\% \approx -32.3\% .$$

This negative percentage indicates that Serbia is below the lowest score in its cluster.

To reach the next higher cluster, Serbia needs to improve its score by at least 9.32 points. We can express this as a percentage increase:

$$\text{Percentage Increase Needed} = \frac{\text{Gap to Next Cluster}}{\text{Serbia's Current Score}} \times 100\%$$

$$\text{Percentage Increase Needed} = \frac{9.32}{36.94} \times 100\% \approx 25.2\% .$$

These mathematical analyses provide a quantitative basis for recommendations on digitization of industry in Serbia. Serbia should aim to increase its technology score by at least 25.2% to reach the next cluster. The first step for Serbia's technological progress is to reduce the gap of 7.59 points to Latvia, which is the leader in the cluster. Serbia needs an improvement of 9.32 points or a jump in technological development of approximately 25% to move to the next higher cluster and surpass regional competitors. By focusing on these quantitative targets, Serbia can develop a data-driven approach to industry digitization, setting clear, measurable goals for technological advancement.

5. CONCLUSIONS AND RECOMMENDATIONS

This analysis confirmed all three hypotheses. Serbia faces significant obstacles in the process of digital transformation that hinder the adoption of 4IR technology in the defense industry. This is indicated by the need to significantly improve its technological score in order to remain competitive. K-means cluster analysis is an effective tool for a deeper understanding of Serbia's position in the adoption of 4IR technologies, as it highlights key gaps and opportunities for improvement in comparison to other countries. Establishing strong national strategies can significantly enhance Serbia's competitive advantage in the defense industry through the adoption of advanced technologies. By setting clear, measurable goals based on the identified quantitative targets, Serbia can effectively drive its technological progress and industry digitization. Concrete measures for enhancing the innovation environment and the

development of the economy and industry in Serbia from the perspective of 4IR in the defense industry are as follows:

- **Increase investments in R&D** to stimulate innovation and the development of new technologies. Greater state investment in the private sector is needed through tax incentives and subsidies, similar to the example of Israel, along with the encouragement of start-up companies in the ICT sector. China's experience in creating a favorable environment for start-ups through incubators and accelerators, as well as the experiences of the USA and Israel in attracting venture capital investments, are valuable.
- **Develop a legal framework** that will support the adoption of 4IR technologies, which includes the standardization of procedures, protection of intellectual property, and security protocols.
- **Introduce new educational programs and courses at universities** that will train students to work with advanced technologies according to the STEM model applied in Israel and Singapore. Additionally, continuous training of the existing workforce is necessary for mastering new technologies.
- **Encourage collaboration between the public sector, academic institutions, and private companies** through public-private partnerships to facilitate the exchange of knowledge and resources. Analysis has shown that China's progress in AI development is based on strong ties with educational institutions, which is why it is a global leader in scientific and technological output.
- **Continue developing a secure and functional digital infrastructure** that can support the integration of complex AI systems and ensure seamless data flow in real time.
- **Actively participate in international projects and initiatives** to exchange knowledge and technologies in a way that does not compromise the country's sovereignty and avoids creating a digital colony of technologically superior states.
- **Specialize production in segments where Serbia's defense industry has competencies** to efficiently utilize existing resources and knowledge while reducing risks and costs associated with the introduction of entirely new technologies or systems, employing modern business models.

REFERENCES

- Bendett, S. (2018). In AI, Russia is hustling to catch up. *Defense One*, 4(6), 1-3.
- Bitzinger, R.A. (2021). Military-technological innovation in small states: The cases of Israel and Singapore. *Journal of strategic studies*, 44(6), 873-900.
- Cheung, T.M., Mahnken, T.G. & Ross, A.L. (2011). Frameworks for analyzing Chinese defense and military innovation. *SITC, Policy Brief No. 27*.
- Cheung, T.M. (2021). A conceptual framework of defence innovation. *Journal of Strategic Studies*, 44(6), 775-801.
- Cheung, T.M. (2022). The Rise of the Chinese Techno-Security State and its Strategic Implications. In: Proceedings of 22nd International Symposium on Security Affairs „Technological Innovation and Security: The Impact on the Strategic Environment in East Asia“ (pp. 49-59). Tokyo, Japan: The National Institute for Defense Studies.
- Chitturu, S., Lin, D. Y., Sneader, K., Tonby, O., & Woetzel, J. (2017). Artificial intelligence and Southeast Asia's future. *Singapore Summit* (page 12). Singapore : Mckinsey global institute.

- Dian, M. (2014). *The evolution of the US-Japan alliance: The eagle and the chrysanthemum*. Chandos Publishing.
- Dombrowski, U., Richter, T. & Krenkel, P. (2017). Interdependencies of Industrie 4.0 & lean production systems: A use cases analysis. *Procedia Manufacturing*, 11, 1061-1068.
- Dutta S. & Lanvin B. (2023). *Network Readiness Index*. Retrieved from: Trust in a Network Society: A crisis of the digital age? (Accessed: 02.06.2024)
https://download.networkreadinessindex.org/reports/nri_2023.pdf#page=38.06.
- Dyduch, J. & Olszewska, K. (2018). *Israeli innovation policy: An important instrument of perusing political interest at the global stage*. Polish Political Science Yearbook, 2.
- Evron, Y. (2022). 4IR technologies in the Israel Defence Forces: blurring traditional boundaries. In: *Defence Innovation and the 4th Industrial Revolution*, 122-143.
- Fiott, D. (2016). Europe and the Pentagon's third offset strategy. *The RUSI journal*, 161(1), 26-31.
- Gad, S.C. & Rousseaux, C.G. (2002). Use and misuse of statistics in the design and interpretation of studies. In: *Handbook of Toxicologic Pathology* (2nd ed.), Volume 1, 327-418. Academic Press
- Horowitz, M.C., Allen, G.C., Kania, E.B. & Scharre, P. (2022). *Strategic competition in an era of artificial intelligence*. Washington: The Center for a New American Security's.
- Kashin, V. & Raska, M. (2017). *Countering the US third offset strategy: Russian perspectives, responses and challenges*. Policy Report, S. Rajaratnam School of International Studies (RSIS), Nanyang Technological University.
- Khan, A., Imam, I. & Azam, A. (2021). Role of Artificial Intelligence in Defence Strategy. *Strategic Studies*, 41(1), 19-40.
- Knox, T.J. (2020). *US Military Innovation In The 21st Century: The Era Of The "Spin-On"*. (Doctoral dissertation, University of Pennsylvania).
- Kozyulin, V. (2019). Militarization of AI from a Russian Perspective. Discussion paper in *Nuclear Weapons* (pp. 1-9), Stanley Center for Peace and Security. Retrieved from: <https://stanleycenter.org>.
- Mehta, A. (2016). Defense Department Budget: \$18 B Over FYDP for Third Offset. Article published in *Defense News* (February, 9th 2016). Available at: <https://www.defencenews.com>
- Metz, C. (2018). *Pentagon Wants Silicon Valley's Help on AI*. Retrieved from: <https://www.nytimes.com/2018/03/15/technology/military-artificial-intelligence.html>. (Accessed 15.03.2024)
- OECD. (2005). *Guidelines for collecting and interpreting innovation data, Third edition*. Paris: OECD publications.
- Owen, W.F. (2010). Punching above its weight - Israel's defence industry. *Defence Review Asia*, 4(3).
- Pece, C. V. (2024). *Federal R&D Funding, by Budget Function: FYs 2022–24*. National Center for Science and Engineering Statistics.
- Raska, M. & Bitzinger, R.A. (2023). *The AI Wave in Defence Innovation: Assessing Military Artificial Intelligence Strategies, Capabilities, and Trajectories*. NY: Routledge.
- Rubin, E. (2017). *Tiny IDF Unit Is Brains Behind Israeli Army Artificial Intelligence*. Retrieved from <https://www.haaretz.com>: <https://www.haaretz.com/israel-news/2017-08-15/ty-article/tiny-idf-unit-is-brains-behind-israeli-army-artificial-intelligence/0000017f-e35b-d7b2-a77f-e35fc8f40000>. Accessed: 19.07.2024.
- Shamah, D. (2015). *How Intel Came to Be Israel's Best Tech Friend*. Retrieved from: <https://www.timesofisrael.com/how-intel-came-to-be-israels-best-tech-friend/>. (Accessed: 23.04.2024).

- SIPRI (2022). *The SIPRI Top 100 arms-producing and military services companies in the world, 2022*. Solna, Sweden: SIPRI.
- SIPRI (2024). *Global military spending surges amid war, rising tensions and insecurity*. Article published by SIPRI, on April 22nd, 2024. <https://www.sipri.org/media/press-release/2024/global-military-spending-surges-amid-war-rising-tensions-and-insecurity>. Accessed 18.06.2024.
- Statista (2024). *Gross domestic product (GDP) at current prices in China from 1985. to 2023. with forecasts until 2029*. Retrieved from: <https://www.statista.com/statistics/263770/gross-domestic-product-gdp-of-china/>. Accessed: 17.04.2024.
- Stowsky, J. (2005). From Spin-Off to Spin-On: Redefining the Military's Role in Technology Development. *UC Berkeley Recent Work*. Available at: <https://escholarship.org/uc/item/0tf8v3c7>
- UNCTAD (2023). *World Investment Report*. Retrieved from: <https://unctad.org/publication/world-investment-report-2023>. Accessed: 02.05.2024.
- Walton, T. (2016). Securing the Third Offset Strategy. *Joint Force Quarterly*, 82, 6-15.
- Wilkinson, M. & Jewell, S. (2017). *UK Defence Innovation—Design and implementation of a system to realise value through exploitation of novelty*. London: Niteworks White Paper.
- WIPO. (2021). *Global Innovation Index 2021: Tracking Innovation through the COVID-19 Crisis*. Geneva: World Intellectual Property Organization.
- Wong, P. K. (2003). From using to creating technology: the evolution of Singapore's national innovation system and the changing role of public policy. In: *Competitiveness, FDI and technological activity in East Asia*. Edward Elgar Publishing.
- Wu, F., Lu, C., Zhu, M., Chen, H., Zhu, J., Yu, K., ... & Pan, Y. (2020). Towards a new generation of artificial intelligence in China. *Nature Machine Intelligence*, 2(6), 312-316.

ANALYSIS OF THE IMPACT OF INNOVATION ON EXPORT PERFORMANCE: THE CASE OF THE WESTERN BALKAN COUNTRIES

Marija Stojmenović*

Faculty of Economics, University of Kragujevac, marijastojmenovic91@gmail.com,
ORCID number 0009-0001-5556-0924

Abstract: *In order to improve the competitive position and export performance, and consequently, survival on the domestic and foreign markets, the Western Balkan countries have recognised the generators of success in innovation. The aim of this research is to identify the impact of innovation on the export performance of the Western Balkan countries (Republic of Serbia, North Macedonia, Albania, Montenegro and Bosnia and Herzegovina). Consequently, regression and correlation analysis were used to analyse the correlation and conditioning of export performance (export of medium-tech and high-tech products and export of knowledge-based services) and innovation (summary innovation score) of the Western Balkan countries, for the period from 2016 to 2023. Data from the European Innovation Scoreboard were used in the analysis. The results of the research showed that innovation does not affect the export of medium-tech and high-tech products of the Western Balkan countries, considering that the observed countries belong to the group of emerging innovators and that a small number of economic entities innovate, but that there is a strong influence on the export of knowledge-based services in the observed countries. Such a result is an indicator that ICT sector is a rapidly developing sector in most Western Balkan countries and has significant potential to increase value added and exports of service across the region.*

Keywords: *Innovation, Export performance, Export of medium-tech and high-tech products, Export of knowledge-based services, The Western Balkan countries*

JEL Classification: *O30, F10*

* Corresponding author

1. INTRODUCTION

The implementation of innovation, especially in technology-intensive sectors, affects the creation of a high-tech society, as well as the increase in the export of high-tech products and services based on knowledge, which indicates the future development of the economy and society as a whole. Modern economies depend more and more on knowledge, information and specific knowledge-based skills, which affects the increase in the production of medium-tech and high-tech products and the provision of knowledge-based services (Dajić, 2017, p. 56). Innovation in technology-intensive products and services based on knowledge represent an important determinant of the competitiveness of an economy, primarily its export competitiveness. The most developed countries of the European Union have recognized the importance of innovation in technology-intensive products and services based on knowledge, and accordingly, they make large investments in this sectors. In economic theory, significant attention is paid to innovation because the difference in the degree of innovation determines the level of development and the possibility of future growth (Romer, 1990; Grossman & Helpman, 1991; Aghion and Howitt, 1992; Schumpeter, 1912; King & Levine, 1993; Ulku, 2004; Aghion et al., 2005) and development of economic entities, the economy and society as a whole. Businesses in which a large number of innovation-oriented business entities operate that effectively realise their innovative ideas, which through the production of products of high-tech and medium-tech innovation, which through the provision of innovative services, can be the source and can ensure increased competitiveness, economic growth, export growth, high value-added creation, high employment and the creation of well-paying jobs, and income population and to create conditions for future sustainable growth and development (Nikolić, 2014, p. 1; Bajić, 2020, p. 213), both in developed countries and in countries in different stage of development (Savanović et al., 2019, p. 125) However, industries that depend on highly sophisticated technologies and business entities engaged in international competition are particularly vulnerable due to the need for constant and rapid modification of the characteristics of their products and the way they operate (Gligović, 2009, p. 130). Today, innovation are considered a key source of competitiveness, but also of lagging behind in the level of achieved economic performance of developing countries (Beraha, 2019, p. 149).

The subject of research in this work is innovation, i.e. the impact of innovation on the export performance of the Western Balkan countries (Republic of Serbia, Montenegro, North Macedonia, Bosnia and Herzegovina and Albania). The aim of this paper is to identify, based on the results and findings obtained from the research, the impact of the summary innovation score of the country on the export of medium-tech and high-tech products, that is, on the export of knowledge-based services. The main hypothesis that arose from the research objective is: the summary innovation score has a statistically positive impact on the export of medium-tech and high-tech products, as well as on the export of knowledge-based services.

2. LITERATURE REVIEW

Innovation is a term that has become an everyday thing in the 21st century. In the last twenty years, the interest of economists and the professional public in researching the phenomenon of innovation and innovativeness has grown rapidly (Cvetanović & Novaković, 2014, p. 13). Innovativeness is the subject of research in numerous and diverse literature. In the theory and practice of innovation management, there is no clear and generally accepted meaning of the term "innovation", although there are a large number of definitions that explain it, depending on the subject of research (Nikolić, 2014, p. 5). Dajić (2017, p. 56) states that innovation can

be considered as a special type of positive change, which is based on the process of applying new ideas in order to achieve better results, either at the level of economic entities or at the level of the economy as a whole.

Innovation in the form of new products, services, processes influence the creation and development of a high-tech society. The relationship between innovation and high-tech society is complex and interdependent. Innovation change and build high-tech society, and high-tech society in turn influences and encourages economic entities to innovate. It is high-tech products, based on knowledge and modern achievements, that have become a prerequisite for long-term economic development, where the compatibility of the economic and export structure is an important prerequisite for successful competition on the market (Jovetić & Stanišić, 2009, p. 1). In a high-tech society, a significant place is occupied by those business entities that are oriented towards the development and application of innovation, that is, the high-tech and medium-tech sectors that represent the backbone of that society. With increasing globalization and more intense international and domestic competition, innovation are advocated to improve export competitiveness (Dong et al., 2022, p. 1). The empirical literature on the impact of innovation on export performance support this view (Ayllon & Radicic, 2019; Cassiman & Golovko, 2011; Silva et al., 2017; Azar & Ciabuschi, 2017). An important determinant of a high-tech society is the export of medium-tech and high-tech products, that is, the export of knowledge-based services. The creation, dissemination and application of knowledge and innovation influence the growth of export of high-tech products, as well as the provision of knowledge-based services. Increasing export primarily means encouraging innovation and productivity of business entities (Ivanović-Đukić & Lazić, 2014, p. 50). In order to survive, business entities must build a strong competitive advantage based of lower production costs (resulting in a lower selling price than competing products) and differentiated, high-quality products that will have greater value for customers than competing products (Lazić, 2013, p. 72), which ultimately affect the export performance of an economy. Innovation is a key capability that can foster a sustainable competitive advantage. Also, innovation can explain heterogeneity in export performance of the firm (Ortiguera-Sanchez et al., 2022, p. 1).

3. METHODOLOGY

The model examines the relationship between the dependant and independent variables. The independent variable is the summary innovation score of the country, while the dependant variables are the export of medium-tech and high-tech products, measured as the share of the export of such products in the country's total merchandise export, and the export of knowledge-based services as the share of the total export of services. Regression and correlation analysis will be used to test the hypothesis. Regression will be used to test the hypothesis, because as an econometric technique it includes temporal and spatial components of the data. The following regression equations will be used in the research:

$$SII_t = \beta_1 + \beta_2 MHTEXP_t + \varepsilon_t \quad (1)$$

$$SII_t = \beta_1 + \beta_2 EXPSER_t + \varepsilon_t \quad (2)$$

where is:

$MHTEXP_t$ - export of medium-tech and high-tech products (percentage share of export in total merchandise export),

$EXPSEr_t$ - export of knowledge-based services (percentage share of export of services in total export of services),

SII_t - summary innovation score and

ε_t - standard error.

The research covers the period from 2016 to 2023. Data on the summary innovation score, export of medium tech and high-tech products and knowledge-based services are taken from the European Innovation Scoreboard (EIS), on the basis of which the European Commission conducts a comparative assessment of the research and innovation performance of EU member states and groups of selected non-EU countries, and which provides an overview of the relative strengths and weaknesses of research and innovation systems. It helps countries to identify areas where efforts need to be concentrated, all with the aim of improving their innovation performance. Statistical data processing was performed in the statistical package for social sciences, IBM SPSS Statistics Version 20.

4. RESULTS AND DISCUSSION

Figure 1, Figure 2 and Figure 3, show the value trends of the observed variables: export of medium-tech and high-tech products, summary innovation score of the country and export of knowledge-based services for the Western Balkan countries, for the period from 2016 to 2023 (compared to the EU average in 2016).

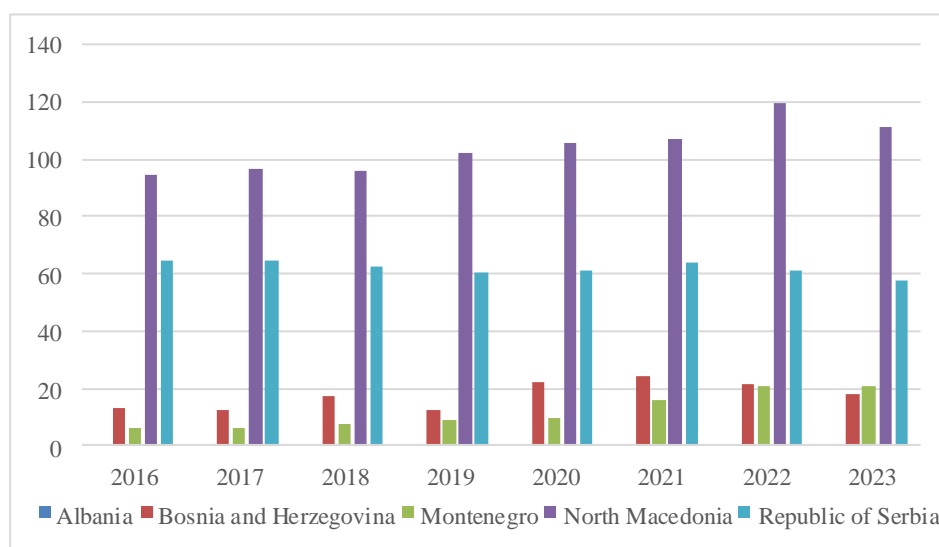


Figure 1. *Export of medium-tech and high-tech products for the Western Balkan countries for the period from 2016 to 2023.*

Source: European Commission (2023). European Innovation Scoreboard 2023. Retrieved on August 20, 2024, from: https://research-and-innovation.ec.europa.eu/statistics/performance-indicators/european-innovation-scoreboard_en

Among the group of the Western Balkan countries, the highest export value of medium-tech and high-tech products in the total merchandise export, in 2023, was achieved by North Macedonia (111.03% of the export value), while the lowest value of the export of medium-tech and high-tech products in total merchandise exports, is achieved by Bosnia and Herzegovina (17.90% of the export value). The Republic of Serbia experienced a decline in the value of exports of medium-tech and high-tech products in total merchandise exports,

from 64.39% in 2016 to 57.79% in 2023. North Macedonia achieved an increase in the value of exports of medium-tech and high-tech products in total merchandise exports, from 94.62% in 2016 to 111.03% in 2023. Bosnia and Herzegovina achieved an increase in the value of exports of medium-tech and high-tech products in the total merchandise exports, from 13.36% in 2016 to 17.90% in 2023. Montenegro achieved an increase in the value of exports of medium-tech and high-tech products in the total merchandise exports, from 6.10% in 2016 to 21.00% in 2023. Of the observed countries, only the Republic of Serbia achieved a decrease in the value of the export of medium-tech and high-tech products in the total merchandise export, a decrease of 6.60%, while the largest increase was achieved by North Macedonia, an increase of 16.41%. The highest average value (eight-year average) of medium-tech and high-tech export of products, is achieved by North Macedonia (104.02% of total merchandise export), while the lowest value is achieved by Montenegro (12.03% of total merchandise export).

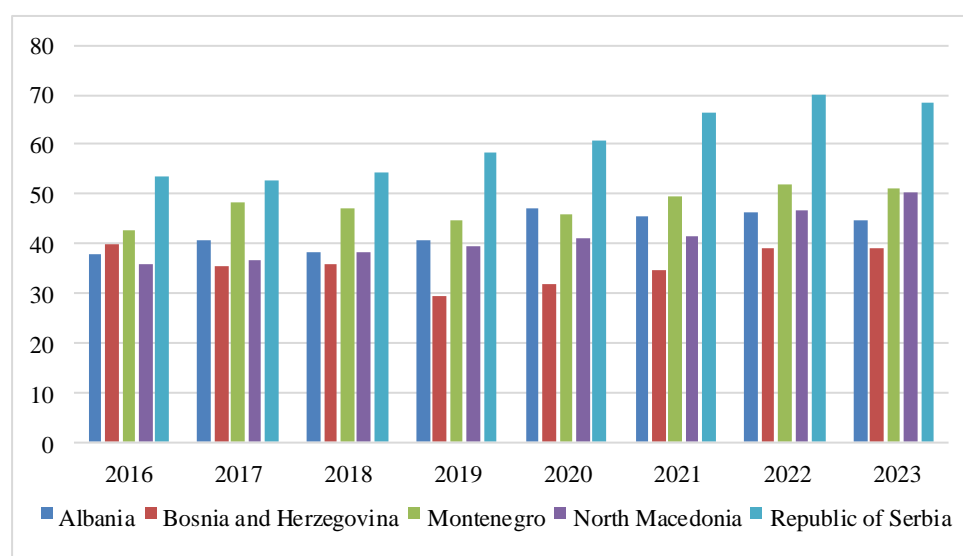


Figure 2. Summary innovation score of the Western Balkan countries for the period from 2016 to 2023.

Source: European Commission (2023). European Innovation Scoreboard 2023. Retrieved on August 20, 2024, from: https://research-and-innovation.ec.europa.eu/statistics/performance-indicators/european-innovation-scoreboard_en

The summary innovation score of the observed economies, in 2023, is the highest in the Republic of Serbia (68.57), while the lowest is in Bosnia and Herzegovina (39.25). The Republic of Serbia achieved an increase in the value of the summary innovation score, from 53.44 in 2016 to 68.57 in 2023. North Macedonia achieved an increase in the value of the summary innovation score, from 35.78 in 2016 to 50.25 in 2023. Albania achieved an increase in the value of the summary innovation score, from 37.96 in 2016 to 44.59 in 2023. Montenegro achieved an increase in the value of the summary innovation score, from 42.62 in 2016 to 51.02 in 2023. Bosnia and Herzegovina achieved a decrease in the value of the summary innovation score, from 39.67 in 2016 to 39.25 in 2023. It can be concluded that of the observed countries, only Bosnia and Herzegovina, achieved a small decrease in the value of the summary innovation score, a decrease of 0.42, while the largest increase was achieved by North Macedonia, an increase of 14.47. According to the values of the summary innovation score, the Western Balkan countries belong to the group of emerging innovators. The highest average value (eight-year average) of the summary innovation score is achieved by the

Republic of Serbia (60.60), while the lowest value is achieved by Bosnia and Herzegovina (35.72).

Based on the data from Figure 3, it can be concluded that in 2023, the highest value of export of knowledge-based services in the total export of services, was achieved by the Republic of Serbia (value of export of knowledge-based services is 67.85%), while the lowest value is achieved by Bosnia and Herzegovina (the value of the export of knowledge-based services is 5.28%). In the observed period from 2016 to 2023, the Republic of Serbia achieved an increase in the value of the export of knowledge-based services in the total export of services, from 46.96% in 2016 to 67.85% in 2023. North Macedonia achieved an increase in the value of the export of knowledge-based services in the total export of services, from 20.28% in 2016 to 50.40% in 2023. Albania achieved an increase in the value of exports of knowledge-based services in the total export of services, from 7.24% in 2016 to 12.58% in 2023. Montenegro achieved an increase in the value of the export of knowledge-based services in the total export of services, from 9.66% in 2016 to 18.66% in 2023. Bosnia and Herzegovina achieved an increase in the value of the export of knowledge-based services in the total export of services, from 0.00% in 2016 to 5.28% in 2023. It can be concluded that all the observed countries achieved an increase in the value of the export of knowledge-based services, and North Macedonia achieved the highest growth, an increase of 30.12% in the value of the export of knowledge-based services in the total export of services. The highest average value of the export of knowledge-based services is achieved by the Republic of Serbia (58.62% of the total export of services), while the lowest value is achieved by Bosnia and Herzegovina (3.39% of the total export of services).

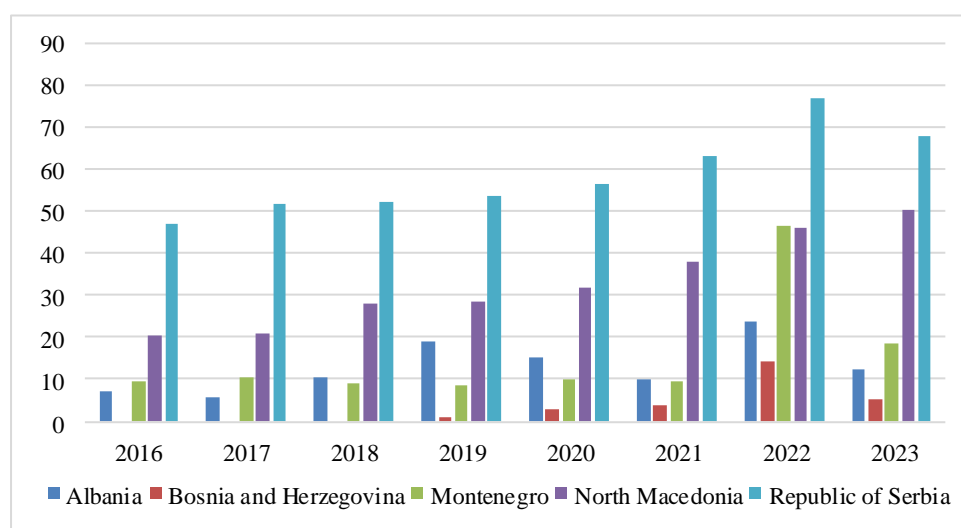


Figure 3. *Export of knowledge-based services to the Western Balkan countries for the period from 2016 to 2023.*

Source: European Commission (2023). European Innovation Scoreboard 2023. Retrieved on August 20, 2024, from: https://research-and-innovation.ec.europa.eu/statistics/performance-indicators/european-innovation-scoreboard_en

The correlation coefficient in the movement of analyzed phenomena for the Western Balkan countries is positive and statistically significant only for the variable export of knowledge-based services (Table 1). The coefficient of determination is 0.039, and indicates that only 3.9% of the variability of the percentage share of medium-tech and high-tech explained by this regression model, i.e. under impact of the summary innovation score. Also, the coefficient

of determination is 0.684, and indicates that 68.4% of the variability of the percentage share of the export of knowledge-based services explained by this regression model, i.e. under impact of the summary innovation score.

Table 1. Parameters of the regression model (dependant variable: export of medium-tech and high-tech products and services based on knowledge for the Western Balkans countries)

Variable	The correlation coefficient	The determination coefficient	Sig.
Export of medium-tech and high-tech products	0.199	0.039	0.219
Export of knowledge-based services	0.827	0.684	0.000

Source: author's calculation

Table 2. Results of correlation analysis for the Western Balkan countries

Variable	Summary Innovation Score	Export of medium-tech and high-tech products	Export of knowledge-based services
Summary innovation score	1	0.199	0.827**
Export of medium-tech and high-tech products	0.199	1	0.626**
Export of knowledge-based services	0.827**	0.626**	1

Source: author's calculation

Table 2 shows the degree of quantitative agreement between the observed variables for the Western Balkan countries. Based on the given data, it can be concluded that the values of the Pearson coefficient are statistically significant at the level of 0.01, that is, with a probability of 99%. The value of the coefficient between the variables summary innovation score and medium-tech and high-tech export is 0.199, and there is no correlation, that is, the summary innovation score does not affect medium-tech and high-tech export. The value of the coefficient between the variables summary innovation score and export of knowledge-based services is 0.827**, so it can be concluded that there is a strong correlation and that the summary innovation score affects the export of knowledge-based services on knowledge. A moderate correlation occurs between the variables high-tech and medium-tech export and export of knowledge-based services and amounts to 0.626**.

Table 3. Results of regression analysis (dependant variable: export of medium-tech and high-tech products)

Variable	B	Sig.
Summary innovation score	0.199	0.219

Source: author's calculation

Table 4. Results of regression analysis (dependant variable: export of knowledge-based services)

Variable	B	Sig.
Summary innovation score	0.827	0.000

Source: author's calculation

Based on the regression analysis, the variable summary innovation score is 0.199, on the basis of which it can be concluded that it does not have a statistically significant impact on medium-tech and high-tech export for the Western Balkan countries. This result indicates that the observed Western Balkan countries invest less the creation of new products, in the innovation of business processes, a large number of personnel are not employed in organisations that innovate, and accordingly, innovation costs per employee are lower. The variable summary innovation score is 0.827, on the basis of which it can be concluded that it has an extremely high impact on the export of knowledge-based services for the Western Balkan countries. Such a result is an indicator that ICT sector is a rapidly developing sector in most Western Balkan countries and has significant potential to increase value added and exports of service across the region.

5. CONCLUSIONS AND RECOMMENDATIONS

The results of the correlation and regression analysis in the observed countries, showed that innovation affects the export of knowledge-based services, but doesn't affect the export of medium-tech and high-tech products. Therefore, the hypothesis from the beginning of this work is partially confirmed. The growth of innovative activity by 1% leads to an increase in the export of knowledge-based services by 0.827% in the Western Balkan countries. The lack of impact of innovation on the high-tech and medium-tech export also stems from the fact that in the Western Balkan countries more investments are made in sectors of low-tech innovation (example: the food production sector, footwear, clothing etc). Also, this counties fall into a group of emerging innovators, because a small number of business entities innovate. The positive impact of innovation on the export of knowledge-based services stems from the fact that the observed countries achieve better results in the sector of knowledge-based services, primarily due to investments in the ICT sector.

Through the analysis of the ratio of innovation and export performance of the Western Balkan countries, this paper aimed to show the impact of the country's summary innovation score on the export of medium-tech and high-tech products, as well as on the export of knowledge-based services. The main contribution of this work is recommendations to the creators of macroeconomic policies of the observed countries to use appropriate measures and strategies to direct greater investments and the implementation of innovation in sectors of medium-tech and high-tech intensity, especially high-tech intensity (investments in the service sector), given that these are the sectors that will form the backbone of the growth and development of developing countries in the future.

REFERENCES

- Aghion, P., Bloom, N., Blundell, R., Griffith, R. & Howitt, P. (2005). Competition and innovation: an inverted U relationship. *Oxford Journals, Quaterly Journal of Economics*, 120(2), 701-728.
- Aghion, P. & Howitt, P. (1992). A model of growth through creative destruction. *Econometrica*, 60(2), 323-351. <https://doi.org/10.2307/2951599>.
- Ayllon, S. & Radicic, D. (2019). Product innovation, process innovation and export propensity: persistence, complementarities and feedback effects in Spanish firms. *Applied Economics*, 51, 3650-3664. <https://doi.org/10.1080/00036846.2019.1584376>

- Azar, G. & Ciabuschi, F. (2017). Organizational innovation, technological innovation, and export performance: The effects of innovation radicalness and extensiveness. *International business review*, 26(2), 324-336.
<https://doi.org/10.1016/j.ibusriv.2016.09.002>
- Bajić, Ž. (2020). Upravljanje inovacijama u funkciji unapređenja poslovanja preduzeća i banaka. *Doktorska disertacija*. Novi Sad: Fakultet za ekonomiju i inženjerski menadžment Univerziteta Privredna Akademija u Novom Sadu.
- Beraha, I. (2019). Ocena inovativnih performansi Republike Srbije. *Ekonomski vidici*, 3-4, 137-151.
- Cassiman, B. & Golovko, E. (2011). Innovation and internationalization through exports. *Journal of International Business Studies*, 42, 56-75.
<https://doi.org/10.1057/jibs.2010.36>
- Cvetanović, S. & Novaković, I. (2014). *Inovativnost i održiva konkurentnost*. Niš: Filozofski fakultet.
- Dajić, M. (2017). Uloga i značaj inovacija u razvoju privrede Srbije. *Ekonomski signali*, 12(1), 55-64. <https://doi.org/10.5937/ekonsig1701055D>
- Dong, G., Kokko, A. & Zhou, H. (2022). Innovation and export performance of emerging market enterprises: The roles of state and foreign ownership in China. *International Business Review*, 31, 1-15. <https://doi.org/10.1016/j.ibusrev.2022.102025>
- European Commission (2023). European Innovation Scoreboard 2023. Retrieved August 20, 2024, from: https://research-and-innovation.ec.europa.eu/statistics/performance-indicators/european-innovation-scoreboard_en
- Gligović, D. (2009). Inovacije i konkurentna prednost. *Škola biznisa*, 130-135.
- Grossman, G. & Helpman, E. (1991). *Innovation and growth in the global economy*. Cambridge: MIT Press.
- Ivanović-Đukić, M. & Lazić, M. (2014). Podsticanje inovativnosti malih i srednjih preduzeća u Srbiji u funkciji unapređenja konkurentnosti u postkriznom periodu. *Ekonomске teme*, 52(1), 49-62.
- Jovetić, S. & Stanišić, N. (2009). Konvergencija izvoznih struktura evropskih tranzicionih zemalja i zemalja EU15 sa posebnim osvrtom na Srbiju. *Industrija*, 3, 1-19.
- King, R. & Levine, R. (1993). Finance, entrepreneurship and economic growth: theory and evidence. *Journal of Monetary Economics*, 32(3), 513-542.
[https://doi.org/10.1016/0304-3932\(93\)90028](https://doi.org/10.1016/0304-3932(93)90028)
- Lazić, M. (2013). Upravljanje intelektualnom svojinom u funkciji unapređenja uspešnosti poslovanja preduzeća. *Master rad*, Niš: Ekonomski fakultet Univerziteta u Nišu.
- Nikolić, M. (2014). Inovativnost malih i srednjih preduzeća kao factor privrednog razvoja Srbije. *Doktorska disertacija*, Niš: Ekonomski fakultet Univerziteta u Nišu.
- Ortiguera-Sanchez, L.C., Welsh, H.B.D. & Stein, W.S. (2022). Innovation drivers for export performance. *Sustainable Technology and Entrepreneurship*, 1, 1-11.
<https://doi.org/10.1016/j.stae.2022.100013>
- Romer, P. (1990). Endogenous technological change. *Journal of Political Economy*, 98(5), S71-S102.
- Savanović, N., Sokić, M. & Subotić, S. (2019). The development potential of the high-tech industry in Serbia. *BizInfo* 10(2), 125-138. <https://doi.org/10.5937/bizinfo1902125S>
- Silva, G.M., Styles, C. & Lages, L.F. (2017). Breakthrough innovation in international business: The impact of tech-innovation and market-innovation on performance. *International Business Review*, 26, 391-404.
<https://doi.org/10.1016/j.ibusrev.2016.10.001>

- Schumpeter, J.A. (1912). *The theory of the economic development: an inquiry into profits, capital, credit, interest and business cycle*. Cambridge: Harvard Press.
- Ulku, H. (2004). R&D, innovation, and economic growth: an empirical analysis. *International Monetary Fund Working Papers*, 4(185), 2-35.

Appendix

Table 5. *Export of medium-tech and high-tech products for the Western Balkans countries for the period from 2016 to 2023.*

	2016	2017	2018	2019	2020	2021	2022	2023
Albania	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bosnia and Herzegovina	13.36	12.42	17.14	12.42	22.40	24.21	21.54	17.90
Montenegro	6.10	5.98	7.66	8.96	9.87	15.66	21.00	21.00
North Macedonia	94.62	96.57	95.97	101.95	105.29	107.06	119.68	111.03
Republic of Serbia	64.39	64.82	62.30	60.17	60.91	63.95	60.88	57.79

Source: European Commission (2023). European Innovation Scoreboard 2023. Retrieved August 20, 2024, from: https://research-and-innovation.ec.europa.eu/statistics/performance-indicators/european-innovation-scoreboard_en

Table 6. *Summary innovation score for the Western Balkans countries for the period from 2016 to 2023.*

	2016	2017	2018	2019	2020	2021	2022	2023
Albania	37.96	40.58	38.30	40.64	47.08	45.57	46.30	44.59
Bosnia and Herzegovina	39.67	35.53	35.95	29.47	32.01	34.69	39.15	39.25
Montenegro	42.62	48.40	47.08	44.53	46.07	49.71	51.94	51.02
North Macedonia	35.78	36.63	38.16	39.55	40.89	41.43	46.87	50.25
Republic of Serbia	53.44	52.65	54.52	58.53	60.85	66.39	69.83	68.57

Source: European Commission (2023). European Innovation Scoreboard 2023. Retrieved August 20, 2024, from: https://research-and-innovation.ec.europa.eu/statistics/performance-indicators/european-innovation-scoreboard_en

Table 7. *Export of knowledge-based services for the Western Balkans countries for the period from 2016 to 2023.*

	2016	2017	2018	2019	2020	2021	2022	2023
Albania	7.24	5.79	10.34	19.20	15.08	9.92	23.84	12.58
Bosnia and Herzegovina	0.00	0.00	0.00	1.03	2.89	3.67	14.23	5.28
Montenegro	9.66	10.41	9.17	8.47	10.06	9.66	46.55	18.66
North Macedonia	20.28	20.98	27.82	28.70	31.80	38.12	46.00	50.40
Republic of Serbia	46.96	51.74	52.38	53.63	56.60	63.02	76.79	67.85

Source: European Commission (2023). European Innovation Scoreboard 2023. Retrieved August 20, 2024, from: https://research-and-innovation.ec.europa.eu/statistics/performance-indicators/european-innovation-scoreboard_en

SUSTAINABLE FINANCE IN THE BOND MARKET: THE CASE OF GREEN BONDS

Milica Pavlović*

Innovation Centre, University of Niš, PhD student Faculty of Economics Niš,
milapavlovic@yahoo.com, ORCID number 0000-0002-3442-4560

Abstract: *Given the urgency of climate change and the short time frames it becomes necessary that society support a transition toward a greener and more sustainable economy. One way to do so is through green bond market that can play a critical role in attracting a more diversified base of investors and directing capital to finance general climate or environmental projects. Namely, green bonds represent an innovative instruments in the area of sustainable finance whose proceeds are used exclusively to finance or refinance projects that belong to the category of eligible green projects and contribute to environmental objectives such as renewable energy, pollution prevention, climate change mitigation, natural resource and biodiversity conservation, while at the same time green bonds offer several benefits for issuers, socially responsible investors and policymakers. With this in mind, the aim of this paper is to outline the key features of these debt instruments and the guidelines underlying their issuance, as well as to assess the current stage of development in the global green bond market. Research indicates that, despite possible barriers, the global green bond market has steadily grown and diversified over the past decade, highlighting the strong potential of these innovative financial tools for supporting the sustainability transition.*

Keywords: *Sustainable finance, Green bonds, Green projects, Green bond market*

JEL Classification: *G10, G15, F64, Q50*

* Corresponding author

1. INTRODUCTION

In recent years, issues such as global warming, deforestation, climate change, and greenhouse gas emissions have attracted increased public attention worldwide, given that they affect the entire economy, and have led to substantial actions and intensified efforts to reduce the negative impact on climate and environment in general. Fulfilling the goals of the Paris Agreement and European Green Deal, as key global initiatives that address these issues, requires significant public and sector investments. Consequently, one of the main challenges is how to finance the transition to a global low-carbon economy (Teti et al., 2022, p. 1). A new financing approach is necessary, so the concept of sustainable finance is gaining importance. Green or sustainable finance can be seen as a combination of finance and business activities guided by care for the environment (Wang & Zhi, 2016, p. 311).

Green bonds, an important product of sustainable finance, are an innovative type of debt instrument, whereby their proceeds are used to fund solely green projects that meet specific criteria, whether for financing new initiatives or refinancing the existing ones (Shi et al., 2023). They are not only issued to finance projects related to mitigation or adaptation to climate change, but also to finance green investments in other areas that are in line with the sustainability concept, such as investments in renewable energy sources, low-carbon transport, wastewater treatment, green construction, and such (Weber & Saravade, 2019). From the moment when the European Investment Bank issued the first series of bonds in 2007, the purpose of which was to encourage the renewable energy and energy efficiency development, the gradual growth of this market segment began, not only in terms of the total issue amount, but also the expansion of the geographical base, the emergence of different types of green bonds and diversification of environmental projects (Tang & Zhang, 2020, p. 3). The green bond market development provides an opportunity for investors to take an active part in the implementation of eligible green projects and thereby demonstrate their commitment to achieving crucial environmental goals, as well as to mitigating and/or adapting to climate change (Liang, 2023). However, despite the fact that this market is developing rapidly, it is younger and relatively small compared to the overall bond market (Ibrić, Kozarević & Mešković, 2024).

With the above in mind, the paper has carefully designed important segments. Following the introduction, Section 2 presents an overview of the main characteristics of green bonds. Section 3 examines the principles, guidelines and standards that govern the issuance of these financial instruments. Next, the paper reviews the development of the global green bond market to date, with a particular emphasis on the period from 2014 to 2023, and identifies potential obstacles to further market growth and development. The final section offers concluding considerations.

2. CHARACTERISTICS OF GREEN BONDS

Green bonds, which are considered one of the most prominent financial innovations in recent years (Maltais & Nykvist, 2021), like conventional bonds, represent a debt instrument and are used to raise long-term capital with low risk. Typically, bond face value, interest payments and maturity are determined prior to issuance (Dietz & Natrup, 2020, p. 17).

The difference between conventional and green bonds, however, is reflected in the deal structure, reporting and audit requirements, as well as in the allocation of collected funds

(UNEP, 2019). Namely, in contrast to conventional bonds, in case of green bonds, the issuers are obliged to use the raised funds exclusively for financing green projects. Also, these financial instruments include pre- and post-issuance assurance to determine whether the objectives of their issuance have been fully met (Pineiro-Chousa et al., 2021). With regard to the green bond yield, Löfer, Petreski & Stephan (2021) state that it is on average 15-20 basis points lower than the conventional bond yield, but also that green bonds carry a lower risk with considering that their emission requires consistent and transparent reporting on the use of funds, as well as on the project's environmental sustainability.

There is still no single, consistent definition of green bonds in the green finance literature, resulting in definitions varying between different economic sectors and geographic areas (Sobik, 2023). Thus, according to one of the definitions, green bonds are “any type of bond instrument where the proceeds will be exclusively used to finance or re-finance, in part or in full, new and/or existing eligible Green Projects” (ICMA, 2022, p. 3). Eligible categories of green projects refer to renewable energy sources, energy efficiency, pollution control and reduction, clean transportation, adaptation to climate change, ecologically sustainable land use, sustainable water and wastewater management (ICMA, 2022). Adekoya et al. (2021) define green bonds in a similar fashion, stating that they are used to finance green projects in order to achieve green economic goals. In addition to financing appropriate climate and/or environmental projects, green bonds can also help increase FDI aimed at solving environmental issues in developing and emerging economies (Weber & Saravade, 2019, p. 9).

Although there are various definitions that provide a slightly different explanation of green bonds, the most important in all these definitions is the following (Ntsama et al., 2021): a) green bonds are used to finance environmentally beneficial projects; b) green bonds can be issued by companies, governments and international institutions; c) green bonds reflect the environmental standpoints and financial obligations of the issuer.

Categorization of existing types of green bonds can be done keeping in mind the following (Sobik, 2023, p. 293):

- [1] *type of issuer* – (corporate green bonds, supranational green bonds, bonds issued by financial sector, municipal green bonds, governmental green bonds);
- [2] *protecting investors' interests - secured* green bonds (that are backed by collateral to lower the financial risk exposure) and *unsecured* green bonds;
- [3] *emissions certification - “labelled”* green bonds - (issuers are obliged to formally introduce their bonds as „green“ to potential investors) and „unlabelled“ green bonds - (they do not carry a formal “green” label, but are in line with projects that improve environmental protection issues (Chiesa & Barua, 2019)).

The green bond market dynamics have resulted in the emergence of new types of this instrument, where the following four categories are currently the most represented on the market (ICMA, 2022, p. 8): (1) *Standard Green Bonds* (interest and principal payments are guaranteed by the issuer financial results (Weber & Saravade, 2019)), (2) *Green Revenue Bonds* (a non-recourse-to-the-issuer debt obligation alligned with the green bond principles in which the credit exposure in the bond is to the pledged cash flows of the revenue streams, fees, taxes), (3) *Green Project Bonds* (bonds issued for one or several pro-ecological investments, with which the investor is directly exposed to project risk with or without potential recourse to the issuer), and (4) *Green Securitised Bonds* (collateralised by one or

several green projects that generate income (Cortellini & Panetta, 2021)). With further dynamic development of the green bond market, new categories of green bonds may emerge.

Successful issuing of green bonds depends on the reputation, credit rating, and ESG score of the potential issuer (Bužinskè & Stankevičienè, 2023).

With regard to the advantages that issuing green bonds brings to issuers and investors, the literature states that, from the issuer's perspective, green bonds represent a source of potentially cheap capital (with the long-term maturity option). Issuers can also increase the credibility of sustainability strategy, expand the breadth of ownership, the investor base (Tang & Zhang, 2020) and the advantages of economies of scale can be used considering that most of the broadcasting costs are in setting up the processes (Sobik, 2023). However, it should be noted that green bond issuers are required to disclose a wider range of information, and are also exposed to additional certification costs and potential reputational risk if they violate agreed green clauses (Tang & Zhang, 2020, p. 4). From the investors' perspective, green bonds can meet their ESG requirements and consequently improve their ESG score based on investing in pro-environmental financial instruments, and also investors can balance risk-adjusted financial returns with environmental benefits (Sobik, 2023, p. 295). The main disadvantages of issuing green bonds for investors are less liquid market, as well as the lack of unified standards that can cause confusion and create room for greenwashing.

3. GREEN BOND REGULATION

Although green bonds have been gaining increasing significance in the green securities market, no consistent international or national regulations exist to govern their issuance and circulation. With this in mind, and with the goal of protecting investors, various organizations and institutions have made efforts to establish guidelines, recommendations, frameworks, and standards of best practice (Sovilj, 2020).

Globally, the *Green Bond Principles (GBP)*, which were adopted by the International Association of Capital Markets in 2014, are the first internationally recognized and best-known standard for issuing green bonds and represent voluntary process guidelines that recommend transparency and disclosure, but also promote integrity in the development of the Green Bond market by clarifying in detail the issuing process (ICMA, 2022). They were revised during 2018, as well as in June 2021, and are not limited to a particular jurisdiction. The guidelines for issuing a credible green bond are formed based on four main components (ICMA, 2022, pp. 4-6): (1) *Use of Proceeds* (raised funds are used exclusively to finance eligible green projects), (2) *Project Evaluation and Selection* (the issuer should clearly define the purpose of using the collected funds while at the same time clearly identifying the benefits for the environment), (3) *Management of Proceeds* (the funds collected through the issue must be kept in a sub-account and used exclusively for financing green projects) and (4) *Reporting* (information on the use of the collected funds must be available at all times, including which projects are financed). Third-party certification is recommended.

Several guidelines and standards adopted after the emergence of the Green Bond Principles follow them, but they also have own specific characteristics in terms of which green projects should be considered eligible. The *Climate Bonds Standard (CBS)* was created by the Climate Bonds Initiative (CBI) in order to mobilize capital in the fight against climate change (Sovilj, 2020). It functions as a screening tool for investors and governments (IFC, 2017). Based on

the GBP, the Climate Bonds Standard goes a step further by establishing a clear taxonomy of eligible green projects and requires external verification on pre- and post-issuance disclosure to obtain the CBS certification (Cortellini & Panetta, 2021, p. 2).

People's Bank of China has adopted specific guidelines aligned with the GBP and the CBS that define the official requirements for projects that qualify as green, as well as the requirements for managing the collected funds, mandatory quarterly reporting and a taxonomy in the form of *Green Bond Endorsed Project Catalogue* (IFC, 2017). The *ASEAN Green Bonds Standards* are also based on GBP, as a result of the cooperation between the ASEAN Capital Market Forum (ACMF) and the International Capital Market Association (ICMA) and their aim is to provide more specific guidelines on how to apply the principles with respect to the regional differences, as well as a kind of support to investors who are interested in green investments (ACMF, 2019), while not providing a close taxonomy of eligible green areas (Cortellini & Panetta, 2021).

As noted above, the previously mentioned standards and guidelines, though rooted in the Green Bond Principles, lack uniformity, which somewhat reduces market transparency and can discourage both issuers and investors (Hadas-Dyduch et al., 2022). Considering these challenges, which hinder the further development of the green bond market, the European Commission made a proposal in July 2021 for the introduction of the *European Green Bond Standard EU-GBS*. Regulation 2023/2631 (European Green Bond Regulation, (EU) 2023/2631) which entered into force in November 2023 (with the beginning of application from December 2024) presented the EU Green Bond Standard, which relies entirely on the criteria of the EU Taxonomies whose application is voluntary. The compliance of the EU-GBS with the Taxonomy implies that all the funds raised by the European Green Bonds must be allocated to activities that are aligned with the EU Taxonomy for environmentally sustainable economic activities (Council of the European Union, 2023). These are activities that - substantially contribute to at least one of the defined six environmental goals, do not harm the other objectives, respect the minimum safeguards of social protection, comply to the technical screening criteria (European Parliament and of the Council of the European Union, 2020). The standard requires full transparency regarding the allocation of funds raised through bond issuance, as well as that all European Green Bonds must be externally reviewed to ensure compliance with the Regulation.

4. RECENT TRENDS IN THE GLOBAL GREEN BOND MARKET

The appearance of green bonds dates back to 2007, when the European Investment Bank issued the first bond called the *Climate Awareness Bond (CAB)*, whose purpose was to encourage the development of renewable energy and energy efficiency. A year later, the World Bank issued a bond with similar characteristics, which was labeled a green bond. Since then, until 2012, the international green bond market has gone through the initial phase of development, and in 2013, the phase of accelerated development has begun. International agencies and international development banks, such as the World Bank, the African Development Bank and the International Finance Corporation dominated this market until 2013, when, due to the rising liquidity of the market in this period, some multinational corporations in developed countries began to issue green bonds (Sovilj, 2020, p. 137).

While in 2014 the total issuance of green bonds was approximately \$37 billion, in the years that followed, the green bond market grew rapidly, reaching a total issuance of \$587.7 billion

by 2023. This trend of immense growth is shown in Table 1. The expansion of the green bond market after 2015 is a consequence of the Paris Agreement ratification, given that further development of this market segment is necessary to achieve the agreement goals. Since the role of green bonds in financing environmental initiatives has become increasingly important, stock exchanges around the world have launched a dedicated green bond section (first in Norway in 2015) (Jones et al., 2020). During 2017, green bonds also appeared in Islamic countries with the issuance of a green bond called "green Sukuk" (Tang & Zhang, 2020), which contributed to consistent geographic diversification in the issuance of green bonds (Cortellini & Panetta, 2021).

Table 1. *Green bond issuance by region in the period 2014-2023 (in billion USD)*

Region	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Europe	23.4	24.6	29.9	65.5	74.0	126.1	172.8	306.6	250.8	309.6
Asia-Pacific	1.6	4.5	27.9	36.8	51.5	70.0	55.4	149.9	140.1	190.2
North America	7.4	12.8	20.9	49.9	39.7	64.6	62.5	107.9	82.8	64.5
Latin America	0.2	1.1	1.7	4.2	2.7	7.3	10.7	10.7	5.8	4.9
Africa	0.4	0.5	0.3	0.3	0.8	1.0	1.4	0.9	0.5	2.0
Supranational	4.0	2.9	4.6	3.3	4.2	5.4	2.6	17.9	29.6	16.5
Total	37.0	46.4	85.3	160.0	172.9	274.4	305.4	593.9	509.6	587.7

Source: Author based on: Climate Bonds Initiative. (2024). Market data.
<https://www.climatebonds.net/market/data/> (01 November 2024).

Due to tightened macroeconomic conditions, the issuance of green bonds at the global scale in the observed period was reduced only in 2022 and amounted to 509.6 billion dollars, which represents a 14% decrease compared to 2021. This can be seen as a consequence of geopolitical uncertainty, rising interest rates and inflation, which have driven up borrowing costs and negatively affected investors' interest to invest in the green bond market (Ostojčić, 2023, p. 189).

Looking more closely at the composition of the green bond market (Table 1), Europe remains the largest issuance region, accounting for more than half of global issuance (53%), which confirms its position as a driving force in the global market (Ibrić, Kozarević & Mešković, 2024). In Europe, in 2023, a 23% increase in the issuance of bonds was recorded compared to 2022. The Asia-Pacific region is the second most prolific region for the issuance of green bonds, accounting for almost one third of the total volume of issuance (of which 44% comes from China), while North America stands out as the third most important region for the issuance of green bonds. Unlike these regions, the data from Table 1 show that only a few green bonds were issued in Africa and South America in the observed period, and also the amount issued by supranationals was comparatively small until 2021, when accelerated growth was recorded.

In the last three years of the observed period, the corporate sector contributed 57% of the total issue of green bonds (Table 2). This indicates the high use of Corporate Green Bonds by the private sector, but also indicates the popularity of this financial instrument among financial institutions (Sobik, 2023, p. 294). Non-financial corporations contributed 29% of the market share in 2023 considering the volume of their issue of \$172 billion. As can be seen from Table 2, Financial corporates emerged as the second-largest issuer type with a 28% share of aligned green volumes. In this case, Chinese banks especially dominated, with Industrial Bank Co., Bank of China and Industrial and Commercial Bank of China being the three

largest financial corporate issuers (Climate Bonds Initiative, 2024). In addition to the previously mentioned, there are also Government-Backed Entity and Sovereigns as significant issuers on the global green bond market.

Table 2. *The volume of green bond issuance by type of issuers in the period 2014-2023 (in billion USD)*

Issuer Type	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Non-Financial Corporate	11.1	8.4	18.2	34.1	36.2	77.4	83.8	174.6	126.6	172.0
Financial Corporate	5.2	12.5	22.1	37.3	59.0	78.9	74.2	160.6	144.2	163.4
Government-Backed Entity	1.6	5.7	17.6	48.2	37.3	56.6	69.1	91.7	97.6	73.1
Sovereign	0.0	0.0	0.8	10.8	17.6	24.7	37.9	92.2	82.9	119.9
Development Bank	15.6	15.6	22.7	22.3	16.2	28.0	27.6	57.2	46.6	47.7
Local Government	3.6	4.0	3.9	7.4	6.6	8.9	12.8	17.6	11.7	11.5

Source: Author based on: Climate Bonds Initiative. (2024). Market data.
<https://www.climatebonds.net/market/data/> (1 November 2024)

As can be seen from Table 3, *clean energy and energy efficiency projects* are the most represented green projects financed using bond proceeds. Due to the large capital needs arising from the energy transition, green bonds undoubtedly represent the most important source of financing energy investments (Sobik, 2023). Investments in *low-carbon buildings* and *sustainable transport solutions* represent the next most important UoP categories. These three categories (*Energy, Building construction and Transport*) collectively contribute 75% of the green debt volume in 2023. However, this is a drop from their contribution of 77% in 2022 and 80% in 2021. The biggest change occurred in the Building construction category.

Table 3. *Use of proceeds from green bond issuance in the period 2014-2023 (in billion USD)*

Use of proceeds	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Energy	18.3	23.8	33.2	53.0	53.7	87.6	105.4	206.7	166.5	205.7
Building construction	7.7	8.7	18.1	47.5	48.3	82.4	84.2	169.6	126.7	107.7
Transport	4.2	6.0	12.7	23.9	30.7	53.1	67.8	97.9	95.8	126.8
Water resource management	2.9	4.0	10.7	20.0	20.4	25.0	18.4	35.9	35.0	32.5
Waste management	1.2	1.6	4.4	6.1	7.6	10.0	7.9	25.2	24.6	29.8
Land use	1.5	0.6	1.7	5.3	7.3	9.0	15.3	30.4	27.5	37.1
Others	1.2	1.7	4.0	3.7	4.4	6.4	5.3	24.9	31.0	47.2

Source: Author based on: Climate Bonds Initiative. (2024). Market data.
<https://www.climatebonds.net/market/data/> (1 November 2024)

The remaining part of the total collected funds was used for green projects in the sectors of waste and wastewater management, sustainable land use and for category other green projects (industry, information and communication technology solutions, adaptation and resilience).

Even though it is evident that the popularity of green bonds on the market is increasing each year world-wide, in literature, *institutional and market barriers* have been identified as potentially threatening the further bond market development (Banga, 2019, p. 8). Examples of *institutional barriers* include the lack of uniform standards for issuing green bonds and legal risk (Sobik, 2023, p. 299). Also, regulatory uncertainty and political instability in terms of energy and climate policy, as well as the approach of policymakers to financing sustainable development can slow down further development of this market (Więckowska, 2013, p.460). As some authors state, the three most significant *market barriers* are too low a volume of emissions, currency of issuance and high transaction costs (Banga, 2019, p. 9). Insufficient issue volume increases transaction costs and results in low liquidity in the market (Więckowska, 2013). The currency of issuance relies on the issue of currency risk, while the high transaction costs related to the process of green label certification and to published documents during the green project duration in order to demonstrate the appropriate use of funds, in the opinion of some authors, represent the most significant barrier to the further development of this market (Sobik, 2023).

In addition to the aforementioned limiting factors, the literature also highlights the risk of greenwashing. Namely, bearing in mind the fact that projects have different environmental impacts, as well as the fact that there are no unified standards that would include precise criteria and that would enable market participants to assess with certainty whether a specific project is truly green, there may be confusion in the green bond market, which will consequently cause investors to fear greenwashing (Dietz & Natrup, 2020, p. 24). Generally speaking, the term greenwashing refers to the practice of companies making false or exaggerated claims about their environmental activities, by selectively disclosing information or using a misleading narrative (Marquis, Toffel, & Zhou, 2016). Having this in mind, issuers can use the label "green" for their bonds, although they do not meet the prescribed requirements, while some authors also state that green bonds can be used to finance projects that have a smaller negative impact on the environment, but still not represent a viable alternative (Dietz & Natrup, 2020).

5. CONCLUSIONS

Given that the efficient use of natural resources and achieving carbon neutrality are gradually becoming global objectives, the concept of green or sustainable finance is gaining growing significance as a key component of the financial system. Namely, considering that the implementation of climate and environmentally friendly projects requires significant financial investments, green bonds as an important product of sustainable finance represent the most acceptable financial solution (Chamera, 2023) to bridge the investment gaps. These innovative financial instruments are important for *investors* who are thus encouraged to focus not only on creating financial but also environmental value (Schoenmaker, 2017), as well as for *issuers*, considering that by issuing them they increase the credibility of their sustainability strategies, expand the investor base and the breadth of ownership, while also for *policy makers* who need considerable financial resources in order to fulfill their commitments under the Paris Agreement (Banga, 2019, p. 2) and the European Green Deal.

The green bond market represents the youngest segment of the overall bond market, and accordingly, the issuing of these financial instruments amount to about 3 to 3.5% of the entire issue of bonds, and there is great potential for further development of this market segment. This is supported by the research results in the paper, which showed that in the period 2014-

2023 the green bond market continuously expanded and diversified (even in the period of the COVID pandemic), with the total amount issued reaching a record 587.7 billion dollars in 2023. This indicates a high level of interest in this financial instrument from both issuers and investors. With regard to regions, Europe remains the largest issuance region in the observed period, accounting for more than half of global issuance. Analyzing the situation on the green bond market, it is evident that the corporate sector contributed 57% to the total issuance of green bonds in the last three years of the observed period, with the largest issuers being non-financial corporations (29%), followed by financial corporations with 28% share of aligned green volumes. Funds collected by issuing green bonds were used to the greatest extent for financing green projects in sectors where fossil fuels were used the most, such as the energy sector, building construction and transport.

Although it is evident that there is a great potential for further development of this market, it could be threatened by certain barriers such as high transaction costs due to insufficient issue volume, lack of uniform standards, regulatory uncertainty and/or insufficient involvement of policy makers. In order to further develop the green bond market and overcome the previously mentioned barriers, some authors believe that it is necessary to improve transparency in order to minimize the risk associated with greenwashing, greater involvement of governments that would implement relevant regulations regarding the issue of green bonds, as well as incentive-based policies such as fiscal and tax incentives.

REFERENCES

- ACMF (2019). ASEAN Green Bond Standards. Retrieved from (30 October 2024):
<https://www.theacmf.org/initiatives/sustainable-finance/asean-green-bond-standards>.
- Adekoya, O.B., Oliyide, J.A., Asl, M.G. & Jalalifar, S. (2021). Financing the green projects: Market efficiency and volatility persistence of green versus conventional bonds, and the comparative effects of health and financial crises. *International Review of Financial Analysis*, 78, 1-8.
- Banga, J. (2019). The green bond market: A potential source of climate finance for developing countries. *Journal of Sustainable Finance and Investment*, 9(1), 17–32.
- Bužinskė, J., & Stankevičienė, J. (2023). Analysis of success factors, benefits, and challenges of issuing green bonds in Lithuania. *Economies*, 11(5), 1-20.
- Chamera, K. (2023). The development of the Polish green bond market in comparison to selected European countries. *Central European review of economics & finance*, 45(4a), 21-34.
- Chen, Y. & Zhao, J.Z. (2021). The rise of green bonds for sustainable finance: global standards and issues with the expanding Chinese market. *Current Opinion in Environmental Sustainability*, 52, 54-57.
- Chiesa, M. & Barua, S. (2019). The surge of impact borrowing: the magnitude and determinants of green bond supply and its heterogeneity across markets. *Journal of Sustainable Finance & Investment*, 9(2), 138-161.
- Climate Bonds Initiative. (2024). Market data. Retrieved from (01 November 2024):
<https://www.climatebonds.net/market/data/>.
- Cortellini, G. & Panetta, C.I. (2021). Green bond: A systematic literature review for future research agendas. *Journal of Risk and Financial Management*, 14, 1-29.
- Council of the European Union. (2023). European Green Bonds: Council adopts new regulation to promote sustainable finance. Retrieved from (30 October 2024):

- <https://www.consilium.europa.eu/en/press/press-releases/2023/10/24/european-green-bonds-council-adopts-new-regulation-to-promote-sustainable-finance/>.
- Dietz, S. & Natrup, M. (2020). An Evaluation of the Financial Performance of Green Bonds Compared to Conventional Bonds. Retrieved from (30 October 2024): https://research-api.cbs.dk/ws/portalfiles/portal/62179523/834234_Thesis_123526_124240.pdf.
- European Parliament & the Council of the European Union (2020). *Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088*. Official Journal of the European Union, L 198/pp.13-43. Retrieved from: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32020R0852&from=EN> (30 October 2024).
- Hadas-Dyduch, M., Puszer, B., Czech, M. & Cichy, J. (2022). Green bonds as an instrument for financing ecological investments in the V4 countries. *Sustainability*, 14(19), 12188.
- Ibrić, M., Kozarević, E. & Mešković, A. (2024). The rise of green bonds: Global context and european insights. *Journal of Economics, Law & Society*, 1(1), 55-71.
- ICMA (2022). *Green Bond Principles. Voluntary process guidelines for issuing green bonds*. Retrieved from (30 October 2024): <https://www.icmagroup.org/assets/documents/Sustainable-finance/2022-updates/Green-Bond-Principles-June-2022-060623.pdf>.
- IFC (2017). *Green Finance. A Bottom-up approach to track existing flows*. Washington:IFC.
- Jones, R., Baker, T., Huet, K., Murphy, L. & Lewis, N. (2020). Treating ecological deficit with debt: The practical and political concerns with green bonds. *Geoforum*, 114, 49-58.
- Liang, Y. (2023). Mitigation strategy for lessening the negative impacts of climate change. *Transformations in Business & Economics*, 22(1), 87-97.
- Löfer, U.K., Petreski, A., & Stephan, A. (2021). Drivers of green bond issuance and new evidence on the “greenium”. *Eurasian Economic Review*, 11, 1-24.
- Maltais, A. & Nykvist, B. (2021). Understanding the role of green bonds in advancing sustainability. *Journal of Sustainable Finance and Investment*, 11(3), 233–252.
- Marquis, C., Toffel, M. W. & Zhou, Y. (2016). Scrutiny, norms, and selective disclosure: A global study of greenwashing. *Organization Science*, 27(2), 483–504.
- Ntsama, U.Y.O, Chen, Y., Nasiri, A. & Mboungam, A.H.M. (2021). Green bonds issuance: Insights in low- and middle-income countries. *International Journal of Corporate Social Responsibility*, 6(1), 1-9.
- Ostojić, I. (2023). Zelene obveznice – inovativni instrumenti tržišta kapitala u funkciji zaštite životne sredine [Green bonds-innovative capital market instruments in the function of environmental protection]. In: *Cirkularna (bio)ekonomija: teorijski i praktični aspekti* (Ž. Stojanović, G. Rikalović, & D. Molnar, eds.), Belgrade: Faculty of Economics, 183-198.
- Pineiro-Chousa, J., López-Cabarcos, M.A., Caby, J. & Šević, A. (2021). The influence of investor sentiment on the green bond market. *Technological Forecasting & Social Change*, 162, 1-7.
- Schoenmaker, D. (2017). Investing for the common good: A sustainable finance framework. Retrieved from: <https://core.ac.uk/download/pdf/91633968.pdf> (30 October 2024).
- Shi, X., Ma, J., Jiang, A., Wei, S. & Yue, L. (2023). Green bonds: Green investments or greenwashing? *International Review of Financial Analysis*, 90, 1-13.

- Sobik, B. (2023). Green bonds - financial innovation for sustainability financing: The case of the Polish green bonds market and their development barriers. *Central European Economic Journal*, 10(57), 287-303.
- Sovilj, R. (2020). Green securities market-the situation and perspectives. *Pravo i privreda*, 58(2), 137-153.
- Tang, D.Y. & Zhang, Y. (2020). Do shareholders benefit from green bonds? *Journal of Corporate Finance*, 61, 1-18.
- Teti, E., Baraglia, I., Dallochio, M. & Mariani, G. (2022). The green bonds: Empirical evidence and implications for sustainability. *Journal of Cleaner Production*, 366, 1-9.
- UNEP (2019). *Strengthening the Environmental Dimensions of the Sustainable Development Goals in Asia and the Pacific*. Manila: Asian Development Bank.
- Wang, Y. & Zhi, Q. (2016). The role of green finance in environmental protection: Two aspects of market mechanism and policies. *Energy Procedia*, 104, 311-316.
- Weber, O. & Saravade, V. (2019). Green bonds: Current development and their future. Retrieved from (30 October 2024):
https://www.cigionline.org/static/documents/documents/Paper%20no.210_0.pdf.
- Więckowska, M. (2013). State and prospects of development climate bonds market. *Zeszyty Naukowe Uniwersytetu Szczecińskiego Finanse, Rynki Finansowe, Ubezpieczenia*, 62(766), 455-465.

ACKNOWLEDGEMENT

The paper is a part of the research financed by the Ministry of Education, Science and Technological Development of the Republic of Serbia (Agreements No. 451-03-66/2024-03/200371).

ACCOUNTING AND BUSINESS FINANCE

COMPARISON OF THE DIFFUSION OF ACTIVITY BASED COSTING AS A STRATEGIC MANAGEMENT TOOL IN HIGHER EDUCATION INSTITUTIONS

Ljilja Antić

University of Niš, Faculty of Economics, Republic of Serbia, ljilja.antic@eknfak.ni.ac.rs,
ORCID number 0000-0001-8796-4619

Bojana Novičević Čečević

University of Niš, Faculty of Economics, Republic of Serbia, bojana.novicevic@eknfak.ni.ac.rs,
ORCID number 0000-0002-4269-0586

Kristina Spasić*

Academy of Professional Studies South Serbia, Department of Business School Leskovac,
Republic of Serbia, spasic.kristina@vpsle.edu.rs,
ORCID number 0009-0005-5974-8472

Abstract: *The evolution of the economic, technological and organizational environment is accompanied by numerous innovations in different segments of their business, which very often condition each other. The process of innovation diffusion takes a long time and requires numerous adjustments to both organizational structure and organizational culture. According to research by numerous authors, the diffusion of the concept of activity-based costing as one of the innovations within cost accounting takes place at a different pace in developed countries compared to developing countries in all sectors of the economy. The speed of the process of diffusion of the concept of activity-based costing in the service sector, and especially in higher education institutions, is influenced by many factors, such as, for example, the size of the organization, the percentage of overhead costs in the structure of total costs, the support of employees and management, satisfaction with the costing that is currently used, availability of training and resources, adoption of IT innovations in order to improve the administrative function and others. The general goal of the paper is to examine the potential impact, relationship and contribution of appropriate contextual variables to the spread of the concept of activity-based costing in private and public higher education institutions in the Republic of Serbia. The paper can be useful to strategic management accountants of higher education institutions and other organizations because it can provide them with guidelines on the basis of which they could more easily implement the process of diffusion of the concept of costing by activity in their organization.*

Keywords: *activity-based costing, higher education, diffusion, strategic management, innovation*

JEL Classification: *M41, I23, I22*

* Corresponding author

1. INTRODUCTION

The concept of diffusion represents the spontaneous spread of new ideas which causes certain social changes. It is about "the process by which, over time, innovations are transmitted through certain communication channels among the members of the social system" (e.g. Rogers, 1983). The author's interest in researching the process of diffusion of innovations in order to accelerate it has increased precisely because the process of adopting new ideas in most cases is slow with very frequent numerous difficulties. Diffusion of the concept of activity-based costing as an innovation within the techniques of strategic management accounting was initially noted in the manufacturing sector, and later this concept was successfully applied in the service sector. Therefore, in the scientific and professional literature, there are more publications that deal with the diffusion of the concept of activity-based costing in the for-profit production sector, while there are significantly fewer publications that are dedicated to researching its diffusion in the service sector, especially in non-profit institutions such as higher education institutions. We should not ignore the fact that each higher education institution has certain specificities in terms of activities, and it is necessary to adapt the concept of activity-based costing to each of them. What is common to all higher education institutions is the process of allocating resource costs using the concept of activity-based costing, which takes place through the following stages: „identifying cost objects, identifying outputs, identifying activities, allocating resources and making cost pools, linking activity costs to output, analysis and cost reporting.“ (e. g. Tatikonda & Tatikonda, 2001). Regardless of the fact that the implementation of this concept at all higher education institutions takes place through the same stages research by many authors around the world has shown that there are certain factors that influence decision-making on its adoption and implementation. The aim of this paper is to examine the potential impact, relationship, and contribution of relevant contextual variables on the adoption of Activity-Based Costing (ABC) in private and public higher education institutions in the Republic of Serbia. To achieve this, Cronbach's Alpha, the Mann-Whitney U test, and the Chi-Square, Kruskal Wallis Test test are used.

The paper consists of three parts. The first part of the paper gives the analysis of previous studies on the factors that determine the diffusion of the concept of activity-based costing in higher education institutions and in organizations from different sectors of the economy. The second part of the paper is dedicated to the research methodology, while the final part of the paper analyzes the results of the empirical research in higher education institutions in the Republic of Serbia and the conclusions reached were given.

2. LITERATURE REVIEW

According to numerous authors, the concept of activity-based costing represents an innovation within the instruments and techniques of strategic management accounting (e.g. Gosselin, 1997; Brown et al., 2004; Al-Omiri & Drury, 2007; Innes & Mitchell, 1995; Anderson, 1995). Authors around the world have investigated the diffusion of the concept of activity-based costing in organizations operating in various sectors of the economy. Research conducted in Libya on 81 companies from different sectors of the economy shows that certain factors such as market competition and market uncertainty do not affect the diffusion of innovations in the field of management accounting. On the other hand, the support from strategic management, the availability of training and resources and the size of the company have a great positive influence on the diffusion of these innovations (e.g. Leftesi, 2008).

Based on the analysis of research results conducted by the Cost Management Group of the Institute of Management Accountants (IMA) in 1996. Krumwiede identified the following factors that influence the diffusion of the concept of activity-based costing in organizations: potential for cost distortion, organization size, usefulness of costs information for the purposes of strategic and operational decisions making and the lack of initiative to restructure or implement information systems that will support the calculation of the concept of activity-based costing (e.g. Krumwiede, 1998). According to this author, if the potential for cost distortion in the organization is greater, it will have a greater interest in implementing the concept of activity-based costing. Also, when it comes to the factor of the size of the organization, the research results show that larger organizations more often decide to implement activity-based costing concept compared to smaller organizations.

In their research, Askarany and Smith came to the conclusion that there is a positive correlation between the size of the organization and the diffusion of the concept of activity-based costing (e.g. Askarany & Smith, 2008). However, the results of the research carried out by Bjørnenak in which 75 Norwegian companies participated show that the size of the organization did not significantly influence the interest in adopting activity costing (e.g. Bjørnenak, 1997). According to Hashim, the diffusion of the concept of activity-based costing in higher education institutions is significantly influenced by: the size of the organization, the potential for cost distortion, satisfaction with the current costing system, as well as the adoption of an IT system in the function of supporting the administration of the higher education institution (e.g. Hashim, 2014). Hashim conducted a study among 98 private and 41 public higher education institutions where he investigated the influence of the mentioned factors on the diffusion of the concept of activity costing. In his research, the mentioned factors were taken as an independent variable, while the complexity, relative advantage and compatibility of the concept of activity-based costing in relation to current costing were used as dependent variables. He came to the conclusion that the size of the organization, the potential for changing the current cost structure in favor of overhead costs and satisfaction with the current costing system affect the diffusion of the concept of activity-based costing, while the significant influence of the IT system on the adoption of this concept has not been identified. According to the surveyed higher education institutions, the concept of activity-based costing has a relative advantage, it is more complex, but also compatible with the existing costing system. In the second decade of the new millennium, the author's interest in researching the application of the concept of activity-based costing in our country, both in the production and in the service sector, is growing (e.g. Jovanović, et al. 2014; Marjanović, 2010; Knežević & Mizdraković, 2010; Jovanović, et al. 2022; e.g. Majstorović, et al. 2011). However, the potential for the application of this concept in higher education has not yet been explored in our country.

In order to investigate the attitudes of surveyed employees in private and public higher education institutions in the Republic of Serbia on the implementation, satisfaction and compatibility of the applied costing system with the activity-based costing system, as well as the potential for the application of the concept of activity-based costing itself, we set the following hypotheses:

- H1: There are no statistically significant differences in the attitudes of respondents from private and public higher education institutions when it comes to the claim that the concept of activity-based costing is not compatible with the current costing system.

- H2: There are statistically significant differences in the attitudes of the respondents from private and public higher education institutions when it comes to the claim that the concept of activity-based costing is significantly more complex compared to the current costing system.
- H3: There is no correlation between respondents' satisfaction with current costing and their interest in applying the activity-based costing concept.
- H4: There are no statistically significant differences between private and public higher education institutions of different sizes in terms of interest in applying the concept of activity-based costing.
- H5: There are no statistically significant differences between private and public higher education institutions that have a different share of overhead costs in total costs in terms of interest in applying the concept of activity-based costing.
- H6: There are no statistically significant differences between higher education institutions with different intensity of application of information technologies for administrative purposes in terms of interest in applying the concept of activity-based costing.

3. METHODOLOGY

The research objective in this paper is to examine the attitudes of finance and accounting employees in public and private higher education institutions in the Republic of Serbia. The paper examines the views on the application of cost accounting in public and private higher education institutions, satisfaction with the performance of the applied cost accounting systems and their comparison with the concept of activity-based costing, as well as the influence of certain factors on the diffusion of the concept of activity-based costing in the observed higher education institutions.

Data for conducting empirical research were collected during January 2024. The data was collected by sending an online questionnaire via e-mail to the financial and accounting services, as well as by telephone surveying at the request of respondents, considering that more than 80% of respondents asked for help when filling out the survey questionnaire. Of the 100 survey questionnaires sent, 60 validly completed questionnaires were returned. The survey questionnaire was created based on previous research by numerous researchers in this field. (e.g. Cardos et al. 2012;. Alshamlan & Zverovich, 2018; Hashim, 2014; Hashim, 2015; Botha & Toit, 2017; Varzaru, 2022). It consists of two parts. The first part of the questionnaire is dedicated to the general characteristics of higher education institutions (location, type of higher education institution, number of employees, etc.). In addition, the first part of the questionnaire contains socio-demographic questions (gender and age of the respondent, workplace and length of service of the respondent).

The second part of the questionnaire examines respondents' views on the application and satisfaction with the information of the applied cost accounting systems for the needs of strategic and operational decision-making, as well as interest in the application of the concept of activity-based costing and its characteristics in relation to the already applied cost accounting systems. A Likert scale was used to evaluate the respondents' answers, based on which the degree of agreement with the given statements was assessed on a scale from 1 – “I do not agree at all” to 5 – “I completely agree”. The individual characteristics of the given sample are shown in Table 1.

Table 1. *Some characteristics of the sample*

Variables	Frequency	Valid %	Cumulative %
All observed higher education institutions	60	100	100
Region			
Belgrade region	38	63,33	63,33
Vojvodina region	10	16,67	80,00
Šumadija and Western Serbia region	5	8,33	88,33
Southern and Eastern Serbia region	7	11,67	100,00
Institution			
College	17	28,33	28,33
Academy	1	1,67	30,00
Faculty	39	65,00	95,00
University	3	5,00	100,00
Number of employees			
11-77	32	53,3	53,3
77,1-143	8	13,3	66,7
143,1-209	4	6,7	73,3
209,1-275	10	16,7	90,0
275,1-341	3	5,0	95,0
341,1-407	1	1,7	96,7
407,1 i više	2	3,3	100,0
Number of students			
36-1020	43	71,7	71,7
1020,1-2004	11	18,3	90,0
2004,-2988	2	3,3	93,3
2988,1-3972	2	3,3	96,7
5940,1 i više	2	3,3	100,0

Source: Author's calculation based on SPSS 20.0

Table 1 shows that the highest percentage participation of higher education institutions is from the Belgrade region (63,33%) and the Vojvodina region (16,67%), while the percentage participation of respondents for the remaining two regions ranges from 8.33% for the Šumadija region and Western Serbia up to 11,67% for the Region of Southern and Eastern Serbia. Among the observed higher education institutions, the most are faculties (65%), followed by colleges (28,33%), while the participation of academies and universities is very small and ranges from 1.67% for academies to 5% for universities. About 1/2 of the surveyed higher education institutions have less than 77 employees, while only 3 institutions have over 341 employees. Regarding the number of students, 90% of respondents have less than 2.004 students, and only 6,6% of respondents have more than 2.988 students. Table 2 provides an overview of the socio-demographic characteristics of the respondents.

Table 2. *Socio-demographic profile of respondents*

Variables	Frequency	Valid %	Cumulative %
Gender			
Male	19	31,67	31,70
Female	41	68,33	100,00

Age			
20,1-29	1	1,67	1,67
29,1-38	7	11,67	13,34
38,1-47	14	23,33	36,67
47,1-56	23	38,33	75,00
56,1 i više	15	25,00	100,00
Education			
College	5	8,33	8,33
Faculty – basic academic studies	33	55,00	63,33
Faculty – master academic studies	21	35,00	98,33
PhD	1	1,67	100,00
Occupation			
Financial analyst	11	18,33	18,33
Financial manager	1	1,67	20,00
Controller	6	10,00	30,00
Manager	1	1,67	31,67
Accountant	40	66,67	98,34
Head of financial and accounting affairs	1	1,66	100,00
Length of work experience			
2-7	5	8,33	8,33
7,1-12	9	15,00	23,33
12,1-17	10	16,67	40,00
17,1-22	20	33,33	73,33
22,1-27	8	13,33	86,66
27,1-32	1	1,67	88,33
32,1 i više	7	11,67	100,00

Source: Author's calculation based on SPSS 20.0

Of the total number of respondents, 31,67% are male, while 68,33% are female. The largest number of surveyed employees is over 47 years old (63,33%), employees aged 38-47 have 23,33%, while the participation of those under 38 is only 13,34%. If we analyze the educational structure of the respondents, we notice that the largest number of surveyed employees in higher education institutions have completed basic academic studies (55%), while the share of respondents with completed master's academic studies is slightly lower and amounts to 35%. Only 1,7% of the respondents have completed a doctorate, while only 8,3% of the respondents have completed higher education. Out of the total number of respondents, the largest number is employed in the position of accountant (66,67%), 18,33% of respondents are financial analysts, and as far as length of service is concerned, the dominant participation is of employees with work experience of 17-22 years (33,33%).

The collected data from the questionnaire was analyzed using the statistical package for social sciences IBM SPSS Statistics 20.0 (*Statistical Package for Social Sciences - SPSS, Version 20.0*). Before statistical analysis of the data with the help of computational (Kolmogorov-Smirn test and Shapiro-Wilk test) and graphic methods, it is necessary to check whether the given variables have a normal distribution. Cronbach's Alpha coefficient was used to measure internal consistency and reliability of variables, while descriptive statistics were used to measure central tendency (arithmetic mean, mode, median) and variability (standard

deviation). In addition to descriptive statistics, in the research, the Mann-Whitney U test, the Chi-Square test, Kruskal Wallis Test were applied.

4. RESULTS AND DISCUSSION

Before the statistical analysis, the reliability, i.e., the internal agreement of the scale was checked with the help of *Cronbach's Alpha* coefficient (e.g. Pallant, 2011). This coefficient is calculated for each question whose answers are given in the form of a Likert scale. The ideal situation is when the value of the *Cronbach's Alpha* coefficient is greater than 0,7 (e.g. DeVellis, 2003). Given that all obtained results are greater than 0,7, we can conclude that the internal consistency of the analyzed scales is acceptable. Also, the normality of the distribution of the used variables was checked by computational and graphical methods. Calculation methods such as Skjunis and Kurtosis, as well as the Kolmogorov-Smirnov tests and the Shapiro-Wilk test showed that the given data do not have a normal distribution. A significance level (Sig.) greater than 0,05 was used as a criterion for confirming the assumption of normality of the distribution in the Kolmogorov-Smirnov and Shapiro-Wilk tests. (e.g. Manasijević, 2011). Because the conditions for the application of the T-test and ANOVA were not met, for the purposes of further research, we decided to use their non-parametric replacements, the *Man-Vitnjev U* test and the *Kruskal Wallis* test. Also, we analyzed the data using the *Spearman's rho correlation* coefficient and the χ^2 test.

The results of the electronic questionnaire show that 48 out of 60 higher education institutions apply a cost accounting based on actual costs, while the remaining 12 institutions declared that they do not apply any cost accounting system. In order to analyze the respondents' views on the accuracy, application and satisfaction with the information of the current cost accounting system for the needs of strategic and operational decision-making, as well as on the interest in the application of the activity-based costing concept, its compatibility and complexity in relation to the existing cost accounting system, we considered only those higher education institutions which apply cost accounting system.

Table 3. *Descriptive Statistic application of cost accounting model informations*

<i>Cronbach's Alpha=0,711</i>	N	AM	SD.	Med.	Mod.	Min	Max
Accuracy of CAS information on tuition fees	48	4,48	0,583	5	5	3	5
Application of MA and CAS information for strategic and operational decision-making	48	4,27	0,818	4	5	2	5
Satisfaction with the current system	48	4,33	0,663	4	4	3	5
Interest in implementing ABC concept	48	2,65	1,280	3	1/4	1	5
Compatibility of current CAS with ABC	48	3,48	1,010	3	3	1	5
Complexity of ABC in relation to current CAS	48	3,85	0,850	4	3	2	5

CAS – cost accounting system, MA – management accounting, ABC – activity-based costing, N - number of respondents, Min. – minimum, Max – maximum, AM – arithmetic mean, SD – standard deviation, Med. – median, Mod. – Mode.

Source: Author's calculation based on SPSS 20.0

Based on the analysis of the data from Table 3, we conclude that the largest number of respondents agree that the information produced by the current cost accounting system is very accurate (AM=4.48; SD=0.583; Med.=5; Mod.=5). Also, the respondents share the same opinion when it comes to the application of management accounting and cost accounting information during strategic and operational decision-making (AM=4.27; SD=0.818; Med.=4;

Mod.=5), which positively reflects on their satisfaction by the current cost accounting system (AM=4.33; SD=0.663; Med.=4; Mod.=4). On the other hand, respondents expressed disagreement and lack of interest when it comes to the application of activity-based costing concept with greater variations in respondents' answers because the value of the standard deviation is greater than 1 ($\sigma > 1$) (AM=2.65; SD=1.280; Med. =3; Mod.=1/4). Also, respondents believe that the concept of activity-based costing is more complex than the existing cost accounting system (AM=3.85; SD=0.850; Med.=4; Mod.=3) while, when it comes to the compatibility of these two systems, the largest number of respondents do not have an opinion (AM=3.48; SD=1.010; Med.=3; Mod.=3). We examined the results of descriptive statistics in more detail using correlation analysis (table 4).

In order to test hypotheses H1 and H2 we applied the T test for independent samples. Given that the observed variables do not have a normal distribution, instead of the T test, we applied the non-parametric alternative *Mann-Whitney U* test.

Table 4. *Test Statistics^a*

<i>Test Statistics^a</i>	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Compatibility of current CAS with ABC	200,500	665,500	-1,573	,116
Complexity of ABC in relation to current CAS	170,500	635,500	-2,245	,025

a. *Grouping Variable: Ownership*

CAS – cost accounting system, MA – management accounting, ABC – activity-based costing

Source: Author's calculation based on SPSS 20.0

Table 4 shows that there is no statistically significant difference between respondents from private and public higher education institutions when it comes to the assessment of the compatibility of the activity-based costing concept with the current costing system (Sig > 0,05; p= 0,116), while level of complexity of the activity-based costing concept in relation to the existing cost accounting system identified the existence of statistically significant differences in the attitudes of respondents from private and public higher education institutions (Sig < 0,05; p=0,025). Thus, hypothesis 1 is confirmed.

Table 5. *Descriptive Statistic complexity of ABC in relation to current CAS*

Higher education institutions by ownership	N	AM.	SD.	Med.	Mod.	Min	Max
Private higher education institutions	18	4,22	0,878	4,50	5	3	5
Public higher education institutions	30	3,63	0,865	4	3	2	5

CAS – cost accounting system, ABC – activity-based costing, N - number of respondents, Min. – minimum, Max – maximum, AM – arithmetic mean, SD – standard deviation, Med. – median, Mod. – Mode.

Source: Author's calculation based on SPSS 20.0

Based on the descriptive statistical analysis by the observed categories of private and public higher education institutions, we can say that private higher education institutions rated activity-based costing as more complex compared to the costing system that is currently applied because they gave a higher average rating that is statistically significant (AM= 4,22; SD=0,878; Med.=4,50; Mod.=5. As many as 50% of the respondents who are employed in

private higher education institutions fully agree that activity-based costing is more complex than the current costing system, 22,2% of respondents agree with this statement, while the remaining respondents do not have an opinion on this issue. Given that the value of the standard deviation is less than 1 ($\sigma < 1$), we conclude that the respondents largely agree with the assessment of the observed variable. On the other hand, the largest number of respondents employed in public higher education institutions (43,33%) do not have an opinion on this issue. Respondents from public higher education institutions gave lower average grades (AM=3,63; SD=0,865; Med.=4; Mod.=3) compared to respondents from private higher education institutions, and as the standard deviation value is below 1 ($\sigma < 1$) we can conclude that the respondents largely agree with the assessment of this variable, which confirms hypothesis 2. Our results differ from the results of the research conducted by Hashim, which show that the concept of activity-based costing is compatible with existing costing systems and is not more complex than them, which facilitates its implementation. Also, he came to the conclusion that the size of the organization and the size of the overhead costs influence the interest in implementing the concept of activity-based costing. (e.g. Hashim, 2012; Hashim 2014). On the other hand, Askarany and Smith pointed out in their research from 2008 that the size of the organization was taken into account as a significant influencing factor on the interest in implementing the concept of activity-based costing only in production organizations (e.g. Askarany & Smith, 2008).

In order to test hypothesis H3, we also examined whether there is a correlation between satisfaction with the current costing system and respondents' attitudes in favor of the concept of activity-based costing.

Table 6. *Chi-Square Tests*

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8,901 ^a	8	0,351
Likelihood Ratio	11,073	8	0,198
Linear-by-Linear Association	0,643	1	0,422
Spearman's rho	0,120	-	0,417
N of Valid Cases	48	-	-

a. 10 cells (66,7%) have expected count less than 5. The minimum expected count is ,31.

Source: Author's calculation based on SPSS 20.0

The research results show that there is no significant correlation between satisfaction with the current costing system and respondents' attitudes in favor of the activity-based costing concept. Although the result of the χ^2 test did not show the presence of dependence between satisfaction with the current costing system and interest in applying the concept of activity-based costing, due to the fact that 66,7% of the cells have an expected count less than 5, we will determine the presence of dependence between the observed variables with the help of the Likelihood Ratio. The probability value of the Likelihood Ratio is greater than 0,05 (Asymp. Sig. (2-sided) = 0,198) and we can say that there is no dependence between the observed variables. Also, the value of the correlation coefficient is 0,120 (Asymp. Sig. (2-sided)=0,417) and we can say that there is no significant correlation, which confirms hypothesis 3. Thus, 89,6% of our respondents are satisfied with the current cost accounting system and do not want to change it, while 10,4% of respondents have no opinion. The results of the statistical analysis showed the absence of a significant correlation and the absence of dependence between the observed phenomena, which is not in accordance with the results of

other researches in the world. The results of numerous researches in the world in the production sector, hospitals, universities and in the public sector show that satisfaction with the current costing system affects the implementation of the concept of activity-based costing (e.g. Krumwiede, 1998; Pizzini, 2006; Hashim, 2012; Anand et. al, 2005; Fadzil & Rababah, 2012; Kostakis 2011).

In order to test hypothesis H4, H5 and H6, we applied the Kruskal Wallis Test, as an adequate non-parametric replacement of the univariate one-factor analysis of variance (ANOVA) because the condition of the existence of normality of the distribution of the variables for its application is not met.

Table 7. Test Statistics (Kruskal Wallis Test)

Interest in implementing ABC concept ^a Grouping Variable: Number of students	All HEI ¹	Public HEI ²	Private HEI ³
Chi-Square	1,309	1,877	,573
Df	4	4	1
Asymp. Sig.	,860	,758	,449
Interest in implementing ABC concept ^a Grouping Variable: Participation of overhead costs (%)	All HEI ¹	Public HEI ²	Private HEI ³
Chi-Square	5,263	6,489	5,440
Df	6	6	5
Asymp. Sig.	,511	,371	,365
Interest in implementing ABC concept ^a Grouping Variable: More intensive use of IT in the administration	All HEI ¹	Public HEI ²	Private HEI ³
Chi-Square	1,789	,619	2,763
Df	2	2	2
Asymp. Sig.	,409	,734	,251

a. Kruskal Wallis Test; HEI – higher education institutions.

CAS – cost accounting system, MA – management accounting, ABC – activity-based costing

Source: Author's calculation based on SPSS 20.0

Based on the results of the analysis from Table 7, we conclude that there are no statistically significant differences between higher education institutions of different sizes regarding the interest in applying the concept of activity-based costing (Sig > 0,05; $p^1 = 0,860$; $p^2 = 0,758$ i $p^3 = 0,449$) which hypothesis 4 confirmed. Also, there are no statistically significant differences between higher education institutions that have a different share of overhead costs in total costs in terms of interest in applying the concept of activity-based costing (Sig > 0,05; $p^1 = 0,511$; $p^2 = 0,371$ i $p^3 = 0,365$) which hypothesis 5 proven. The stated results are not in accordance with the results of previously conducted research (Hashim, 2012; Hashim, 2014; Askarany & Smith, 2008; Fadzil & Rababah, 2012; Kostakis 2011). Furthermore, it was determined that there are no statistically significant differences between higher education institutions of different intensity of application of information technology for administrative purposes in terms of interest in applying the concept of activity-based costing (Sig > 0,05; $p^1 = 0,409$; $p^2 = 0,734$ i $p^3 = 0,251$) which hypothesis 6 is proven. The obtained results are in accordance with the research results of other authors in the world who came to the conclusion

that the high intensity of the application of information technologies is not a decisive factor for the implementation of the concept of activity-based costing, because many organizations very successfully apply this concept of costing, regardless of having weak IT system (e.g. Hashim, 2014; Krumwiede, 1998; Maelah & Ibrahim, 2007).

5. CONCLUSIONS AND RECOMMENDATIONS

This paper analyzed the influence of certain contextual factors on the diffusion process of the activity-based costing concept in private and public higher education institutions of the Republic of Serbia. Of the mentioned factors, the emphasis was on the analysis of the impact of the size of the organization, the size of the overhead costs and the potential impact of information technology on the application of the given concept. No statistically significant differences were identified between private and public higher education institutions in terms of interest in implementation the activity-based costing concept in any of the aforementioned factors. The results of the research further showed that satisfaction with the current cost accounting system in private and public higher education institutions does not affect the implementation of the activity-based costing concept in the given sample of respondents. Respondents believe that the activity-based costing concept is more complex than the current cost accounting system, that is, the results of the research showed the existence of statistically significant differences in the attitudes of respondents from private and public higher education institutions when it comes to the claim that the concept of activity-based costing is more complex in compared to the current cost accounting system. However, when examining whether the activity-based costing concept is compatible with the current costing system, no statistically significant differences were identified between the two observed groups of respondents. Although 38,3% of respondents have heard or are familiar with activity-based costing, we believe that activity-based costing can be implemented in higher education institutions in the future with great efforts. However, for now, a large number of respondents have outdated knowledge, do not have much experience in the application of cost accounting and are not familiar with the advantages of applying innovative cost accounting systems primarily in the service sector and in non-profit organizations such as, for example, a higher education institution and professional training of financial and accounting staff is needed.

Although this paper makes a contribution to the literature on examining the influence of certain contextual factors on the process of diffusion of the activity-based costing concept in higher education institutions, it also has certain limitations. Some of the limitations of the study are sample size, neglecting the specificity of each of the observed higher education institutions, as well as the subjectivity of respondents during the survey. Also, it is desirable to conduct the following research through a semi-structured interview with an extended list of questions in order to examine in more detail the factors that determine the diffusion process of the activity-based costing concept.

REFERENCES

- Anand, M., Sahay, B. S., & Saha, S. (2005). Activity-Based Cost Management Practices in India: An Empirical Study. *Decision*, 32(1), 123-152.
- Anderson, S. W. (1995). A Framework for Assessing Cost Management System Changes: The Case of Activity Based Costing Implementation at General Motors, 1986-1993. *Journal of Management Accounting Research*, 7, 1-51.

- Al-Omiri, M., & Drury, C. (2007). Organizational and behavioral factors influencing the adoption and success of abc in the UK. *Cost Management. Boston*, 21(6), 38-49.
- Alshamlan, H. M., & Zverovich, S., (2018). The Costing Systems in Saudi Arabian Hospitals: Do They Need to Be Modified?; *International Journal of Accounting and Financial Reporting*, 8(1), 359-379, <https://doi.org/10.5296/ijafr.v8i1.12774>
- Askarany, D., & Smith, M. (2008) Diffusion of Innovation and Business Size: A Longitudinal Study of PACIA. *Managerial Auditing Journal*, 23, 900-916. <http://www.emeraldinsight.com/journals.htm?articleid=1751590&show=html>
- Botha, G., & Toit, E. (2017) The adoption of activity-based costing in private health care facilities in South Africa, *Journal of Economic and Financial Sciences*, 10(2), 338-355.
- Bjørnenak, T. (1997) Diffusion and Accounting: The Case of ABC in Norway. *Management accounting research*, 8(1), pp. 3-17.
- Brown, D. A., Booth, P., & Giacobbe, F. (2004). Technological and organizational influences on the adoption of activity-based costing in Australia. *Accounting and Finance*, 44, 329-356.
- Cardos, I. R., Pete S., & Cardos, V. D., (2012). An Overview On The Adoption And Implementation Of Activity - Based Costing In Practice, *Romanian Journal of Economics*, 35(2(44)), pp. 185-200.
- DeVellis, R. F. (2003). *Scale development: Theory and application* (2nd Ed.). Thousand Oaks, CA: Sage.
- Fadzil, F.H., & Rababah, A. (2012). Management Accounting Change: ABC Adoption and Implementation. *Journal of Accounting and Auditing: Research & Practice*, 7.
- Gosselin, M. (1997). The Effect of Strategy and Organizational Structure on the Adoption and Implementation Activity-Based Costing. *Accounting, Organizations and Society*, 22(2), 105-122.
- Hashim, J. H., (2015) The activity-based costing (abc) in the institutions of higher education (IHE): Do private and public bring a different?, *Asian journal of basic and applied sciences* 2(1), 16-30.
- Hashim, H. (2014). The Diffusion of Activity-Based Costing (ABC) in the Institutions of Higher Education (IHE): A note from Malaysia. *International Journal of Liberal Arts and Social Science*, 2(6), 178-191.
- Hashim, J. H. (2012). The Perceived Usefulness of Activity-Based Costing (ABC) Information In A Public Multi-Campus University System:- A Case Of Universiti Teknologi MARA (UiTM). IIUM, Kuala Lumpur, Malaysia.
- Innes, J., & Mitchell, F. (1995) A survey of activity-based costing in the U.K. 's largest companies. *Management Accounting Research*, 6, 137-152.
- Jovanović, D., Fedajev, A., & Gračanin, Š., (2022), Tehnike strategijskog upravljačkog računovodstva u srednjim i velikim preduzećima u Srbiji, U: Obradović, V., Malinić, D., Todorović, M., Karapavlović. (red.), *Računovodstvena znanja kao činilac ekonomskog i društvenog napretka*, Ekonomski fakultet, Kragujevac, (str. 276-290).
- Jovanović, D., Janjić, V., & Janković, M. (2014). Uticaj veličine preduzeća na implementaciju savremenih sistema obračuna troškova: Slučaj Srbije, *Teme*, 38(3), 1095-1114.
- Kostakis, H., Boskon, G., & Palisidis, G. (2011). Modelling Activity Based Costing in Restaurants. *Journal of Modelling in Management*. 6(3), 243-257
- Knežević, G., & Mizdraković, V. (2010). Exploratory research of activity-based costing method implementation in Serbia, *Ekonomska istraživanja*, 23(3), 68-81.
- Krumwiede, K. R. (1998). ABC: Why it's tried and how it succeeds. *Journal of Management Accounting Research*, 79(4), 32-38.

- Leftesi, A. (2008). *The Diffusion of Management Accounting Practices in Developing Countries: Evidence from Libya*. [Doctoral thesis, University of Huddersfield], <http://eprints.hud.ac.uk/id/eprint/6220/>.
- Maelah, R., & Ibrahim, D. N. (2007). Factors influencing Activity Based Costing (ABC) adoption in Manufacturing. *Investment Management and Financial Innovations*, 4(2), 113 - 124.
- Majstorović, B., Kastratović, D., Vučović, D., Milaković, B., & Miličić, B. (2011), Analiza operativnih troškova u anesteziji, *Srpski Arhiv za Celokupno Lekarstvo*, 139 (7-8), 501-508.
- Manasijević, D. (2011) *Statistička analiza u SPSS program*. Bor: Tehnički fakultet.
- Marjanović, V. (2010) „Stanje i perspektive sistema obračuna troškova u privrednim društvima“, *Računovodstvo*, 5-6, 42-49.
- Pallant, J. (2011). *SPSS – Priručnik za preživljavanje*. (4th edn.) Beograd: Mikro knjiga.
- Pizzini, M. J. (2006). The relation between cost-system design, managers' evaluations of the relevance and usefulness of cost data, and financial performance: an empirical study of US hospitals. *Accounting, Organizations and Society*, 31, 179 - 210.
- Rogers, E. (1983) *Diffusion of innovations (Third Edition)*. New York: The Free Press.
- Tatikonda, L., & Tatikonda, R. (2001). Activity-based costing for higher education institutions. *Management Accounting Quarterly*, 2(2), 19-27.
- Varzaru, A., 2022., „Assessing Digital Transformation of Cost Accounting Tools in Healthcare“, *International Journal of Environmental Research and Public Health*, 19(23), 2-18., <https://www.mdpi.com/1660-4601/19/23/15572>

ACKNOWLEDGEMENT

The research presented in this paper was done with the financial support of the Ministry of Science, Technological Development and Innovation of the Republic of Serbia, within the funding of the scientific research work at the University of Niš, Faculty of Economics, according to the contract with registration number 451-03-65/2024-03.

COMPARATIVE LEGAL ANALYSIS OF THE CONSISTENCY BETWEEN CIVIL LAW, TAX AND ACCOUNTING QUALIFICATIONS OF FINANCIAL LEASING

Smajo Šabić*

University of Zenica, Faculty of Law, smajo.sabic@hotmail.com
ORCID number 0009-0004-7214-7017

Alaudin Brkić

University of Zenica, Faculty of Law, alaudin.brkic@unze.ba
ORCID number 0009-0004-8047-0246

Amna Gagula

University of Zenica, Faculty of Law, amna.gagula@unze.ba
ORCID number 0000-0002-5483-5789

Abstract: *The objectives of this study are focused on a comparative legal analysis of the importance of achieving consistency between the legal, tax and accounting qualifications of financial leasing transactions within the economic and legal system of Bosnia and Herzegovina (B&H), as well as offering an assessment of the potential of transposing different economic-legal concepts and the development of relevant practices based on examples from Germany, England, and the USA. The issue of congruence between civil law and tax qualifications of financial leasing transactions presents a significant challenge in providing consistent answers for national economic systems, both of continental and common law traditions. Furthermore, the civil law qualifications of financial leasing transactions in B&H are not complementary with the qualifications adopted in national and relevant international accounting standards (IAS 17 and FASB 13). Some national accounting frameworks do not recognize leasing capitalization criteria at all, while others wrongly classify most leasing transactions under the treatment for operating leases. This opens up broad opportunities for the development of undesirable practices, such as the disappearance of financial leasing assets from the lessee's balance sheet, as well as the duplication of leasing assets in the balance sheets of both the lessor and the lessee. The answers to the questions raised in this paper are of multiple importance for achieving a more creative development of the leasing industry in B&H and formulating appropriate proposals for improvements based on the results of the comparative legal analysis of the reference examples from Germany, England and the USA.*

Keywords: *Financial leasing, Operating Leasing, Depreciation of leased assets, Balancing and taxation*

JEL Classification: *K15, K34, M41, P51*

* Corresponding author

1. SOURCES OF REGULATION OF FINANCIAL LEASING TRANSACTIONS

In the former Yugoslav countries, there was no adequate legal infrastructure or awareness of the importance of leasing transactions for the development of the national economy for a long time. (Gavela, 2005). Until the dissolution of Yugoslavia, financial leasing existed as an independent contract under autonomous commercial law, separate from the designated lease agreement. (Velimirović, 2001).

Due to the lack of regulation in the Law on Obligations of the SFRY (abbreviated: ZOO FBiH/RS), provisions related to foreign trade operations were partially applied to it, while customs, foreign exchange, and tax regulations were applied in another part. Under such circumstances, leasing providers were free to develop their own adapted leasing practices. This state of autonomous regulation lasted until the dissolution of Yugoslavia and the emergence of independent states, where, for the first time, a clear need was recognized to legally regulate this complex area of commercial legal relations. In the Republic of Serbia, the Law on Financial Leasing was first adopted in 2003, and in 2011, it was subjected to significant amendments (abbreviated: ZFL RS). On the other hand, the Republic of Montenegro adopted the Law on Financial Leasing in 2005 (abbreviated: ZFL RCG), which was repealed in 2017 with the adoption of the Law on Financial Leasing, Factoring, Debt Collection, Microcrediting, and Credit-Guarantee Transactions. Similarly, the Republic of Croatia replaced the initially adopted Law on Leasing from 2006 with a new version in 2013 (abbreviated: ZL RH). Bosnia and Herzegovina was not exempt from this inevitable process, as two entity-level leasing regulations were adopted: the Law on Leasing of the Republic of Srpska in 2006, which was amended in 2011 (abbreviated: ZL RS), and the Law on Leasing of the Federation of Bosnia and Herzegovina in 2008, which was amended in 2013 and 2016 (abbreviated: ZL FBiH).

In the ZL FBiH, "financial leasing transaction" is defined as a transaction in which the leasing provider transfers to the leasing user the right to possess and use the leased item for a specified period, while the leasing user is obligated to pay the agreed leasing fee in return, with the option to purchase or acquire ownership of the leased item. (Velimirović, 2001). At first glance, it may seem like a significant oversight that it is not emphasized that the leasing provider must also acquire ownership of the leased item being delivered to the leasing user. However, this impression is dispelled once the role of the supplier in the financial leasing transaction is properly interpreted.

Furthermore, the financing function of the leasing provider is not clarified, nor is the existence of a tripartite relationship between the subjects of the financial leasing transaction. Nevertheless, the adopted definition is not lacking, as the missing elements are borrowed from the adopted definition of the financial leasing contract. On the other hand, the ZL RS deviated significantly with the adopted definition of the financial leasing transaction, emphasizing not only the financial nature of the operation by highlighting the tripartite relationship but also stating that the leasing fee is determined based on the depreciation of the entire or most significant part of the leased item's value. The explicit provision in the ZL RS that the leasing provider, based on the delivery agreement, acquires ownership of the leased item is a systemically better solution compared to the ZL FBiH, as it contributes, if nothing else, to establishing a conceptual distinction of mutual relations between the subjects of the financial leasing transaction in one place. In this way, the complexity and interdependence of the contractual elements within the financial leasing transaction are highlighted, as well as the specificity of the position of the leasing user, who is not a party to the delivery

agreement.(Perović, 2003). Some of these conceptual issues have, among other things, led to the initiation of certain discussions aimed at revising the ZL FBiH. For this purpose, in early 2016, the Law on Amendments and Additions to the ZL FBiH was adopted, which, among other things, contains definitions of direct and indirect leasing in its introductory part.

2. DISTINCTION BETWEEN FINANCIAL AND OPERATIONAL LEASING

In terms of distinguishing financial and operational leasing, the entity legislators have not abandoned their efforts to achieve clarity in this distinction by highlighting the typical characteristics of operational leasing. On one hand, the ZL FBiH stipulates that operational leasing transactions do not involve the transfer of ownership risks nor the agreement of a purchase option for the leasing user. On the other hand, the ZL RS emphasizes that the roles of the supplier and the leasing provider in operational leasing are unified, and the transfer of ownership risks to the leasing user is absent.

What is certainly an inherent characteristic of financial leasing transactions, as opposed to operational leasing, is the transfer of ownership risks to the leasing user. This provision, analogous to a sale with retention of ownership rights, introduces yet another exception to the principle *res perit in domino*.

After the contract expires and the leased item is returned in a condition corresponding to the usual level of wear and tear, comparable to partial depreciation, the final payment comes into play, which includes all amounts of the leasing fee that were partially exempted from collection up to that point.

3. SUBJECT OF FINANCIAL LEASING

Regarding the determination of the subject of financial leasing, both the ZL FBiH/RS and ZFL RS stipulate that it can include movable and immovable property as defined in the respective entity property laws. However, the reference in the ZL FBiH was redundant until the adoption and entry into force of the Law on Property Rights in RS and FBiH (abbreviated: ZSP1 RS/FBiH) for the simple reason that the previous ZOVO did not include legal definitions of basic property law terms, such as “thing”, “accessory”, “parts of a thing”, etc. Despite this, it did not present a serious problem in previous practice, as legal doctrine stepped in with its creativity. Thus, it has been clear from the beginning that the subject of leasing can only be non-consumable things, assuming they are in legal circulation.

4. TRANSFORMATION RIGHTS OR OPTIONS IN THE FINANCIAL LEASING AGREEMENT

In a financial leasing transaction, depending on the specific arrangement, a regular feature is the option or transformation rights (Stanković/Vodinelić 1996, Popov 2009, Babić 2011), that place the leasing user in a position to either extend the leasing agreement for the same leased item after the leasing period expires or purchase it at a price determined at the time the leasing agreement was concluded (Giovanoli, 1980). Compared to German contracts with partial depreciation, the ZL FBiH/RS, as well as domestic leasing practice, do not recognize leasing contract models with a purchase option in favor of the leasing provider. According to the ZL RS, at the end of the leasing contract, the leasing user is obliged to notify the leasing provider

in writing whether they wish to exercise the agreed purchase option or extend the contract for the same leased item.

To eliminate any uncertainty regarding the submission of the notice for the exercise of the transformation right, the ZL RS adds a dispositive rule stipulating that the leasing user must do so no later than one month after the expiration of the contract. However, the ZL FBiH deviates from this approach, leaving the parties to the contract the discretion to determine the deadline within which the leasing user should exercise their transformation right. The consequences of the leasing user's failure to fulfill this obligation ("they are obliged to") within the agreed or legal timeframe primarily depend on whether and to what extent the value of the leased item has diminished during that period, to the detriment of the leasing provider.

5. STATUS CONDITIONS FOR CARRYING OUT LEASING ACTIVITIES

In terms of legal status, ZL FBiH/RS, ZFL RS, and ZL RH adopt an approach according to which leasing activities can only be carried out by legal entities. According to the ZL FBiH/RS, leasing activities can be carried out by leasing companies established in FBiH, RS, and BD BiH, as well as by branches of leasing companies with their headquarters in FBiH, RS, and BD BiH, provided that they obtain a prior permit from the Banking Agency of FBiH/RS. Exceptionally, banks with their headquarters in FBiH, RS, and BD BiH, as well as branches of banks with their headquarters in FBiH, RS, and BD BiH, can also carry out leasing activities.

In organizational terms, leasing companies can be established as limited liability companies or joint-stock companies, provided that they ensure the legal minimum of basic capital amounting to 250,000 BAM.

6. FINANCIAL LEASING IN THE FUNCTION OF DEVELOPING CREDIT RELATIONS

The fundamental idea behind financial leasing as a method of financing is rooted in the notion that unused capital is invested in the acquisition of various goods for which interested parties, who lack the financial means for direct purchase, are willing to pay an appropriate fee (Bernd, Schmid-Burgk, 2012). In this arrangement, the lessor does not aim for economic exploitation of the financed goods but retains ownership of the asset to secure the claims against the lessee. On the other hand, the lessee is the entity engaging in economic activity, using the economic value of the goods leased to achieve both private and broader social goals.

7. FINANCIAL LEASING AS A METHOD OF FINANCING INVESTMENT GOODS

Economic theory suggests that two primary reasons have contributed to the rapid development of financial leasing: the difficulty in placing investment goods and their obsolescence due to technological progress. (Trifković 2010). The everyday reality for businesses operating in any market is marked by the limited availability of financial resources and the ongoing need to maintain liquidity in making and implementing various investment decisions. To address these challenges, companies have access to the advantages associated with financial leasing as a method of external financing for the acquisition of different business goods, compared to financing purchases through their own or borrowed funds. (Graynor, Martinek 1991, Koščica 2003).

8. INTERNATIONAL ACCOUNTING STANDARDS FOR LEASE TRANSACTIONS

The accounting treatment of financial leasing occupies a significant place both within individual countries and internationally in terms of standardizing accounting practices. (Gligorić, 2005) In the United States, for a long time, it was allowed for leaseholders to report leased assets from financial leases in the footnotes of their financial statements. This led to users of leasing obtaining off-balance-sheet financing for necessary investments. This practice changed in 1976 when the Financial Accounting Standards Board (FASB) issued Statement No. 13 (Accounting for Leases), with a clear directive to recognize financial lease transactions on the lessee's balance sheet.

In U.S. accounting practice, a broad classification of lease transactions has been adopted, so that today, leases can be categorized as either sales-type leases, direct financial leases, leveraged leases, or operating leases.

On the other hand, European accounting treatment for lease transactions has been exclusively regulated by the International Accounting Standards Board (IASB). In 1997, the IASB issued International Accounting Standard 17 (IAS 17), which specifically addresses leases. This standard was revised in 2003 and, as such, is now widely applied in European accounting practices regarding lease relationships. What is the most important when making a "leasing decision" is understanding the effects that both operating and financial leases have on operational efficiency, including costs, profits, taxes, balance sheets, and financial leverage. (Lukić, 2004).

Unlike operating leases, in financial leasing, the leased asset is typically shown on the balance sheet of the lessee, while liabilities are recognized as the present value of the expected lease payments. This is one of the reasons many companies turn to operating leases, as it allows them to "hide" their potential liabilities and reduce their effect on financial leverage. However, in such a scenario, lessors are deprived of the tax deductions typically available for financial leases.

From a comparative perspective, some national accounting frameworks (e.g., Italy) omit capitalization criteria for leasing transactions, while in others (e.g., France), all leases are treated under the same framework as operating leases. (Lukić, 2004). These approaches significantly diverge from the regulation under US GAAP (Generally Accepted Accounting Principles – United States) and IFRS (International Financial Reporting Standards), which are based on strictly economic indicators. These standards adhere to the fundamental principles of "substance over form" (IAS 17) and "economic substance over legal form" (FASB 13). (Gligorić, 2005).

For these purposes, a qualification of leasing transactions has been adopted, subject to the so-called risk transfer test, which is based on whether the specific leasing arrangement is aimed at renting or acquiring an asset through financing. (Contino, 2002). If the lessor transfers significant risks and rewards associated with ownership of the leased asset to the lessee, it is considered a finance lease according to IAS 17, while for the same purposes, FASB 13 introduces the term "capital lease." On the other hand, operating leases encompass situations in which the lessor retains, rather than transfers, significant risks and rewards associated with the ownership of the leased asset. Although the adopted classification may seem simple at first glance, the widely available possibilities for structuring leasing arrangements in practice contradict this simplicity. (Sredović, 2008). The criteria for the existence of a finance lease,

according to IAS 17, are contained in paragraph 10, while US GAAP requires that only one of the prescribed tests from paragraph 7 of FASB 13 be met.

And a somewhat superficial comparative analysis reveals that the criteria of FASB 13 largely align with those mentioned in the first four examples in paragraph 10 (a) to (d) of IAS 17. (Lukić, 2004). However, this hasty assessment is partially corrected in paragraphs 7 (c) and (d) of FASB 13, which require that the lease term be 75% or more of the economic life of the leased asset, and that the present value of the lease payments be greater than 90% of the fair value of the leased asset.

In terms of commercial regulations, such configurations qualified as financial leases will be considered operating leases for accounting purposes. Since the quantitative indicators of FASB 13 can be circumvented in other cases, this presents an enticing invitation for financial lease users to continue achieving off-balance sheet effects inherent in the accounting treatment of operating leases. (Mäntysaari, 2009). In both American and European accounting practices, there can also be the no less significant problem of the disappearance of the leased asset from the lessee's balance sheet (Tvrtković, 2002). This occurs when the lessor classifies the leasing arrangement as a financial lease, while the lessee classifies it as an operating lease. (Schrot, 2011). Conversely, the problem of duplicating the leased asset is not excluded if the lessor classifies the same leasing arrangement as an operating lease, while the lessee classifies it as a financial lease (Tvrtković, 2002).

9. ACCOUNTING TREATMENT OF LEASING TRANSACTIONS IN BOSNIA AND HERZEGOVINA

BALANCE SHEET POSITION OF THE LESSOR

The accounting treatment of operating leases proceeds in such a way that the lessor-owner records the leased asset and the income for the period to which the lease applies, while depreciation of the leased asset, including other expenses, is recorded as an expense in proportion to the lease term. This makes it much clearer and also introduces a ban on the lessor from recording sales revenue from the basis of operating leases. On the other hand, the essence and financial reality of financial leasing are such that the lessee gains economic benefits for a larger part of the economic life of the leased asset, in exchange for lease payments that are close to the fair value of the asset. If, at the end of the contract, the lessee acquires ownership of the leased asset, then the financial lease is recorded on the lessor's balance sheet as a "sale with leaseback". In this case, the lessor records part of the leasing income as sales income and another part as other leasing income, while the calculated costs are recorded as expenses for the lease period to which the "sale with leaseback" income relates. In financial leasing, without transferring ownership to the lessee, the lessor is required to record income from lease payments, as well as expenses related to the costs that accompany such a leasing arrangement.

BALANCE SHEET POSITION OF THE LESSEE

The accounting treatment of leasing transactions is much more interesting when viewed from the perspective of the lessee. Unlike operating leases, the obligation to account for the leased asset in a financial lease lies with the lessee, as if they are the formal legal owner of the leased asset. In this case, the initial value of the leased asset is determined in the same way as if it had been purchased or received as a gift. According to the principle of double-entry

bookkeeping, the rights and obligations arising from the financial lease are recorded on the lessee's balance sheet based on a calculation derived from the fair value of the leased asset or the present value of all lease payments.

TAX TREATMENT OF LEASING TRANSACTIONS IN BIH

OPERATING LEASE

The primary purpose of an operating lease is the use of an asset during the optimal period of its lifespan without the option to purchase. Given the prohibition on the transfer of ownership, operating leases, according to the state Value Added Tax Law (ZPDV BiH), are not considered the sale of goods but rather the provision of a service.

FINANCIAL LEASE

In accordance with ZPDV BiH, financial leasing is considered a “delivery of goods based on a lease agreement for a fixed period under a sales contract with deferred payment, where it is anticipated that ownership rights will transfer no later than upon payment of the last instalment. Although the term “delivery” is vaguely defined, it is clarified by the explanation provided in the VAT Law and its Annex I. In conjunction, these two regulatory provisions define the sale of goods to include full amortization lease contracts (full-pay out), partial amortization leases (non full-pay out), and special leases.

10. CONCLUSION

The term “leasing” adopted in the entity leasing regulations is, in a sense, linguistically opposed to the established terms of “rent” or “lease” in accounting and tax purposes. Despite this terminological discrepancy, the legal formulas for financial and operating leasing in the entity leasing regulations remain consistent with the conceptual understanding that applies in legal doctrine.

For financial leasing, the key feature is the triangular relationship in which three entities are connected through two interrelated contracts: one being the delivery contract concluded by the lessor with the supplier, and the other being the financial leasing contract between the lessor and the lessee. Furthermore, the function of financing by the lessor is highlighted, as well as the transfer of ownership risks to the lessee in a financial leasing arrangement. This is what differentiates financial leasing from operating leasing, where the triangular relationship does not exist and the position of the lessor relative to the lessee resembles that of a classic lease relationship. Another distinguishing feature, clearly outlined in the entity leasing regulations, is the lack of an option to purchase the leased asset for the lessee in operating leasing transactions.

Despite this substantial distinction, there are different approaches to regulating leasing in our immediate surroundings. What should be changed as soon as possible in the entity leasing regulations, and which has been identified in this paper as a serious obstacle to the further development of the leasing industry, are the status provisions limiting the operations of leasing companies across Bosnia and Herzegovina. The current state is evidently discriminatory, as leasing companies from the Federation of BiH (FBiH) or the Republic of Srpska (RS) can only operate in the other entity's territory if they are registered as branches. The problem could be even bigger, as it shows the latent risk of introducing a dual regime for leasing companies from FBiH operating as branches in RS. On the other hand, alignment

between civil law and tax law qualifications for financial leasing in terms of goods delivery occurs when an extension option is agreed upon, the amortization period exceeds 90% of the asset's useful life, or when a purchase option is agreed upon or mandatory ownership transfer is established at the end of the lease agreement. However, doctrinally, the issue of harmonizing civil and tax qualifications can be seen as a minor issue in comparison to the practical consequences of the taxation procedure for operating and financial leasing transactions.

REFERENCES

- Babić, I. (2011). *Civil Law*. Volume 1: Introduction to Civil Law. Banja Luka: Faculty of Law in Banja Luka.
- Bernd, P., Schmid-Burgk, K.(2007), *Das Leasinggeschäft*, 2. Aufl., Rn. 1 Köln.
- Cicmil, N. (2008). Supervision of the National Bank of Serbia over Financial Leasing Transactions. *Legal Life*. No. 12.
- Contino, R.M.(2002), *Complete Equipment-Leasing Handbook: A Deal Maker's Guide with Forms, Checklists and Worksheets*, AMACOM.
- Draškić, M. (1990). *International Economic Law*. Sixth Edition. Belgrade: Savremena administracija.
- Đurđević, M. (2002). Legal Characteristics and Key Elements of the Financial Leasing Contract. *Legal Life*. No. 11.
- Gavella, N. (2005). : *Civil Law and Belonging of Legal Systems to Legal Circles*. In: N. Gavella, M.Alinčić, P. Klarić, K. Sajko, T. Tumbri, Z. Stipković, T. Josipović, I. Gliha, R. Matanovac, H.Ernst, H. *Theoretical Foundations of Civil Law – Civil Law and Belonging of the Croatian Legal System to the Continental European Legal Circle* (ed.Gavella, N.). Zagreb: Faculty of Law, University of Zagreb.
- Giovanoli, M. (1980). *Le crédit-bail (Leasing) en Europe: Development and Legal Nature*. Paris.
- Gligorić, Č. (2005), Ekonomski, knjigovodstveni i pravni aspekt lizinga, *Pravo i privreda*, 5-8/2005.
- Korica, M. (2011). *Leasing of Equipment*. Zagreb: Trgovačka akademija;
- Košćica, D. (2003). *International contracts of importance for countries in transition – leasing contracts clauses*. Nr. 11.
- Lukić, R. (2004). *Financial Accounting of Leasing*, Belgrade.
- Martinek, M. (1991). *Moderne Vertragstypen – Band I: Leasing und Factoring*, Munich.
- Medić, D. (1995). Leasing. *Advokatura - Journal of the Bar Association of the Republic of Srpska*. No. 13-14.
- Mäntysaari, P. (2009), *The Law of Corporate Finance: General Principles and EU Law Volume III: Funding, Exit, Takeovers*, Springer.
- Okičić, M., Bijorac, R. (2003) . Financial Leasing – A New Opportunity for Safer Placement of Bank Funds. *Legal Life*. No. 11.
- Perović, J.(2003). *Commentary on the Law on Financial Leasing*. Glossary. Belgrade.
- Popov, D. (2009). *Civil Law*. 6th edition. Novi Sad: Faculty of Law in Novi Sad.
- Povlakić, M. (2001). *Modern Tendencies in the Development of Collateral Instruments, with Special Focus on the Non-Possessory (Registered) Pledge*. Sarajevo: Faculty of Law in Sarajevo.
- Schrot, P.W.(2011), Financial Leasing of Equipment in the Law of the United States, *Uniform Law Review*, Vol. 16, Issue 1-2/2011.

- Sredović, J. (2008). *Comment on the application of new standards (MFSI and MRS) with interpretation (IFRIC SIC)*. Belgrade. Poslovni biro.
- Stanković, O., Vodinelić, V. (1996). *Introduction to Civil Law*. Belgrade: Nomos. Vasiljević, M. (1999). *Business Law*. Sixth Revised and Updated Edition. Belgrade: Savremena administracija.
- Trifković, M. (2001), *Međunarodno poslovno pravo*, Ekonoski fakultet u Sarajevu, Sarajevo.
- Velimirović, M. (2001). *Commercial Law*. East Sarajevo: Law Faculty of East Sarajevo University.
- The Civil Code of the SFRY ("Official Gazette of the SFRY", Nos. 29/78, 39/85, 45/89, and 57/89).
- The Law on Foreign Trade Policy of Bosnia and Herzegovina ("Official Gazette of BiH", No. 7/98).
- VAT Law of Bosnia and Herzegovina ("Official Gazette of BiH", no. 9/05 and 35/05).
- Law on Financial Leasing of Republic of Serbia ("Official Gazette of RS", No. 55/03, 61/05, and 31/11).
- Law on Financial Leasing of Montenegro ("Official Gazette of Montenegro", No. 81/05).
- Law on Leasing of Republic of Croatia ("Official Gazette", No. 141/13).
- Law on Leasing of the Republic of Srpska ("Official Gazette of RS", Nos. 70/07, 116/11).
- Law on Leasing of the Federation of Bosnia and Herzegovina ("Official Gazette of FBiH", Nos. 85/08, 39/09, 65/13, and 104/16.).

PERFORMANCE ANALYSIS AND AUDIT OF BANKS' FINANCIAL STATEMENTS IN THE REPUBLIC OF SERBIA

Biljana Jovković

Faculty of Economics, University of Kragujevac, bjovkovic@kg.ac.rs,
ORCID number 0000-0003-2433-0963

Aleksandra Radojević*

Faculty of Economics, University of Kragujevac, aleksandra.radojevic@ekonomski.org,
ORCID number 0000-0001-8000-9248

Abstract: Banks are financial institutions of great importance for maintaining the stability of a national economy. The stable and profitable operations of banks will prevent market disturbances and means that banks are ready to support all other participants through the provision of credit and deposit services. Fraudulent financial reporting and irregularities in financial statements that have occurred in history have shown the special role and importance of audit firms. Presenting the auditor's opinion in an audit report ensures greater certainty for decision makers who are interested in those audited financial statements. Auditors cannot provide a complete guarantee, but provide a high degree of assurance that the examined financial statements provide a proper insight into the condition and success of the banks. The subject of research in the paper will be the realized performance of banks operating in the Republic of Serbia, specifically focusing on profitability, liquidity and management quality of the observed banks. Additionally, the subject of the research will be the audit reports of the banks, that is, the opinions of the auditors for the financial reports of the observed banks will be identified. The aim of the research is to determine the interdependence of the observed financial indicators of bank operations. An additional goal of the research is the analysis of audit opinions presented for the financial statements of banks in the Republic of Serbia and the determination of the connection between the financial indicators and the audit opinions. The most desirable audit opinion is a positive opinion and means that banks truthfully and objectively present their state and business success in financial reports.

Keywords: Banks, Auditor's report, Auditor's opinion, Republic of Serbia, Financial statements

JEL Classification: M 42

* Corresponding author

1. INTRODUCTION

In accordance with the business activities and services provided by banks as financial institutions, and consequently with their impact on all segments of society, their importance and the need for adequate regulation of business conditions can be discussed, as well as the monitoring of the results these institutions achieve. Business results and financial indicators reflect the condition and role of banks in the financial system of a country. The performance of banks significantly affects various stakeholders. Additionally, in order for users of financial statements to have a high degree of trust in the presented financial statements of banks, external confirmation of the information presented in them is necessary. Namely, by expressing an opinion on the truthfulness and objectivity of the information presented in the banks' financial reports, auditors increase the level of trust and ensure the safety of users of financial and audit reports. The exceptional importance of banks as institutions has influenced the creation of conditions, regulations and rules that they must fulfill. Seen as a whole, the supervision of bank operations consists of several segments, which includes internal controls followed by internal audit, then there is the necessity of independent examination of external auditors, i.e. external audit and supervision performed by the National Bank of Serbia (Jovković & Radojević, 2024, 27).

The performance indicators of all companies change over time under the influence of numerous factors, internal and/or external, and in this sense it is important to monitor business operations, that is, performance indicators over time. The main goal of business operations of companies/banks is to achieve the best possible result, i.e. greater profitability. In contrast to profitability is liquidity, which must be satisfied, that is, the company/bank must be able to settle all its obligations within the stipulated period. A significant tool for measuring and evaluating the performance of banks is the CAMELS model. CAMELS is an international bank rating system in which a supervisory authority, such as the Central Bank, rates banking institutions according to six elements (Inyada et al., 2019, 41).

The subject of research in this paper is the performance achieved by banks operating in the Republic of Serbia, that is, profitability, liquidity and management quality of the observed banks. The analyzed indicators are part of the CAMELS model structure. If the bank encounters certain problems, this will be reflected in the financial indicators of its operations, which is an appropriate warning sign for all stakeholders. Also, the subject of the research will be the audit reports of the banks, that is, the opinions of the auditors for the financial reports of the observed banks will be identified.

In accordance with the defined research subject, the aim of the research is to determine the interdependence of the observed financial performance indicators of banks. The value of these performance indicators largely shows the bank's ability to harmonize all the demands that are imposed on it, while at the same time achieving the best possible business results, without jeopardizing its survival. In this sense, wants to be examined the connection between the observed variants, that is, to show the strength of the connection between these performances. An additional aim is the analysis of audit opinions presented for the financial statements of banks in the Republic of Serbia and the determination of the connection between the banks' financial indicators and the audit opinions obtained. First, a review of the literature and previous research that dealt with the observed problem area will be performed, after which the research methodology will be presented. The financial indicators of banks' operations will be

analyzed, as well as whether a strong financial position of the bank is related to the opinion provided by the auditor for that specific bank.

2. LITERATURE REVIEW

Modern banks have a role and a number of functions of great importance, as financial institutions dedicated to providing loans, create credits, mobilize savings and economic development (Knežević et al., 2021, 66). The efficiency of the banking system is one of the important issues in the monetary and financial environment (Kosmidou & Zopounidis, 2008, 80).

The quality of management is one of the key elements that affects the achieved performance of banks, and is a prerequisite for the success and development of every bank (Singh & Al-Balushi, 2016, 60). Indicators of bank performance include, among others, profitability ratios, such as return on assets and return on equity (Aebi et al., 2012, 3217). Antoun, Coskun and Georgievski use ROA and ROE indicators as profitability indicators of the CAMELS model in examining the performance of banks in Central and Eastern Europe (Antoun et al., 2018, 520). ROA, which represents the ratio of net income to total assets, and ROE, which is obtained as the ratio of net income to share capital, are indicators of financial health in banking (Wanke et al., 2019, 57).

A bank should dispose of sufficient amounts of cash, to compose its assets from the most liquid sources of funds and to have available lines for quick taking of short-term loans, in order to maintain its liquidity (Vesić et al., 2019, 8). Holding higher amounts of cash can reduce banks' liquidity risk (Berger & Bouwman, 2013, 153). A bank's liquidity is its ability to meet its obligations as they fall due.

Research that examined the profitability of banks (Domanović et al., 2018) showed a high degree of correlation between ROA and ROE indicators during the period from 2012 to 2015. year, however, these profitability indicators show a low degree of correlation with capital adequacy, even in some years this relationship is negative. An earlier study focused on banks in Morocco from 2010 to 2016 investigated the correlation between profitability indicators (ROA and ROE) and capital adequacy and liquidity (Jaouad & Lahsen, 2018). The results show that capital adequacy is positively related to ROA and negatively to ROE indicator, i.e. liquidity is negatively related to both profitability indicators, but weakly positively related to capital adequacy.

Earlier research showed a negative and weak correlation between liquidity indicators (L1 - the ratio of cash and balances with central bank and total assets; L3 - the ratio of total liabilities and total assets), based on reports from the period 2008 to 2013, which is interpreted and confirms the theoretical assumptions that the increase in the share of loans in total assets affects the decrease in liquidity measured by the ratio of cash to total assets (Milošević-Avdalović, 2017).

Gosh et al. (2024) claim in their research that the financial statements of banks are more reliable than the financial statements of companies that are not banks, that is, they found that auditors invest less effort in auditing banks than in auditing of non-banking institutions. These authors note that the combination of bank auditing and banking regulation/supervision significantly improves the quality of bank internal control and the reliability of financial

statements, despite auditors having a smaller workload. Due to frequent changes in the environment, various forms of internal supervision are subject to continuous improvement and modification (Jovković & Radojević, 2024, 36), which allows auditors to use the results of the work of participants who established different forms of control in banks, as well as those who have already conducted specific tests and verifications. In this way, the volume of work is reduced, and a high degree of reliability is ensured as a result of the auditor's work.

Regardless of the scope of work and testing conducted by auditors, their work and the activity of auditing financial statements increases the credibility of the reviewed reports. Auditors do not provide an absolute guarantee, but a high degree of assurance that the financial statements are reliable. Accordingly, the auditor's report contains the relevant opinion and the presented results of the auditor's work, that is, the conclusion reached by the auditor after reviewing the relevant evidence. The auditor's opinion can be a unmodified opinion and a unmodified opinion with emphasis of matter, as the two most desirable forms of opinion, and in addition to these unmodified opinions, the auditor can issue one of the modified opinions, which are qualified opinion, disclaimer of opinion or adverse opinion (Law on auditing, article 39).

Based on the observed problem area, in accordance with the defined subject and aim of the research and following the review of the literature, the hypotheses from which the paper is based are:

H1: There is a statistically significant positive correlation between the indicators of management quality, profitability and liquidity.

H1.1: There is a statistically significant positive correlation between the indicator of management quality and profitability.

H1.2: There is a statistically significant positive correlation between the indicator of management quality and liquidity.

H1.3: There is a statistically significant positive correlation between the indicators of profitability and liquidity.

H2: There is a statistically significant relationship between financial indicators of banks and auditor's opinion issued.

3. METHODOLOGY

The research was conducted based on publicly available secondary data found in the financial statements of banks for a five-year period (from 2019 to 2023). Data on the banks' operations were obtained from their financial reports, which were sourced from the websites of the National Bank of Serbia, the Business Registers Agency, and the official websites of individual banks. Data regarding the opinions issued by auditors for the financial statements of the banks were obtained from the audit reports for the year under observation. Information about active banks in the Republic of Serbia was obtained from the registry of the National Bank of Serbia. The empirical research includes the sample of 15 banks that were active in 2024, resulting in 75 observations for the five-year period under review. To assess the performance of banks in the Republic of Serbia, seven indicators were used, grouped into four categories. Data on the variables used in the research are presented in Table 1.

Table 1. *Description of variables*

Variables	Method of calculation
Quality of Management (M)	Total assets/Number of employees
Profitability (E)	ROA=Net income/ Total assets
	ROE= Net income /Share capital
Liquidity (L)	L1= Cash and balances with central bank/ Total assets
	L2 = Cash and balances with central bank /Total deposits
	L3 = Total liabilities/ Total assets
Audit opinion	The opinion presented in the audit report

Source: Authors'

For the purposes of the conducted research, qualitative and quantitative economic analysis was used. Quantitative analysis is supported by the method of descriptive statistics and correlation analysis. The degree of linear dependence between the observed variables was determined using the Pearson correlation coefficient. Collected data from publicly available reports distributed by year, were prepared for analysis in the Microsoft Excel program. The data sorted in this way were imported into the SPSS statistical program, where further analysis was carried out.

4. RESULTS AND DISCUSSION

The results of the performed analysis are presented through descriptive statistics, followed by the results of the correlation analysis. The results of descriptive statistics are shown in Table 2, where the data for the observed variables are presented, including the arithmetic mean, minimum and maximum values, median, and standard deviation. The results of the correlation analysis of the financial indicators of the banks are presented in Table 3.

Table 2. *Descriptive statistics*

Variables	\bar{X}	Minimum	Maximum	Median	Standard deviation
M	223,978.93	30,631.00	535,610.00	209,121.00	105,581.14
ROA	0.0119	-0.0399	0.0634	0.0110	0.0139
ROE	0.1735	-0.0892	0.9609	0.1489	0.1808
L1	0.1840	0.0832	0.4780	0.1742	0.0761
L2	0.2494	0.1165	1.1637	0.2077	0.1734
L3	0.8410	0.7011	0.9442	0.8440	0.0486

Source: Autors' calculation

As can be seen in Table 2, the average profitability of banks is 1.19% (measured by the ROA indicator) and 17.35% (measured by the ROE indicator). For the profitability indicators, the standard deviation is higher in the ROE indicator, which means that this indicator has a lower degree of agreement between the observed sample units. The minimum value of management quality is 30,631 (in 000 dinars), which means that this is the minimum realized asset per employee in banks in the Republic of Serbia. For the liquidity indicators, the standard deviation is the lowest for the L3 indicator, which suggests that this indicator has the highest degree of agreement of the sample units in relation to the observed group of liquidity indicators.

Table 3. Correlation analysis – financial indicators

	M	ROA	ROE	L1	L2	L3
M	1					
ROA	0.347**	1				
ROE	0.462**	0.773**	1			
L1	0.044	0.041	-0.045	1		
L2	-0.100	0.046	-0.047	0.469**	1	
L3	0.101	-0.121	0.067	0.345**	0.081	1

Source: Authors' calculation

Note: Statistically significant correlation of the level 0.01(**)

Statistically significant correlation of the level 0.05(*)

The obtained results of the correlation analysis presented in Table 3 show that there is a statistically significant relationship of medium intensity between the profitability indicator ROA, on one hand, and the indicator M, on the other hand, while the relationship with the ROE indicators is strongly positive. A relationship of medium intensity that is statistically significant is present between indicators M and ROE, L1 and L2, as well as between L1 and L3. The strength of the relationship was identified according to the guidelines for determining the strength of the relationship between variables (Pallant, 2009, 135).

The auditor's opinion that is most desirable is a unmodified opinion.. Considering the auditor's opinions issued for the financial statements of banks, it can be said that, in most cases, they confirm that the financial statements accurately and fairly present the financial position, performance, and cash flows of the banks. For the observed 15 banks and for the analyzed period, a unmodified opinion with emphasis of matter was published eight times, and a modified opinions only twice. A unmodified opinion with emphasis of matter is an unmodified form of opinion that draws attention to certain matters that may be of importance to users of the auditor's report. Observed by year, this opinion was expressed for one bank each in 2021 and 2022, while it was expressed twice each in 2019, 2020 and 2023. The banks that received these opinions are *Banka Poštanska štedionica* for 2019 and 2020, *Erste bank* for 2023 and *Srpska banka* for all years of the observed period. *API Bank* in 2019 and *Alta Bank* in 2020 received a modified auditor's opinions. The reason for presenting such an opinion, in the first case, was insufficient respect for the principle of prudence when valuing receivables from debtors, which exposed the bank to significant risk, and the calculation of the allowance for impairment. In the second case, the reason is the mismatch between the purchase of future receivables reported by the bank and reported by the clients.

At the time the research was conducted, there were 79 audit firms active in the Republic of Serbia, of which four companies are members of the "Big Four". During the observed period, it was these four globally dominant auditing firms that conducted the audits of banks. Out of 75 possible cases, 46 audits were carried out by one of these companies, 16 times by *KPMG*, 14 audits by *Deloitte*, 4 times by *PWC* and 12 times by *Ernst & Young*. In the research that analyzed the opinions issued by the auditors for the financial statements of banks in the period from 2011 to 2017, the audit of the financial statements of the banks was mostly entrusted to the members of the "Big Four" which had a dominant participation in the opinions issued (Jovković & Đorđević, 2018, 403).

For the remaining 29 audits, some of the other audit firms in the Republic of Serbia were engaged. These were audit companies *BDO* (8 bank audits), *PKF* (4 audits) and *Moore*

Stephens (17 audits). It is concluded that the members of the "Big Four" have the dominant participation in the audit of financial statements of banks. In a situation where banks did not decide on these leading audit firms, they took into account only a small number of them in relation to all audit firms operating in the Republic of Serbia. The reason for this can be found in the knowledge, experiences, opportunities and abilities to perform audits of banks. Namely, the audit of banks is specific, taking into account the nature of business and the types of transactions they perform, and accordingly, not all audit firms are specialized in performing this type of audit of financial statements. Based on the sample used, a statistically significant relationship was established between profitability indicators ROA and the auditor's opinion expressed in the audit report, this relationship is weakly positive ($r=0.293$) and statistically significant at the 0.05 level. Between the auditor's opinion and other financial indicators (quality of management, profitability measured by the indicator ROE and liquidity), there is no statistically significant relationship was established, i.e. $p>0.05$.

5. CONCLUSIONS AND RECOMMENDATIONS

The purpose of the conducted research was to determine the relationship between the achieved financial results of banks' operations, as well as to determine the relationship between these indicators and the published audit opinion for financial statements. Banks play a significant role in the functioning of a national economy, especially in a market such as the Republic of Serbia, which is bank-centric, and for this reason it is necessary to monitor and control the results of their operations.

In accordance with the results of the research, hypothesis H1 is partially accepted. Hypothesis H1.1. was confirmed, i.e. a positive relationship between profitability indicators and management quality was identified. Hypothesis H1.2. it was not confirmed, that is, a statistically significant relationship between indicators of management quality and indicators of liquidity was not established. And finally, hypothesis H1.3. is rejected, that is, there is no statistically significant correlation between indicators of profitability and liquidity. Hypothesis H2 was partially accepted, because the research identified a statistically significant relationship between the ROA profitability indicator and the auditor's opinion, while no statistically significant relationship was identified between the financial indicators M, ROE, L1, L2 and L3, on the one hand, and the auditor's opinion, on the other hand. A higher value of the indicator ROA may indicate that the bank will receive an unmodified auditor's opinion. That is, higher profitability measured by the indicator ROE, liquidity or management quality does not mean that banks will truthfully and objectively present their financial position and business success. This suggests that factors such as the ethical values of responsible persons in banks, requirements of regulatory bodies and a culture in banks that punishes fraudulent actions and malfeasance related to financial reporting may influence the quality of financial statements.

The obtained results indicate that the audit of financial statements is a complex job and an activity that requires extensive knowledge and experience of the auditor. Auditors must be familiar with the way of functioning and performance of activities in banks in order to perform a quality audit of their financial statements. Future research conducted by the authors could examine the relationship between auditors' opinions and non-financial indicators of bank, such as employee satisfaction, their expertise and competences in relation to the preparation of financial reports, the bank's management policies, and the like.

REFERENCES

- Aebi, V., Sabato, G., & Schmid, M. (2012). Risk management, corporate governance, and bank performance in the financial crisis. *Journal of Banking & Finance*, 36(12), 3213-3226.
- Antoun, R., Coskun, A., & Georgievski, B. (2018). Determinants of financial performance of banks in Central and Eastern Europe. *Business and Economic Horizons*, 14(3), 513-529.
- Berger, A., & Bouwman, C. (2013). How does capital affect bank performance during financial crises?. *Journal of Financial Economics*, 109(1), 146-176.
- Domanović, V., Todorović, V. & Savović, S. (2018). Internal factors of bank profitability in the republic of Serbia. *Business and Economic Horizons*, 14(3), 659-673.
- Ghosh, A., Jarva, H., & Ryan, S. G. (2024). Bank Regulation/Supervision and Bank Auditing. *European Accounting Review*, 1–26.
- Inyada, S. J., Olopade, D. O. & Ugbede, J. (2019). Effect of forensic audit on bank fraud in Nigeria. *American International Journal of Contemporary Research*, 9(2), 40-45.
- Jaouad, E., & Lahsen, O. (2018). Factors affecting banks performance: Empirical Evidence from Morocco. *European Scientific Journal*, 14(34), 255-267.
- Jovković, B., & Radojević, A. (2024). Uloga internog nadzora u regularnosti poslovanja banaka. U: Jovković, B., Čupić, M., Atanasovski, A. & Radić, S. (Ur.), *Računovodstvena znanja kao činilac ekonomskog i društvenog napretka* (str. 27-38) Kragujevac: Ekonomski fakultet Univerziteta u Kragujevcu
- Jovković, B., & Đorđević, M. (2018). Comparative analysis of the cause of modification in auditor's opinion in financial sector and real sector companies. In: Babić, V. (Ed.), *Contemporary issues in economics, business and management* (pp. 401-412) Kragujevac: Faculty of economics University of Kragujevac.
- Knežević, S., Živković, A., & Milojević, S. (2021). Uloga i značaj interne kontrole i interne revizije u sprečavanju i identifikovanju prevarnih radnji u bankama. *Bankarstvo*, 50(1), 66-89.
- Kosmidou, K., & Zopounidis, C. (2008). Measurement of bank performance in Greece. *South-Eastern Europe Journal of Economics*, 6(1), 79-95.
- Milošević-Avdalović, S. (2017). The impact of bank-specific factors on liquidity of commercial banks in Serbia. *Ekonomika preduzeća*, 66(3-4), 257-265.
- Pallant, J. (2009). *SPSS priručnik za preživljavanje*. Beograd: Mikro knjiga.
- Singh, D., & Al-Balushi, A. A. R. (2016). Performance Measurement of GCC Banks: A CAMEL Approach. *Globsyn Management Journal*, 10(1-2), 56-65.
- Vesić, T., Ravić, N., & Đekić, M. (2019). Komparativna analiza pokazatelja likvidnosti najvećih banaka Srbije - indikator merenja performansi. *Anali Ekonomskog fakulteta u Subotici*, 55(42), 3-15.
- Wanke, P., Abul Kalam Azad, M., Emrouznejad, A., & Antunes, J. (2019). A dynamic network DEA model for accounting and financial indicators: A case of efficiency in MENA banking. *International Review of Economics & Finance*, 61, 52-68.
- Law on audit. "RS Official Gazette", no. 73/2019

PROFITABILITY OF SERBIAN INFORMATION TECHNOLOGY COMPANIES: THE IMPACT OF EXPORT

Nemanja Karapavlović*

Faculty of Economics, University of Kragujevac, nkarapavlovic@kg.ac.rs

ORCID: 0000-0002-3421-7828

Vladimir Obradović

Faculty of Economics, University of Kragujevac, vobradovic@kg.ac.rs

ORCID: 0000-0001-6068-0069

Abstract: *The objective of this paper is to examine whether the profitability of Serbian information technology companies differs depending on whether the company is an exporter or non-exporter. Our study covers 100 information technology companies from a developing and transition country of the Republic of Serbia. It relies on hand-collected data from the financial statements for 2021, 2022, and 2023 available on the official website of the Serbian Business Registers Agency. All observed companies are registered under industry code 6201 – Computer Programming. We have divided sample companies into two groups: (1) companies that had sales on foreign markets in all three observed years and (2) companies that had no sales on foreign markets in none of all three observed years. Profitability is measured by (1) return on equity and (2) return on (total) assets (with earnings before interest and taxes in the numerator). We find that exporters are more profitable than non-exporters. However, the differences between profitability indicators are mostly not statistically significant. Although profitability determinants of companies from both developed and developing countries have been studied in many prior studies, to the best of our knowledge, this is the first study on the impact of exports on the profitability of Serbian information technology companies.*

Keywords: *profitability, export, Serbian information technology companies*

JEL Classification: *M 41*

* Corresponding author

1. INTRODUCTION

As in the case of countries that belong to the European Union (EU), the industry of information and communication technologies (ICT) plays an important role in the future growth of the Western Balkan economies (Kleibrink *et al.*, 2018, 6), to which the Republic of Serbia (RS) belongs. The main components of EU exports of services in 2023 were (1) other business services, (2) telecommunication, computer, and information services, and (3) transport. Percentage share of those services in total services exports was 23.4%, 20.5%, and 17.7%, respectively. In the same year, the value of EU exports of telecommunication, computer, and information services was 2.6 times as high as the value of EU imports of the same services (Eurostat, 2024). The RS generates 10% of its Gross domestic product (GDP) from the ICT sector, which is among the top four export sectors, along with steel, cars, and agriculture (ITA, 2024).

Considering that the ICT sector is one of the key factors that influence the economic growth and innovation of society, their development and application are often the focus of national and regional development strategies (Kalinić and Ranković, 2019, 480). Moreover, as the Fourth Industrial Revolution progressed, the trade of ICT services experienced rapid growth capturing the attention of numerous researchers (Zhang *et al.*, 2024). Nath and Liu (2017, 81) point out that ICT development has significant positive contributions to the growth of international trade in most service items, whereas Kalinović *et al.* (2022, 189) marked ICT services as the most dynamic component of international trade in the first two decades of the 21st century. Considering the above, the motivation for this paper arises, whereas the objective of the paper is to examine whether the profitability of Serbian information technology companies differs depending on whether the company is an exporter or non-exporter. Our research covers 100 information technology companies from the RS and relies on hand-collected data from the financial statements for 2021, 2022, and 2023 available on the official website of the Serbian Business Registers Agency (SBRA).

The next section of the paper reviews the literature regarding the relationship between exports and the profitability of companies. Thereafter, the research sample, methodology, and results of empirical research are presented and discussed.

2. LITERATURE REVIEW

The profitability of companies from developed and developing countries has been examined from various aspects and previous research revealed numerous profitability determinants. In that regard, Return on Assets (ROA), Return on Equity (ROE), and Return on Sales (ROS) are the most often used profitability measures, and liquidity, leverage, sales growth, company size, company age, export intensity, capital intensity, effective tax rate, lagged profitability, etc. are analyzed as profitability determinants. Wagner (2012, 253) points out that the number of studies regarding export and profitability is still small and the number of countries covered is even smaller, whereas the results differ widely across the studies. Similar observation also exists in the more recent research (Čupić and Vržina, 2024, 130). Below we discuss the results of available empirical research regarding the relationship between exports and profitability.

Fryges and Wagner (2010) (according to Wagner, 2012a), based on the research covering German manufacturing companies from 1999 to 2004, find that exporters are more profitable

than non-exporters, but the difference in profitability is small. They also find that the profit rate tends to increase with the increase in the export-sales ratio. Wagner (2012a) also examined German manufacturing companies, but from 2003 to 2006 by using gross firm surplus as a measure of the return rate (computed as gross value added minus gross wages minus costs for social insurance divided by total sales minus net change of inventories). He finds that the average return rate tends to be similar between the groups of companies with different forms of international activities (companies (1) without international trade, (2) that only export, (3) that only import, and (4) that both export and import). Grazzi (2009) finds that the exporting activity of Italian manufacturing companies from 1989 to 2004 is not systematically associated with higher company profitability measured by ROS. On the other hand, Kox and Rojas-Romagosa (2010) find that the profitability of exporters is higher than the profitability of non-exporters. They measured profitability as gross value added minus wages and minus depreciation and analyzed Dutch companies from 1997 to 2005. Kao *et al.* (2023) examined the relationship between trade activities and profitability for Taiwanese manufacturing companies from 2006 to 2016. They find that trading firms (two-way trade, exporter only, and importer only) have higher profitability than local firms, which do not engage in international trade.

Considering the objective of this paper and sample structure, it is useful to review previous research regarding service companies, small and medium-sized (SME) companies, and companies from the RS. Temouri *et al.* (2011) (according to Wagner, 2012a) find that French service exporters are more profitable than non-exporters, whereas German service exporters are less profitable than non-exporters. Vogel and Wagner (2010) (according to Wagner, 2012a) find that German service exporters are less profitable compared to non-exporters, but the difference is small. Temouri *et al.* (2013), among other things, compared the profitability of service exporters and non-exporters from France, Germany, and the United Kingdom. They used profit rate (computed as gross value added minus gross wages divided by total sales) as a profitability measure. Their research shows that profitability differs across borders. Namely, the profitability of exporters is statistically and economically significantly smaller in Germany and statistically significantly larger in France and the United Kingdom.

Maurel (2009) conducted the study on a sample of 214 French SMEs wineries to determine the most important factors for improving export performances. The study reveals that business partnerships, innovation, greater size, and an effective export commitment are linked to higher levels of export performance. Bava and Gromis di Trana (2016) examined the profitability determinants of 45 SME wine producers from the Piedmont region in Italy. They find that export intensity (ratio of export sales to total sales) has a positive and statistically significant impact on ROA with Earnings before Interest and Taxes (EBIT) in the numerator and the relation between EBIT and operating revenues, whereas the impact on the relation between operating revenues and total assets is positive but statistically insignificant.

Andrašić *et al.* (2018) find a positive and statistically significant impact of exports (as a dummy variable) on the profitability measured by ROA with net income in numerator. Their sample consists of 420 medium-sized and large agricultural companies from the Vojvodina region in the RS, from 2006 to 2015. Čupić and Vržina (2024) examined the relationship between exports and performances (productivity and profitability) in a sample of 500 Serbian companies from 2014 to 2018. They measured profitability using ROA, ROE, and ROS, whereas exports were measured by the ratio of export sales to net sales. On the sample level, they find that export is positively and statistically significantly associated with ROE, whereas

observation for the manufacturing industry shows that export is positively and statistically significantly associated with both ROA and ROE.

Based on the results of the previous research, the following research question (RQ) is formulated:

RQ: Are exporters from the Serbian information technology sector more profitable than non-exporters from the same sector?

3. RESEARCH SAMPLE AND METHODOLOGY

Our sample comprises 100 randomly selected Serbian information technology companies. All observed companies are registered under industry code 6201 – Computer Programming. The structure of the sample is shown in Table 1.

Table 1. *Sample structure*

	Number of companies	%
<i>SIZE*</i>		
Micro	45	45.00
Small	43	43.00
Medium-sized	7	7.00
Large	5	5.00
<i>Total:</i>	100	100.00
<i>LEGAL FORM</i>		
Limited liability company	98	98.00
Stock company	2	2.00
<i>Total:</i>	100	100.00
<i>FINANCIAL REPORTING BASIS IN 2023</i>		
Full IFRS	11	11.00
IFRS for SMEs	51	51.00
Ordinance of the Minister of Finance	38	38.00
<i>Total:</i>	100	100.00
<i>AGE** (in years)</i>		
Up to 20	45	45.00
20 and up	55	55.00
<i>Total:</i>	100	100.00

*Classification is based on the 2019 Accounting Law.

**Difference between the date of the last available statement of financial position and incorporation date.

Source: Authors' calculation

Most of the sampled companies are micro and small (88%), and almost all are organized as limited liability companies. This is not surprising, because most Serbian companies that submitted financial statements for 2023 to the SBRA (2024) are micro or small limited liability companies. The majority of sampled companies are permitted to choose a financial reporting basis (large and listed companies, as well as those that prepare consolidated financial statements, are obligated to use full IFRS). In that regard, the majority of micro companies (84%) have opted for the Ordinance of the Minister of Finance, whereas about

13% of them have opted for IFRS for SMEs. About 78% of middle-sized and 93% of small companies have also opted for IFRS for SMEs.

The research is based on the individual statements of financial position (balance sheets) at the end of 2021, 2022, and 2023 and income statements (statements of net income) for the same years available at the official website of the SBRA and relies on hand-collected data from the mentioned financial statements. In the information collection process, we have relied on comparative information presented in financial statements because they are more reliable than the original information (Obradović and Karapavlović, 2020, 295).

Čupić and Vržina (2024, 132) point out that a company that sells on foreign markets is not necessarily an active exporter. In that sense, we have divided sample companies into (1) those with sales on foreign markets in all three observed years – exporters and (2) those with no sales on foreign markets in none of the observed years – non-exporters. The ICT companies with sporadic export activity are excluded from further analysis. The profitability of observed companies is measured by (1) ROE and (2) ROA (with EBIT in the numerator – ROA_{EBIT}). To measure the determinants of the mentioned profitability indicators, we have also calculated (a) Equity Turnover Ratio (EQTR) and Return on Sales (ROS) (in the case of ROE) and (b) Total Assets Turnover Ratio (TATR) and EBIT margin (in the case of ROA_{EBIT}). The calculation process of the mentioned variables is shown in Table 2.

Table 2. Definition of profitability indicators and its determinants

Variable	Definition
ROE (in %)	$(\text{Net income} / \text{Average equity}) \times 100$
EQTR	$\text{Sales} / \text{Average equity}$
ROS (in %)	$(\text{Net income} / \text{Sales}) \times 100$
ROA_{EBIT} (in %)	$(\text{EBIT} / \text{Average total assets}) \times 100$
TATR	$\text{Sales} / \text{Average total assets}$
EBIT margin (in %)	$(\text{EBIT} / \text{Sales}) \times 100$

Source: Authors' calculation

We have used the Mann-Whitney U test for data processing because we compared companies from two groups – exporters and non-exporters. Our choice to use this non-parametric test is also supported by the fact that our variables do not have a normal distribution. We have used the 0.05 level (α) to determine statistical significance. The data collected is processed using IBM® SPSS® Statistics 26 software package and Microsoft Excel program.

4. RESULTS AND DISCUSSION

On a three-year average, the ROE of observed companies is 20.15%. The comparison of 2022 with 2021 shows that ROE increased in the case of 45% of companies and decreased in the case of 55% of companies. When we compared 2023 and 2022, ROE increased in the case of 38% of companies, decreased in the case of 60% of companies, and did not change in the case of 2% of companies. The average ROA_{EBIT} for observed companies is 15.43%. ROA_{EBIT} increased in the case 47% of companies and decreased in the case of 53% of companies in 2022 compared to 2021. The comparison of 2023 with 2022 shows that ROA_{EBIT} increased in the case of 39% of companies, decreased in the case of 59% of companies, and retained the same value in the case of 2% of companies.

We have identified 59 exporters, 26 non-exporters, and 15 companies with sporadic export activities in 2021, 2022, and 2023. It means that about 60% of companies in our sample are exporters. The export intensity ratio for that group of companies is about 52%, whereas the median value is 51%. The export intensity ratio is 100% in all three observed years in the case of 14% of exporters, whereas that ratio is over 80% in the case of 36% of exporters. In the case of 47% of exporters, the export intensity ratio is over 50%, whereas this ratio is less than 10% in the case of 15% exporters.

Table 3 shows that the median value of the ROE of exporters is higher than the median value of the ROE of non-exporters in all three years. However, the difference is statistically significant only in 2023. Effect size statistics (r) show that the differences are small. In the same year, there is also a statistically significant and small difference between exporters and non-exporters concerning ROS. In 2021 and 2022, the ROS of exporters is also higher than the ROS of non-exporters, but the differences are not statistically significant. However, non-exporters have higher EQTR than exporters in all three years, but the differences are not statistically significant. It means that, on average, non-exporters achieve more sales using average equity than exporters.

Table 3. Mann-Whitney U (MWU) Tests for ROE and its determinants

	2021	2022	2023
<i>ROE</i>			
<i>MWU</i>	496.000	511.000	362.000
<i>Z</i>	-0.838	-0.838	-2.242
<i>p</i>	0.402	0.402	0.025*
<i>r</i>	0.091	0.091	0.243
Median (exporters)	20.880	19.990	15.920
Median (non-exporters)	19.060	17.865	9.710
<i>EQTR</i>			
<i>MWU</i>	462.500	438.500	510.000
<i>Z</i>	-1.233	-1.682	-0.439
<i>p</i>	0.218	0.093	0.661
<i>r</i>	0.134	0.182	0.048
Median (exporters)	1.910	1.880	1.965
Median (non-exporters)	2.350	3.500	2.240
<i>ROS</i>			
<i>MWU</i>	464.000	496.000	362.000
<i>Z</i>	-1.215	-1.012	-2.242
<i>p</i>	0.224	0.311	0.025*
<i>r</i>	0.132	0.110	0.243
Median (exporters)	9.640	8.170	7.015
Median (non-exporters)	6.340	5.360	2.210

Note: statistically significant at 5% (*)

Source: Authors' calculation

The median ROA_{EBIT} values of exporters are higher than the median ROA_{EBIT} values of non-exporters in 2021 and 2023, whereas the situation is the opposite in 2022. However, those differences are small and are not statistically significant (Table 4). The EBIT margin of exporters is higher than the EBIT margin of non-exporters in all three years, but the difference

is statistically significant only in 2021. In all three years, the differences are small. On average, non-exporters are more efficient in total asset usage. The TATR of non-exporters is higher than the TATR of exporters in all three years. However, the differences are small and insignificant.

Table 4. Mann-Whitney U (MWU) Tests for ROA_{EBIT} and its determinants

	2021	2022	2023
<i>ROA_{EBIT}</i>			
<i>MWU</i>	496.500	547.000	476.000
<i>Z</i>	-1.327	-0.824	-1.179
<i>p</i>	0.185	0.410	0.238
<i>r</i>	0.144	0.089	0.128
Median (exporters)	16.880	12.730	13.520
Median (non-exporters)	13.695	14.840	8.330
<i>TATR</i>			
<i>MWU</i>	473.000	472.500	500.500
<i>Z</i>	-1.588	-1.653	-0.894
<i>p</i>	0.112	0.098	0.371
<i>r</i>	0.172	0.179	0.097
Median (exporters)	1.295	1.325	1.310
Median (non-exporters)	1.635	1.720	1.490
<i>EBIT margin</i>			
<i>MWU</i>	435.000	505.000	444.000
<i>Z</i>	-2.010	-1.291	-1.551
<i>p</i>	0.044*	0.197	0.121
<i>r</i>	0.218	0.140	0.168
Median (exporters)	12.430	10.880	8.480
Median (non-exporters)	3.9450	6.080	5.760

Note: statistically significant at 5% (*)

Source: Authors' calculation

5. CONCLUSIONS AND RECOMMENDATIONS

On the sample of 100 information technology companies from a developing and transition country of the RS, we have examined whether the profitability of information technology companies in 2021, 2022, and 2023 differs depending on whether the company is an exporter (i.e., had sales on foreign markets in all three observed years) or non-exporter (i.e., had no sales on foreign markets in none of the observed years). The profitability is measured by ROE and ROA_{EBIT} . We find that exporters are mostly more profitable than non-exporters. In the case of ROE, exporters are more profitable in all three years, but the difference is statistically significant only in one year. On the other side, the ROA_{EBIT} of exporters is higher in two years and lower in one year, whereas the differences are not statistically significant.

The most important limitation of this research is that the financial statements of the majority of observed companies (81%) were not subject to external audit. In that sense, the amounts from the balance sheets and income statements of those companies should be accepted with caution. The different basis for financial reporting used by observed companies distorts comparability between them and this is also the limitation of our research. Segmentation of

the sample according to the basis used for the preparation of general-purpose financial statements can be a recommendation for future research, but future research should also include more information technology companies and cover more reporting years. The increase in the number of sample companies could enable discrimination analyses regarding not only profitability but also some other variables (such as liquidity, leverage, and company age).

REFERENCES

- Andrašić, J., Mijić, K., Mirović, V., & Kalaš, B. (2018). The modeling factors of agricultural companies performances. *Custos e@gronegocio on line*, 14(4), 223–240.
- Bava, F., & Gromis di Trana, M. (2016). Profitability Determinants in Wine Industry: the case of Piedmont. *Impresa Progetto - Electronic Journal of Management*, 2, 1–20.
- Čupić, M., & Vržina, S. (2024). Firm Exports and Performance: Evidence from Serbia. *Economic Horizons*, 26(2), 127–142. doi:10.5937/ekonhor2402133C.
- Eurostat (2024). *International trade in services by type of service*. Available on: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=International_trade_in_services_by_type_of_service#International_trade_in_services_.E2.80.93_overall_developments (14.10.2024)
- Grazzi, M. (2009). Trade and profitability: Is there an export premium? Evidence from Italian manufacturing firms, *LEM Working Paper Series*, 2009/16, Pisa: Scuola Superiore Sant'Anna, Laboratory of Economics and Management (LEM). Available on: <https://www.econstor.eu/bitstream/10419/89566/1/640625835.pdf> (04.11.2024)
- International Trade Administration – ITA (2024). *Information and Communications Technology Market*. Available on: <https://www.trade.gov/country-commercial-guides/serbia-information-and-communications-technology-market> (14.10.2024)
- Kalinić, Z., & Ranković, V. (2019). Razvoj informacionog društva u Srbiji u funkciji evropskih integracija. In *Ekonomski efekti tranzicije i restrukturiranja privrede Srbije u funkciji evropskih integracija* (Šapić, S., Obradović, V., Drenovak, M., Kostić, M. and Todorović, V., eds.), Kragujevac: Ekonomski fakultet Univerziteta u Kragujevcu, 479–489.
- Kalinović, M., Todorović, M., & Marković, I. (2022). The significance of ICT services for the balance of payments in the Republic of Serbia. *Economic Themes*, 60(2), 187–204. doi: 10.2478/ethemes-2022-0011.
- Kao, E. H. C., Wu, C. Y., & Liu, J. T. (2023). Extensive margins of trade and profitability: evidence from Taiwan. *Applied Economics Letters*, 31(16), 1569–1573. doi: 10.1080/13504851.2023.2203894.
- Kleibrink, A., Radovanović, N., Kroll, H., Horvat, D., Kutlača Dj., & Živković, L. (2018). *The Potential of ICT in Serbia: An Emerging Industry in the European Context*. Available on: <https://publications.jrc.ec.europa.eu/repository/handle/JRC114209> (14.10.2024)
- Kox, H. L. M., & Rojas-Romagosa, H. (2010). Exports and productivity selection effects for Dutch firms. *De Economist*, 158(3), 295–322. doi: 10.1007/s10645-010-9147-0.
- Maurel, C. (2009). Determinants of export performance in French wine SMEs. *International Journal of Wine Business Research*, 21(2), 118–142. doi: 10.1108/17511060910967971.
- Nath, H.K., & Liu, L. (2017). Information and communications technology (ICT) and services trade. *Information Economics and Policy*, 41, 81–87. doi:10.1016/j.infoecopol.2017.06.003

- Obradović, V., & Karapavlović, N. (2020). Restatements of financial statements: causes and consequences, In: *Contemporary Issues in Economics, Business and Management – EBM 2020: Conference Proceedings* (Domanović, V. and Zlatanović, D., eds.), Kragujevac: University of Kragujevac – Faculty of Economics, 289–296.
- Serbian Business Registers Agency – SBRA (2024). *Financial Statements: Annual Bulletin*. Available on:
https://apr.gov.rs/upload/Portals/0/GFI_2024/Bilten/Bilten_GFI_2023__1_.pdf
(10.10.2024)
- Temouri, Y., Vogel, A., & Wagner, J. (2013). Self-selection into export markets by business services firms – Evidence from France, Germany and the United Kingdom. *Structural Change and Economic Dynamics*, 25, 146–158. doi: 10.1016/j.strueco.2012.02.004.
- Wagner, J. (2012). International Trade and Firm Performance: A Survey of Empirical Studies since 2006. *Review of World Economics*, 148(2), 235-267. doi: 10.1007/s10290-011-0116-8.
- Wagner, J. (2012a). Exports, imports and profitability: First evidence for manufacturing enterprises. *Open Economies Review*, 23(5), 747–765. doi: 10.1007/s11079-011-9235-z.
- Zhang, Y., Xu, J., & Yang, W. (2024). Analysis of the evolution characteristics of international ICT services trade based on complex network. *Telecommunications Policy*. 48(3), Article 102697. doi: 10.1016/j.telpol.2023.102697.

USING EVENT STUDY ANALYSIS TO DETERMINE THE INFLUENCE OF DONALD TRUMP'S ELECTION RESULTS ON FINANCIAL SECTOR

Nenad Tomić*

Faculty of Economics, University of Kragujevac, ntomic@kg.ac.rs

ORCID: 0000-0003-1565-3197

Aleksandra Vasić

Faculty of Economics, University of Kragujevac, apesterac@kg.ac.rs

ORCID: 0000-0002-2843-1000

Violeta Todorović

Faculty of Economics, University of Kragujevac, v.todorovic@kg.ac.rs

ORCID: 0000-0002-3258-160X

Abstract: *The event study methodology was applied in this paper in order to determine the effects of the results of the presidential elections in the United States of America on financial sector companies. The analysis focused on three election cycles in which Donald Trump participated as the candidate of the Republican Party. The goal was to determine whether the election results led to the creation of an abnormal return and, if so, what was its sign. The assumption is that the sign of the abnormal return will depend on the outcome of the election, because in general the Republican Party is perceived as the protector of big business, primarily due to the practice of relaxing regulatory and tax solutions in various areas. The research showed that the financial sector reacts to the outcome of the presidential elections and that the reaction is consistent through different election cycles. Republican candidate victories produced a positive abnormal return in the financial sector, while Democratic candidate victory produced a negative abnormal return. All tests confirm the existence of statistically significant returns in the post-election period. In the period before the elections, the situation is somewhat different, because the tests do not always succeed in confirming the statistical significance of abnormal returns. The general trend in the part of the period of events before the election day itself depends on the exit polls, that is, on the rational expectations of the market, so even in that case, a positive return is recorded when the polls give a bigger chance to the Republican candidate, that is, a negative return is present when the polls favour the Democratic candidate.*

Keywords: *Event study, Donald Trump, financial sector, abnormal return*

JEL Classification: *G 14, C 12*

* Corresponding author

1. INTRODUCTION

Donald Trump represents the most expressive eccentric among the presidential candidates in the United States of America in recent history. He participated as a candidate of the Republican Party in the presidential elections of 2016, 2020 and 2024. In the first and third elections, he defeated the candidates of the Democratic Party, Hillary Clinton and Kamala Harris, while in the 2020 elections he was defeated by Joe Biden. In addition to the very sharp and exclusive political (Winberg, 2017) and economic views (Cassidy, 2024) that he advocated during all three presidential campaigns, his professional background has a great influence in the assessment of his rule. He is one of the few presidents who took office as a personal representative of high business, and because of that, there were certain expectations of the professional public on all three occasions. In general, the Republican Party was perceived as the protector of big business, primarily due to the practice of relaxing regulatory and tax solutions in various areas (Lee, Nelson & Wiley, 2024). For decades, there has been a belief that the financial sector is favourable to the Republicans, regardless of the fact that the largest institutions appear as financiers in both campaigns.

The event study enables the determination of an abnormal return on the financial market, which occurs as a consequence of a specific event (Fama et al., 1969). By applying parametric and non-parametric tests, it is determined whether the return of the observed stocks in the event period tends to move outside the value of the projected trend. Since in practice there will always be a certain difference in relation to the trend, the statistical significance of the calculated deviation is determined. Deviation can be positive or negative, so it can be concluded whether the observed event had a positive or negative impact. It is important that during the period in which the existence of an abnormal return will be determined, no other events occur, which may further disrupt the movement of the observed stocks' returns.

The paper will apply the event study methodology in order to determine the effects of the results of the presidential elections in the United States of America on financial sector companies. The focus of the analysis will be three election cycles in which Donald Trump participated as a candidate. The goal is to determine through analysis whether the results of the election led to the creation of an abnormal return and, if so, what was its sign. The assumption is that the sign of the abnormal return will depend on the outcome of the election. Three hypotheses will be tested:

H₁: The victory of Donald Trump in the 2016 election led to a positive abnormal return of the financial sector.

H₂: The defeat of Donald Trump in the 2020 elections led to a negative abnormal return of the financial sector.

H₃: The victory of Donald Trump in the 2024 election led to a positive abnormal return of the financial sector.

In the second part of the paper, a brief literature review is given. In the third part of the paper, the methodology of the event study is presented and the method of sample formation is defined. In the fourth part, the obtained results are analysed.

2. LITERATURE REVIEW

Political events are actually a very common topic in event study analysis. There are many studies that were proving the existence of an abnormal return resulting from the election event. Thus, Niederhoffer, Gibbs & Bullock (1970) analyse the market's reaction to the results of presidential elections in the USA, concluding that the market's reaction on the first day and the first week after the election differs depending on whether the winner is a Republican or a Democratic candidate. The results they reached show that, on average, the market reacts with growth after the victory of the Republican candidate, that is, with a fall after the victory of the Democratic candidate. Riley & Luksetich (1980) also analysed the tendency of the market for the Republicans, concluding that the market rose immediately before the victory of the Democrats, and mostly fell after the election, while in the case of the victory of the Republicans, the market rose immediately after the election. Leblang & Bumba use a comparative analysis to compare the impact of presidential elections in the USA and Great Britain over a period of 7 decades (2005). In this analysis, the authors do not use the event study, but the GARCH procedure.

Roberts (1990) conducted a regression analysis of the impact of the outcome of the 1980 presidential election and the victory of Republican candidate Ronald Reagan on the movement of stock prices of military companies, concluding that there was a positive effect on stock prices. Knight (2006) also performed a sectorial analysis, taking into account several sectors when analysing the victory of George Bush Jr. over Al Gore in the 2000 elections, however, the financial sector was not included in the analysis. Obradović & Tomić (2017) analyzed the victory of Barack Obama over Mitt Romney in 2012, concluding that there is a strong negative reaction of the financial sector due to the defeat of the Republican candidate, which is most pronounced on the first day after the election. Finally, Tomić, Todorović & Jakšić compared the reaction of several sectors after the 2016 and 2020 elections, concluding that the financial sector strongly favoured Donald Trump. The 2016 elections are particularly indicative, because during the observed period, in the days before the election itself, the financial sector recorded a markedly negative abnormal return, because all predictions said that Hillary Clinton would win the election. Conversely, there was a markedly positive abnormal return in the days following the election.

3. METHODOLOGY AND SAMPLES

After selecting the event whose effects will be the subject of analysis, it is necessary to determine the estimation window and the event window. The first represents a sufficiently long period of time lasting 6 to 8 months, during which there were no major market shocks and serves to determine the trend. Since it is a sufficiently long period, numerous events that daily or weekly affect the stock prices of individual companies or groups of companies are compensated during it (Serra, 2002, 2). Based on historical data for the observed stocks and the market indicator, for which the relevant index is most often taken, the expected return for the observed stocks is calculated based on the trend. The period during which will be determined whether there is a statistically significant abnormal return is called the event period. It will be done by comparing historical return and the calculated expected return. This is the period during which one expects the effects of the event to manifest in the market.

In order to determine the abnormal return, the normal return should first be determined. MacKinlay (1997, pp. 17-19) states that there are several models for determining it, but recommends the market model, which will be applied in this paper:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \quad (1)$$

Where R_{it} denotes the normal return of stock i in the moment of time t which belongs to the estimation window, R_{mt} denotes the return of market indicator in the same moment of time, and ε_{it} denotes random error, i.e. residual factor with expected value $E(\varepsilon_{it}) = 0$ and variance $var(\varepsilon_{it}) = \sigma_i^2$, which makes it normally distributed. α_i and β_i are the parameters of the market model and are obtained by the process of regression of the market returns of each stock to the returns of the market indicator.

In order to determine the abnormal return, the expected return for each stock should be calculated, using the market model methodology. Once the expected return $E(R_i)$ is obtained, it will be used to determine the existence of abnormal returns:

$$AR_{it} = R_{it} - E(R_{it}) \quad (2)$$

$$Var(AR_{it}) = \sigma_{\varepsilon_i}^2 \quad (3)$$

Where AR_{it} denotes the abnormal return of stock i in the moment of time t which belongs to the event window, R_{it} denotes historical return of stock i in the same moment of time, and $E(R_{it})$ denotes expected return of the same stock in the same moment of time, with estimation being constructed based on the market model. In practice, the abnormal return exists always, but the question is whether it is statistically significant.

In the analysis, one does not use abnormal return for every single stock, but an aggregate form of it. Aggregation can be performed on two levels: the first one is for every day of event window, which can be used to determine an average abnormal return for day t - \overline{AR}_t :

$$\overline{AR}_t = \frac{1}{N} \sum_{i=1}^N AR_{it} \quad (4)$$

$$Var(\overline{AR}_t) = \frac{1}{N^2} \sum_{i=1}^N \sigma_{\varepsilon_i}^2 \quad (5)$$

The other approach to aggregation is for multiple days on the level of single stock. It can be done for selected days or whole event window, resulting in cumulative abnormal return of stock i - CAR_i :

$$CAR_{i(t_1, t_2)} = \sum_{t=t_1}^{t_2} AR_{it} \quad (6)$$

$$Var(CAR_{i(t_1, t_2)}) = \sigma_{i(t_1, t_2)}^2 = (t_2 - t_1 + 1) \sigma_{\varepsilon_i}^2 \quad (7)$$

Finally, one may determine average cumulative abnormal return - \overline{CAR} .

$$\overline{CAR}_{(t_1, t_2)} = \frac{1}{N} \sum_{i=1}^N CAR_{i(t_1, t_2)} \quad (8)$$

$$Var(\overline{CAR}_{(t_1, t_2)}) = \frac{1}{N^2} \sum_{i=1}^N \sigma_{i(t_1, t_2)}^2 \quad (9)$$

Condition for (3), (5), (7) and (9) is the high value of estimation window (MacKinlay, 1997, 21). For analysis purpose one might need also standardized cumulative abnormal return - $SCAR_i$, which is standardized for single stock by dividing its CAR_i with its standard deviation:

$$SCAR_{i(t_1,t_2)} = \frac{CAR_{i(t_1,t_2)}}{\sigma_i} \quad (10)$$

After determining all categories of abnormal returns, it is possible to perform tests of their significance. It should be emphasized that two types of tests are most often applied - parametric and non-parametric. A condition for applying parametric tests is a normal distribution of test statistics, which is fulfilled for a sufficiently large sample ($N > 30$). For non-parametric tests, this condition is not necessary, so non-parametric tests are recommended in the analysis of small financial markets. From the parametric tests, the t-test, J_1 and J_2 test will be applied in the paper, and from the non-parametric J_3 (Sign test) and J_4 (Corrado test) test.

Using the t-test, the difference between the historical and hypothetical values of some statistic is tested. One can perform a t-test of the average abnormal return for each day, or the cumulative abnormal return for each observed stock. From a practical point of view, it is much simpler to perform testing according to the first approach, because a smaller number of results are obtained, so the test is more transparent and it is easier to draw a conclusion. The t-test statistic is:

$$t = \frac{\overline{AR}_t - AR_0}{s/\sqrt{N}} \quad (11)$$

As the hypothetical value of $AR_0 = 0$, the t-statistic is obtained by dividing the average abnormal return on a specific day by the quotient of the standard deviation of the entire sample during the evaluation period (Samitas & Kenourgios, 2004, 9) and the root of the number of stocks under consideration. Since it is a two-tailed test, the critical value is ± 1.96 with a confidence level of 95%

The remaining two parametric tests, J_1 and J_2 provide a unique result for selected periods within the entire event window. J_1 tests the value of \overline{CAR} , and J_2 tests the value of $SCAR$, with this value being obtained as an average of $SCAR$ values for all observed stocks.

$$J_1 = \frac{\overline{CAR}_{(t_1,t_2)}}{\sqrt{\overline{\sigma}_i^2}_{(t_1,t_2)}} \quad (12)$$

$$J_2 = \sqrt{\left(\frac{N(L_1-4)}{L_1-2}\right)} \overline{SCAR}_{(t_1,t_2)} \quad (13)$$

The values of t_1 and t_2 in (12) and (13) can be taken as any days during the event window. Critical values for these tests are also ± 1.96 with a confidence level of 95%, as these are two-sided tests.

Among the non-parametric tests, the sign test and the Corrado test, which can also be found in the literature under the names J_3 and J_4 tests, will be applied in this research. The sign or J_3 test examines the distribution of the observed statistic around the median value (Luoma,

2011). The statistics of interest in this case will be cumulative abnormal return, i.e. CAR values. The values of CAR for all stocks included in the analysis should be arranged in ascending order, and the median value of CAR should be found according to the principle $(N+1)/2$, where N is the number of observations. The formula for calculating J3 is:

$$J_3 = \left(\frac{N^{+(-)}}{N} - 0.5 \right) \frac{\sqrt{N}}{0.5} \quad (14)$$

In (14), N is the total number of observed stocks, and N+(-) is the number of positive or negative statistics values (in this case, the number of positive CAR values). Usually, the number of positive statistics is used, except in the case of one-sided tests when examining whether the observed event leads to a negative abnormal return. The critical value of the test is ± 1.64 in the case of a two-way test, which will be applied in this paper.

The Corrado test or J₄ test examines the rank of returns for each observed company. The observation period is the estimation window plus the event window. Compared to the previous test, its advantage lies in the fact that now only the rank of the return is important for the analysis, not its sign, so that extreme values have no influence on the value of the test. The formula for the J4 test was given by Cowan (1992) and refined by Kolari & Pynnonen (2008).

$$J_4 = \frac{1}{N} \sum_{i=1}^N \left(K_{i0} - \frac{L_2+1}{2} \right) / S(L_2) \quad (15)$$

$$S(L_2) = \sqrt{\frac{1}{L_2} \sum_{t=T_0+1}^{T_2} \left(\frac{1}{N} \sum_{i=1}^N \left(K_{it} - \frac{L_2+1}{2} \right) \right)^2} \quad (16)$$

In (16), $(L_2 + 1)/2$ is median rank K_{i0} is the rank of return on the event day, $S(L_2)$ is standard deviation of rank of return, K_{it} rank of return for stock i on the day t , $t \in L_2$. Critical value of the test is ± 1.64 in the case of two-sided test.

4. RESULTS AND DISCUSSION

Analyses were conducted on samples of the 50 largest companies in the financial sector listed on the New York Stock Exchange at the time of the election, where the size criterion was market capitalization. SP500 was used as a market indicator in calculating the expected return. A total of 31 companies appear in all three samples, while 16 of them are present in at least two samples. The data was downloaded from *Yahoo! Finance*, while the calculations were performed with the support of the *SPSS 22* statistical package. In all three analyses, six-month estimation windows were used, while the event windows were formulated as $T_{-3} - T_{+3}$ periods, where T_0 is the day of the presidential elections. In doing so, a t-test was performed for each day individually, while aggregate tests were performed in the time horizons $T_{-3} - T_0$ and $T_0 - T_{+3}$. The reason for this is the fact that the unique period $T_{-3} - T_{+3}$ could lead to offsetting negative and positive abnormal returns, giving the wrong conclusion that nothing unexpected happened. A single asymmetric period of events is impossible, because not all events had the same degree of predictability. For example, analyses before the 2016 and 2020 elections said that the victory of the Democratic candidate was very certain, but in the first case they were completely wrong. It can be expected that the market reacted differently in these cases.

Table 1 shows test statistics related to the first Election Day, November 8, 2016. The statistics show that the financial sector was in decline in the days leading up to the election, and that all tests except J_3 identified statistically significant negative abnormal return. It should be borne in mind that immediately before the election, all polls predicted a convincing victory for Hillary Clinton, and that the sector was preparing for this development of the situation. On the day of the election, there is a change in the sign of the return, so that in the days after the election, the market would react strongly positively, which was registered by all the tests. Based on the results presented in Table 1, the hypothesis H_1 is confirmed.

Table 1. Test statistics for the 'elections 2016' event window

period	t-test	J_1	J_2	J_3	J_4
T_{-3}	-0.9881	(-3;0)	(-3;0)	(-3;0)	(-3;0)
T_{-2}	-0.9344	<u>-4.1418</u>	<u>-2.078</u>	-1.6168	<u>-1.8307</u>
T_{-1}	<u>-3.568</u>				
T_0	0.963				
T_{+1}	<u>8.2524</u>	(0;+3)	(0;+3)	(0;+3)	(0;+3)
T_{+2}	<u>4.9147</u>	<u>9.9831</u>	<u>8.4755</u>	<u>2.2562</u>	<u>4.014</u>
T_{+3}	<u>2.0236</u>				

Authors, according to their own calculation

Table 2 shows test statistics related to the second Election Day, November 3, 2020. Similar to the previous event, the financial sector had a slightly negative abnormal return before the elections, which was not registered as statistically significant except by the t-test for the last day before the elections. However, when Joe Biden's victory became certain, the sector reacts negatively, which is registered by all tests. On the third day after the election, a recovery was registered, so the financial sector recorded a slightly positive abnormal return, without statistical significance. Based on the results presented in Table 2, hypothesis H_2 is confirmed.

Table 2. Test statistics for the 'elections 2020' event window

period	t-test	J_1	J_2	J_3	J_4
T_{-3}	-0.6122	(-3;0)	(-3;0)	(-3;0)	(-3;0)
T_{-2}	0.9805	-1.7657	-1.4493	-0.975	-0.8365
T_{-1}	<u>-2.1227</u>				
T_0	0.4145				
T_{+1}	<u>-6.1171</u>	(0;+3)	(0;+3)	(0;+3)	(0;+3)
T_{+2}	<u>-3.919</u>	<u>-4.092</u>	<u>-3.7275</u>	<u>-2.016</u>	<u>-1.994</u>
T_{+3}	0.4755				

Authors, according to their own calculation

Table 3 shows test statistics related to the third Election Day, November 5, 2024. This is the only event where positive abnormal returns are recorded in the period before Election Day. Election Day and the entire post-election period are followed by a positive abnormal return that has high statistical significance. Based on the results presented in Table 3, hypothesis H_3 is confirmed.

The results obtained in the three tests are consistent and show that when the Republican candidate was winning, the financial sector reacted very positively. On the contrary, the financial sector reacted very negatively in case of victory of the Democratic candidate. There

is no consistency in the period before Election Day, but there is a reason for that. Relevant predictions were completely different in these three cases. In the last election, there was no clear advantage of any candidate according to the exit polls, which gave Donald Trump a better chance, considering that in the previous two times he achieved significantly better results than the polls predicted (Tait, 2024). Therefore, in the third event, there is no negative abnormal return present, because the entire market does not expect a negative result.

Table 3. Test statistics for the 'elections 2024' event window.

period	t-test	J ₁	J ₂	J ₃	J ₄
T ₋₃	0.4772	(-3;0)	(-3;0)	(-3;0)	(-3;0)
T ₋₂	1.6258	0.8115	0.988	1.5657	0.8459
T ₋₁	-0.2285				
T ₀	<u>1.9752</u>				
T ₊₁	<u>7.313</u>	(0;+3)	(0;+3)	(0;+3)	(0;+3)
T ₊₂	<u>4.2027</u>	<u>11.2511</u>	<u>8.662</u>	<u>4.8584</u>	<u>4.232</u>
T ₊₃	<u>4.8905</u>				

Authors, according to their own calculation

5. CONCLUSIONS AND RECOMMENDATIONS

The research showed that the financial sector reacts to the outcome of the presidential elections and that the reaction is consistent across different election cycles. Wins for a Republican candidate produced a positive abnormal return on the market, while a victory for a Democratic candidate produced a negative abnormal return. All tests confirm the existence of statistically significant returns in the post-election period. In the pre-election period, the situation is somewhat different, as the tests do not always succeed in confirming the statistical significance of abnormal returns. This is especially true for cumulative tests, while the t-test in some cases shows the statistical significance of the abnormal return for a selected day. The general trend in the part of the period of events before the election day itself depends on the exit polls, i.e. on the rational expectations of the market, so even in that case a positive return is recorded when the polls give a chance to the Republican candidate, i.e. a negative return is present when the polls favor the Democratic candidate.

This research focused on the results of the election in which Donald Trump participated. To fully confirm the idea that the financial sector always reacts to election results consistently, the research should be extended to several election cycles, and at least all presidential elections after the year of 2000 should be included. The important thing that this would bring is changed conditions, because not all election cycles had the character of uncertainty. Also, the next research related to the election results of Donald Trump could include other sectors, in order to fully confirm the idea of the impact of political events on the financial market.

REFERENCES

- Cassidy, J. (2024) What would Donald Trump do to the economy? *NewYorker.com*, October 21.
- Cowan, A.R. (1992). Nonparametric Event Study Tests. *Review of Quantitative Finance and accounting*, 2(4), 343-358. <https://doi.org/10.1007/BF00939016>

- Fama, E., Fischer, L., Jensen, M.C., Roll, R. (1969). The adjustment of stock prices to new information. *International Economic Review*, 10(1), 1-21
- Knight, B. (2006). Are policy platforms capitalized into equity prices? Evidence from the Bush/Gore 2000 presidential election. *Journal of Public Economics*, 90(4), 751-773. <https://doi.org/10.1016/j.jpubeco.2005.06.003>
- Kolari, J.W. & Pynnonen, S. (2008). Nonparametric rank test for event studies. 21st *Australasian Finance and Banking Conference*
- Leblang, D. & Bumba M. (2005). Government partisanship, elections, and the stock market: examining American and British stock returns, 1930–2000. *American Journal of Political Science*, 49(4), 780-802. <https://doi.org/10.1111/j.1540-5907.2005.00155.x>
- Lee, W., Nelson, L.J. & Wiley, H. (2024). Why some Silicon Valley investors are backing the Trump-Vance campaign? *Los Angeles Times*, July 18
- Luoma, T. (2011) *A Sign Test of Cumulative Abnormal Returns in Event Studies Based on Generalized Standardized Abnormal Returns*. Wasa, Finland: Universitas Wasaensis
- MacKinlay, A.C. (1997). Event Studies in Economics and Finance. *Journal of Economic Literature*, 35(1), 13-39
- Niederhoffer, V. Gibbs S. & Bullock, J. (1970). Presidential elections and the stock market. *Financial Analysts Journal*, 111-113.
- Obradović, S. & Tomić, N. (2017). The effect of presidential election in the USA on stock return flow – a study of political event. *Economic Research*, 30(1), 112-124. <https://doi.org/10.1080/1331677X.2017.1305802>
- Riley, W. B. & Luksetich W. A. (1980). The market prefers republicans: myth or reality. *Journal of Financial and Quantitative Analysis*, 15(3), 541-560
- Roberts, B. E. (1990). Political institutions, policy expectations, and the 1980 election: a financial market perspective. *American Journal of Political Science*, 34(2), 289-310
- Samitas, A.G. & Kenourgios, D.F. (2004). Market Efficiency and Signaling: An Event Study Analysis for Athens Stock Exchange. 1st *Applied Financial Economics International Conference “Advances in Applied Financial Economics”*, Samos island, Greece
- Serra, A.P. (2002). *EVENT STUDY TESTS - A brief survey*. Working Papers da FEP no. 117
- Tait, R. (2024). 2024 US presidential polls tracker: Trump v Harris latest national averages. *The Guardian*, November 2
- Tomić, N., Todorović, V. & Jakšić, M. (2023). Measuring the Impact of the US Presidential Elections on the Stock Market using Event Study Methodology. *Journal for Economic Forecasting*, 26(2), 92-103.
- Winberg, O. (2017). Insult Politics: Donald Trump, Right-Wing Populism, and Incendiary Language. *European Journal of American Studies*, 12(2), <https://doi.org/10.4000/ejas.12132>

THE IMPACT OF ISO 9001 STANDARD ON FINANCIAL PERFORMANCE

Ivana Vuković*

Faculty of Economics, University of Kragujevac, ivana.vukovic@ef.kg.ac.rs

ORCID: 0009-0007-7595-0624

Abstract: *In modern business conditions, characterized by complexity, dynamism, and interactivity, constant changes and adaptations to new conditions occur as a normal sequence of events. Companies are increasingly realizing the importance of quality management. As a result, the number of companies implementing the ISO 9001 standard in their operations is growing. The subject of this research is the relationship between the ISO 9001 standard and financial performance. The goal is to determine the effects of implementing the standard on financial performance, i.e. to identify differences in financial performance between companies that have implemented the ISO 9001 standard and those that have not. The empirical research was conducted on a sample of 55 companies in the Republic of Serbia which according to the Accounting law are required to disclose non-financial information. The research is based on statistical data analysis using descriptive statistics, correlation analysis, and the non-parametric Mann-Whitney U test. The results of the research indicated that companies that have implemented the ISO 9001 standard have better financial performance, as measured by liquidity, compared to companies that have not implemented the standard. The main contribution of this paper is to provide insight into the current situation faced by companies in Serbia regarding the implementation of the ISO 9001 standard, given that there are few studies on this subject in Republic of Serbia.*

Keywords: *ISO 9001 standard, quality management, financial performance*

JEL Classification: *L 15, M 41*

* Corresponding author

1. INTRODUCTION

The development of management standards encompasses a wide range of business activities, such as quality management (e.g. ISO 9001), environmental management (e.g. ISO 14001), workplace hazard prevention and the provision of occupational health and safety regulations (e.g. OHSAS 18000), as well as corporate social responsibility (e.g. SA 8000) (Boiral & Heras-Saizarbitoria, 2013). The ISO 9001 standard, which relates to quality management, is not a performance standard, but rather a standard that provides guidelines for systematizing and formalizing a company's processes. More specifically, ISO 9001 standardizes procedures, duties, and roles, but not goals and outcomes (Guler, Guillen & MacPherson, 2002). In recent decades, quality management systems and their corresponding standards have expanded globally. The international organization for standardization reports that the number of certifications issued for the ISO 9001 standard reached 1,129,446 by the end of 2013 (Martí-Ballester & Simon, 2016). When it comes to quality management standards, some researchers argue that industrial companies can recover their investments in implementation more quickly than other types of companies. They found that, in less than three years, 66.39% of industrial companies had recovered their investments, 46.43% of service companies, and 72.73% of manufacturing and service companies. They also discovered that medium-sized companies recover their investments in the ISO 9001 standard more quickly than large companies, and that 66.67% of multinational companies recoup their investments in less than two years, with 83.33% doing so in less than three years. On the other hand, they concluded that 46.60% of domestic companies recovered their investments in less than two years, and 58.17% in less than three years (Aba, Badar & Hayden, 2014 according to: Santos, Costa & Leal, 2012).

Given the growing importance of the implementation of the ISO 9001 standard (Sharma, 2005; Cândido, Coelho & Peixinho, 2015; İlkay & Aslan, 2012; Astrini, 2018; Martí-Ballester & Simon, 2017), and taking into account the relatively small number of studies addressing this issue, a certain research gap can be identified, which this study aims to address. It is expected that this research will contribute to a better understanding of the importance of implementing the ISO 9001 standard. The conducted research is significant as it sheds light on the current situation of companies in the Republic of Serbia regarding the implementation process of the ISO 9001 standard, as well as its impact on the financial performance of companies.

The subject of this research is the relationship between the ISO 9001 standard and financial performance. The goal is to determine the effects of implementing the standard on financial performance, specifically to identify differences in financial performance between companies that have implemented the ISO 9001 standard and those that have not.

The research primarily used a qualitative methodology, with the study being conducted through inductive and deductive methods. In conducting the empirical research, certain quantitative methods were employed, such as descriptive statistics, correlation analysis, and the non-parametric Mann-Whitney U test, using the SPSS (Statistical Package for the Social Sciences) software. In addition to these methods, the interpretation of results and the drawing of conclusions is based on the use of analysis, synthesis, and comparison methods.

The paper is structured into five sections. After the introduction, the paper presents a review of previous research. The third section deals with the presentation of the research

methodology. The fourth section includes the research results and the analysis of the obtained results, while the final section of the paper presents the conclusion of the research.

2. LITERATURE REVIEW

The ISO 9001 standard, which pertains to quality management, has been implemented by over one million organizations worldwide. Therefore, this standard is receiving increasing attention in research (Tari, Molina-Azorin & Heras, 2012). The ISO 9001 standard is of a generic nature and is considered a suitable solution for all types of companies (Astrini, 2018). The implementation of the ISO 9001 standard offers numerous advantages, such as: improving efficiency (cost savings, error reduction, better management control), improving product quality, enhancing customer satisfaction, increasing profitability, and improving employee performance (Tari, Molina-Azorin & Heras, 2012). However, the findings in the literature regarding the impact of ISO 9001 certification on financial performance are inconsistent. Some studies show positive effects, some show neutral or mixed effects, and some even identify negative effects (De Vries, Blind & Manders, 2013). In their research, Aba, Badar, and Hayden (2014) pointed out that certified companies significantly improved their financial performance after certification. They argued that this conclusion is sufficient to encourage companies to implement the ISO 9001 standard in their operations and that managers will be able to assess whether the benefits of implementation outweigh the costs of obtaining certification. Ochuebg, Muturi, and Njihia (2015) concluded that the implementation of the ISO 9001 standard has a positive impact on profitability, specifically the return on total assets. Cândido, Coelho, and Peixinho (2015) concluded that there were no statistically significant differences in financial performance, expressed through profitability and liquidity, between certified and non-certified companies, although the literature suggests that certification leads to improved company performance. Sharma (2005) in his research states that the profitability of certified companies, i.e., companies that have implemented the ISO 9001 standard, is significantly better compared to companies that do not have this certification. A study conducted by Astrini (2018) aimed to highlight the connection between the implementation of the ISO 9001 standard and financial performance, expressed through profitability and liquidity. For this purpose, scientific articles were selected from seven databases. The analysis revealed that 69% of previous studies indicate a positive relationship between ISO 9001 and financial performance.

Martin (2017) concludes that operational decisions in any industry directly depend on the implementation of ISO standards, given that the implementation of the ISO 9001 standard influences customer satisfaction. After implementing the ISO 9001 standard, companies have more satisfied customers, better processes, and improved decision-making, leading to greater profitability. Many companies' main goal is precisely higher profit. The goal set when implementing the standard plays a key role in the outcome of certification. Similar results were found by Bakator and Čočkalo (2018), who concluded from their research that ISO 9001 certification can improve operational performance, customer satisfaction, financial performance, and overall business performance. İlkey and Aslan (2012) in their research pointed out the absence of statistically significant differences between certified and non-certified companies in terms of financial performance, expressed through profitability. Certification did not have a direct impact on performance. They also argued that quality practices in certified companies were at a higher level than in non-certified companies, but a higher level of quality practices does not necessarily imply better performance. Nurcahyo and Habiburrahman (2021) conducted a study that showed that ISO 9001 certification has a

significant positive impact on operational performance, as well as on financial performance. This study also identified the main barriers to the effective implementation of the ISO 9001 standard, among which the following stand out: lack of qualified personnel, insufficient training, employee resistance, and lack of commitment from top-level management. Based on the previously mentioned studies, the following hypotheses will be tested in the paper:

H1: Companies that have implemented the ISO 9001 standard more profitable than companies that have not implemented the standard.

H2: Companies that have implemented the ISO 9001 standard have higher liquidity ratios than companies that have not implemented the standard.

3. METHODOLOGY

In accordance with the defined research goal and research hypotheses, an empirical study was conducted on a sample of 55 companies in the Republic of Serbia which according to the Accounting law are required to disclose non-financial information. The given sample was considered because an analysis of non-financial reports revealed that many companies among other things, disclose information related to aspects such as quality policy, quality management and the implementation of standards in their non-financial reports. The research was carried out through the collection and analysis of secondary data for a period of three years, from 2019 to 2021. The data were collected from available reports published on the website of the Serbian Business Registers Agency (www.apr.gov.rs), as well as from the companies' own websites. The information about which companies have implemented the ISO 9001 standard and which companies have not was obtained by analyzing the websites of the observed companies.

The study employs a quantitative methodology, specifically based on statistical data analysis using descriptive statistics, correlation analysis, and the non-parametric Mann-Whitney U test, with the assistance of SPSS (Statistical Package for the Social Sciences). Based on the results obtained, conclusions will be drawn using the methods of analysis, synthesis, and comparison. The Mann-Whitney U test is used to examine differences between two independent groups on a continuous scale. In this case, one group consists of companies that have implemented the ISO 9001 standard, while the other group consists of companies that have not implemented the standard. The Mann-Whitney U test converts the values of the continuous variable into ranks for each group and then calculates whether the ranks differ significantly. When examining the difference in financial performance between companies with and without the ISO 9001 standard, the categorical variable with two groups (implemented / not implemented) is considered, while the continuous variable is the financial performance indicator.

In this study, financial performance is expressed through liquidity and profitability, where liquidity is measured by the current liquidity ratio and the cash liquidity ratio, while profitability is measured by the return on assets. These indicators were chosen to express financial performance because they have been widely used in various empirical studies as financial performance indicators (Cândido, Coelho & Peixinho, 2015; İlkey & Aslan, 2012; Astrini, 2018; Martí-Ballester & Simon, 2017; Ochieng, Muturi, Njihia, 2015). The current liquidity ratio represents the result of the ratio between current assets and short-term liabilities, while the cash liquidity ratio represents the result of the ratio between cash and

short-term liabilities. The rate of return on total assets is calculated by dividing net profit by average total assets.

4. RESULTS AND DISCUSSION

The following section of the paper presents the results of the empirical research. Testing the proposed hypotheses was conducted using the non-parametric Mann-Whitney U test. The goal is to answer the question of whether companies that have implemented a standard have better financial performance, as reflected in profitability and liquidity, compared to companies that have not implemented the standard.

Table 1 will present the minimum and maximum values, arithmetic mean and standard deviation of the return on total assets for the observed period from 2019 to 2021.

Table 1. *Presentation of the minimum and maximum values, arithmetic mean, and standard deviation of the return on assets*

Indicators	N	Arithmetic mean	Standard deviation	Minimum	Maximum
Return on assets-2019	55	6.8055	31.67972	-35.90	226.80
Return on assets-2020	55	3.0820	11.62869	-37.57	47.48
Return on assets-2021	55	3.5975	16.74155	-71.01	47.36

Source: Author

Based on Table 1, the minimum and maximum values of the return on total assets indicator can be observed for the three-year period. The average value of the indicator in 2019 was 6.81%, in 2020 it was 3.08%, and in 2021 it was 3.60%. The standard deviation, as a measure of deviation from the average value, was 31.68 in 2019, 11.63 in 2020, and 16.74 in 2021.

Table 2 will present the minimum and maximum values, arithmetic mean, and standard deviation of the current liquidity ratio and cash liquidity ratio for the observed period from 2019 to 2021.

Table 2. *Presentation of the minimum and maximum values, arithmetic mean, and standard deviation of the current liquidity ratio and cash liquidity ratio*

Year	Indicators	N	Arithmetic mean	Standard deviation	Minimum	Maximum
2019	Current liquidity ratio	55	2.2890	3.30070	0.0300	17.98
	Cash liquidity ratio	55	0.2800	0.55812	0.0003	3.00
2020	Current liquidity ratio	55	2.5105	4.39981	0.0100	26.26
	Cash liquidity ratio	55	0.3239	0.54603	0.0004	2.76
2021	Current liquidity ratio	55	2.3658	4.17964	0.0900	26.99
	Cash liquidity ratio	55	0.3824	0.81646	0.0009	4.77

Source: Author

Based on Table 2, the minimum and maximum values of the current liquidity ratio and cash liquidity ratio can be observed for the three-year period. The average value of the current liquidity ratio in 2019 was 2.29, in 2020 it was 2.51 and in 2021 it was 2.37. The standard deviation, as a measure of deviation from the average value was 3.30 in 2019, 4.40 in 2020,

and 4.18 in 2021. The average value of the cash liquidity ratio in 2019 was 0.28, in 2020 it was 0.32 and in 2021 it was 0.38. The standard deviation for the cash liquidity ratio, as a measure of deviation from the average value, was 0.56 in 2019, 0.55 in 2020 and 0.82 in 2021.

Table 3 will present the correlation analysis of the financial performance indicators, specifically the return on assets, current liquidity ratio and cash liquidity ratio.

Table 3. *Correlation between financial performance indicators*

Indicators	Return on assets	Current liquidity ratio	Cash liquidity ratio
Return on assets	1		
Current liquidity ratio	.465**	1	
Cash liquidity ratio	.461**	.623**	1

Source: Author

To determine the strength of the relationship between the variables related to financial performance indicators, a correlation analysis was performed, and the results are presented in Table 3. Based on the obtained values, it can be concluded that there is a statistically significant positive relationship at the 0.01 level between all analyzed variables. Analyzing the results, it is evident that between the variable return on assets and the variable current liquidity ratio, there is a moderate degree of linear correlation. Similarly, between the variable return on assets and the cash liquidity ratio, a moderate degree of linear correlation is observed. Furthermore, a strong linear correlation exists between the current liquidity ratio and the cash liquidity ratio.

The results of the Mann-Whitney U test for each year of observation individually are presented in Tables 4, 5 and 6.

Table 4. *Differences in the return on assets, current liquidity ratio and cash liquidity ratio in 2019 between companies that have implemented the ISO 9001 standard and companies that have not implemented the aforementioned standard*

Year	Indicators	ISO 9001	N	Mean Rank	Mann-Whitney U	Z	Sig.	Median
2019	Return on assets	Implemented	36	30.56	250.000	-1.628	.103	3.5250
		Not implemented	19	23.16				2.4200
	Current liquidity ratio	Implemented	36	33.08	159.000	-3.239	.001	1.8862
		Not implemented	19	18.37				.3995
	Cash liquidity ratio	Implemented	36	31.33	222.000	-2.124	.034	.1072
		Not implemented	19	21.68				.0336

Source: Author

Based on the results of the Mann-Whitney U test for 2019, presented in Table 4, it can be observed that there is no statistically significant difference in terms of profitability between companies with and without the ISO 9001 standard implemented ($P > 0.05$). Furthermore, it

can be concluded that in 2019 there is a statistically significant difference in terms of liquidity, as indicated by the current liquidity ratio, between companies with and without the ISO 9001 standard implemented ($p < 0.05$). The results suggest that companies with the ISO 9001 standard implemented (Mean Rank = 33.08) have higher liquidity ratios than companies without the standard implemented. Since SPSS does not calculate the statistical effect size (r), this measure was calculated according to Cohen's criterion, yielding a value of 0.436 ($r = 0.436$ – medium effect size). Additionally, it is concluded that in 2019, there are statistically significant differences in liquidity, as indicated by the cash liquidity ratio, between companies with and without the ISO 9001 standard implemented ($p < 0.05$). The results indicate that companies with the ISO 9001 standard implemented (Mean Rank = 31.33) have higher liquidity ratios than companies without the standard implemented. Since SPSS does not calculate the statistical effect size (r), this measure was also calculated according to Cohen's criterion, and it is 0.286 ($r = 0.286$ – small effect size).

Table 5. Differences in the return on assets, current liquidity ratio and cash liquidity ratio in 2020 between companies that have implemented the ISO 9001 standard and companies that have not implemented the aforementioned standard

Year	Indicators	ISO 9001	N	Mean Rank	Mann-Whitney U	Z	Sig.	Median
2020	Return on assets	Implemented	36	29.38	292.500	-.876	.381	3.2850
		Not implemented	19	25.39				2.5400
	Current liquidity ratio	Implemented	36	33.58	141.000	-3.558	.000	1.5649
		Not implemented	19	17.42				.3840
	Cash liquidity ratio	Implemented	36	31.75	207.000	-2.390	.017	.1079
		Not implemented	19	20.89				.0308

Source: Author

Based on Table 5 and the results of the Mann-Whitney U test for 2020, it can be observed that there is no statistically significant difference in terms of profitability between companies with and without the ISO 9001 standard implemented ($P > 0.05$). Furthermore, it can be observed that companies with the implemented standard (Mean Rank = 33.58) have a higher current ratio of liquidity than companies without the implemented standard. When it comes to the cash ratio of liquidity, it can also be observed that companies with the implemented standard (Mean Rank = 31.75) have a higher liquidity ratio than companies without the implemented standard. According to Cohen's criterion, the effect size indicator, when it comes to the current ratio of liquidity is 0.480 ($r = 0.480$ - medium effect size). When it comes to the cash ratio of liquidity, the effect size is 0.322 ($r = 0.322$ – medium effect size).

By analyzing the results of the Mann-Whitney U test for 2021 presented in Table 6, a similar situation can be observed as in the previous two years, since no statistically significant difference was found between companies that have implemented the ISO 9001 standard and those that have not, in terms of profitability ($p > 0,05$). From the liquidity aspect, it was found that companies with the implemented standard (Mean Rank = 32.61) have a higher current liquidity ratio than companies without the implemented standard. According to Cohen's criterion, the effect size indicator, when it comes to the current ratio of liquidity is 0.396 ($r = 0.396$ - medium effect size). When it comes to the cash liquidity ratio, it was also found that companies with the implemented standard (Mean Rank = 31.10) have a higher liquidity ratio than companies without the implemented standard. According to Cohen's criterion, the effect

size indicator, when it comes to the cash ratio of liquidity is 0.266 ($r = 0.266$ - small effect size).

Table 6. Differences in the return on assets, current liquidity ratio and cash liquidity ratio in 2021 between companies that have implemented the ISO 9001 standard and companies that have not implemented the aforementioned standard

Year	Indicators	ISO 9001	N	Mean Rank	Mann-Whitney U	Z	Sig.	Median
2021	Return on assets	Implemented	36	30.08	267.000	-1.327	.184	5.9200
		Not implemented	19	24.05				2.1900
	Current liquidity ratio	Implemented	36	32.61	176.000	-2.938	.003	1.3761
		Not implemented	19	19.26				.6270
	Cash liquidity ratio	Implemented	36	31.10	230.500	-1.974	.048	.1431
		Not implemented	19	22.13				.0252

Source: Author

Based on the presented research results, it can be observed that there is no statistically significant difference in financial performance, as expressed through profitability, between companies that have implemented the ISO 9001 standard and those that have not. Therefore, the first hypothesis cannot be accepted. The obtained results are contrary to those found by Ochieng, Muturi, and Njihia (2015), Sharma (2005), Martin (2017), Bakator and Čóckalo (2018) and Nurcahyo and Habiburrahman (2021). However, the results align with the findings of Cândido, Coelho, and Peixinho (2015) and İlkey and Aslan (2012). These results can be explained by the fact that companies in Serbia still do not significantly recognize the importance and benefits that come with the implementation of ISO standards and as a result, these standards are insufficiently integrated into business operations. When it comes to the liquidity aspect, it was proven that there is a statistically significant difference between companies that have implemented the ISO 9001 standard and those that have not. Specifically, it was determined that companies with the ISO 9001 standard implemented have higher liquidity ratios than companies that have not implemented the standard. Therefore, the second hypothesis is accepted. The obtained results differ from those of Cândido, Coelho and Peixinho (2015), but are consistent with the findings of Aba, Badar and Hayden (2014) and Astrini (2018) in their studies.

5. CONCLUSIONS AND RECOMMENDATIONS

Since the International organization for standardization released the ISO 9000 series of standards in 1987. quality management systems based on the ISO 9000 international standards have been widely adopted around the world. These standards define the minimum requirements for the quality management systems of organizations (Zeng, Tian & Shi, 2005). It can be concluded that the implementation of the ISO 9001 standard has a positive effect on the financial performance of companies, as reflected in their liquidity. Given that the ISO 9001 standard relates to quality management and that some of the key benefits of its implementation include improved efficiency, cost savings, error reduction, enhanced product quality, and increased customer satisfaction, the results obtained in this study, in the form of higher liquidity ratios are quite logical. These savings lead to the allocation of a larger amount of resources for settling short-term liabilities, which ultimately can improve a company's liquidity position.

Given the identified research gap, the theoretical implications of this study relate to bridging the gap in domestic literature on this topic, as it sheds light on the current situation of domestic companies regarding the level of ISO standard implementation. It is expected that this work will contribute to advancing knowledge about the benefits associated with the implementation of the ISO 9001 standard, considering the comparative presentation of research results conducted worldwide and the results of the study conducted on a sample of domestic companies. The research conducted in this paper represents a step forward in explaining the role and significance of ISO implementation. By analyzing the results obtained in this study, certain conclusions can be drawn for developing countries, offering insights into how ISO 9001 can influence both business practices and financial outcomes in such contexts.

The practical implications of this paper are reflected in its emphasis on the importance of ISO implementation. Based on the results, conclusions and recommendations can be drawn that may help domestic companies improve their quality management processes. Companies should encourage employees to behave more responsibly and to be more rational in their use of resources. The paper enables the identification of the current situation that domestic companies face in terms of implementing quality management standards, specifically the ISO 9001 standard. By demonstrating that companies with ISO 9001 implementation have higher liquidity ratios compared to companies that have not implemented the standard, the study provides a significant contribution to company policies. It highlights that, in dynamic periods, the ability to meet short-term obligations is largely conditioned by improvements in business quality. This research underscores the potential benefits of ISO 9001 certification, showing that companies that adopt this standard are likely to see not only enhanced operational efficiency but also stronger financial performance, particularly in terms of liquidity. These findings can help guide domestic businesses in strategically improving their management practices and their ability to respond to financial challenges.

The research conducted in this study has certain limitations that could serve as a good foundation and direction for future studies in this field. Some of the limitations identified during data analysis and processing include the fact that the study covered only 55 companies that according to the Accounting law are required to disclose non-financial information (a relatively small sample), as well as the lack of information regarding when the ISO 9001 standard was implemented, which complicates tracking results before and after the implementation of the standard. Directions for future research may include: incorporating primary data into the analysis, collected through surveys directed at managers responsible for quality, including a time dimension to examine the benefits of implementing ISO standards, expanding the sample size of companies and including other financial performance indicators in the analysis, such as leverage, return on equity and similar indicators.

REFERENCES

- Aba, E. K., Badar, M. A., & Hayden, M. A. (2015). Impact of ISO 9001 certification on firms financial operating performance. *International Journal of Quality & Reliability Management*, 33(1), 78-89. <https://doi.org/10.1108/IJQRM-02-2014-0021>
- Astrini, N. (2018). ISO 9001 and performance: a method review. *Total Quality Management & Business Excellence*, 32(1–2), 5–32. 10.1080/14783363.2018.1524293
- Bakator, M., & Čóckalo, D. (2018). Improving business performance with ISO 9001: a review of literature and business practice. *The European Journal of Applied Economics*, 15(1), 83-93. 10.5937/EJAE15-16145

- Boiral, O., & Heras-Saizorbitoria, I. (2013). ISO 9001 and ISO 14001: Towards a Research Agenda on Management System Standards. *International Journal of Management Reviews*, 15, 47-65. 10.1111/j.1468-2370.2012.00334.x
- Cândido, C. J. F., Coelho, L. M. S., & Peixinho, R. M. T. (2016). The financial impact of a withdrawn ISO 9001 certificate. *International Journal of Operations & Production Management*, 36(1), 23-41. 10.1108/IJOPM-11-2014-0540
- De Vries, H. J., Blind, K., & Mandres, B. (2013). The Relationship Between ISO 9001 and Financial Performance: a Meta-analysis. *Academy of Management Proceedings*, 1, 12255-12315. 10.5465/AMBPP.2013.12255abstract
- Guler, I., Guillen, M. F., & MacPherson, J. M. (2002). Global competition, institutions, and the diffusion of organizational practices: the international spread of ISO 9000 quality certificates. *Administrative Science Quarterly*, 47(2), 207-232. <https://doi.org/10.2307/3094804>
- İlkay, S. M., & Aslan, E. (2012). The effect of the ISO 9001 quality management system on the performance of SMEs. *International Journal of Quality & Reliability Management*, 29(7), 753-778. 10.1108/02656711211258517
- Martí-Ballester, C. P., & Simon, A. (2017). Union is strength: The integration of ISO 9001 and ISO 14001 contributes to improve the firms' financial performance. *Management Decision*, 55(1), 81-102. 10.1108/MD-09-2015-0414
- Martin, A. (2017). ISO 9001 impact on operational performance. *International Journal of Recent Advances in Multidisciplinary Research*, 4(3), 2407-2415.
- Nurcahyo, R., & Habiburrahman, M. Z. (2021). Relationship between ISO 9001:2015 and operational and business performance of manufacturing industries in a developing country (Indonesia). *Heliyon*, 7(1), 1-9. 10.1016/j.heliyon.2020.e05537
- Ochieng, J., Muturi, D., & Njihia, S. N. (2015). The impact of ISO 9001 implementation on organizational performance in Kenya. *The TQM Journal*, 27(6), 761-771. 10.1108/TQM-06-2015-0071
- Santos, G., Costa, B., & Leal, A. (2012). The estimation of the return on firms' investments – as to ISO 9001. *International Journal of Engineering, Science and Technology*, 4(2), 46-57. 10.4314/ijest.v4i2.4
- Sharma, D. S. (2005). The Association between ISO 9000 Certification and Financial Performance. *The International Journal of Accounting*, 40, 151-172. 10.1016/j.intacc.2005.01.011
- Tari, J. J., Molina-Azorin, J. F., & Heras, I. (2012). Benefits of the ISO 9001 and ISO 14001 standards. *Journal of Industrial Engineering and Management*, 5(2), 297-322. 10.3926/jiem.488
- Zeng, X. S., Tian, P., & Shi, J. J. (2005). Implementing integration of ISO 9001 and ISO 14001 for construction. *Managerial Auditing Journal*, 20(4), 394-407. 10.1108/02686900510592070

**APPLIED INFORMATICS AND QUANTITATIVE METHODS IN
ECONOMICS AND MANAGEMENT**

UNIFIED BUSINESS INTELLIGENCE IN THE MICROSOFT FABRIC ENVIRONMENT

Jelena Plašić

Faculty of Technical Sciences in Cacak, University of Kragujevac, jelena.plasic@ftn.edu.rs,
ORCID number 0000-0003-0404-6682

Andrijana Gaborović

Faculty of Technical Sciences in Cacak, University of Kragujevac, andrijana.gaborovic@ftn.edu.rs,
ORCID number 0000-0002-3465-6150

Nenad Stefanović*

Faculty of Economics, University of Kragujevac, nenad@ef.kg.ac.rs,
ORCID number 0000-0002-0339-3474

Abstract: *Data has become the strategic asset used to transform businesses to uncover new insights. Business Intelligence (BI) has been helping organizations across industries uncover insights from their data and turn them into actionable strategies. However, the world of data and BI is rapidly evolving in ways that are transforming the industry and motivating enterprises to consider new approaches of gaining insights. In this paper, Microsoft Fabric, as an innovative and holistic data analysis platform that integrates advanced business intelligence tools and enable organizations to transform big data into strategic insights, is presented. Microsoft Fabric is a cloud-based platform that provides a unified environment for data management and analytics, including data engineering, data science, data warehouse, real-time intelligence, business intelligence and artificial intelligence. To demonstrate effectiveness and capabilities of Microsoft Fabric platform for end-to-end analytics, the complete cloud-based BI solution was designed and deployed. The solution is based on a single, unified, logical data lake capable to processes large volumes of data from various sources. Several real-world datasets were integrated via Data Factory pipelines into the lake-centric Synapse data warehouse. To equip business users with actionable insights, various dashboards, reports, and machine learning models are designed and deployed in cloud for collaborative analytics and decision making. By employing such analytical platform and solution, organizations can quickly adapt to changing market conditions, increase productivity, and develop strategies based on deep insights, which ultimately gives them competitive advantage.*

Keywords: *Business intelligence, Data science, Data warehousing, Real-time intelligence, Advanced analytics*

JEL Classification: *C 55, C 88, C 89, L81*

* Corresponding author

1. INTRODUCTION

In the modern business world, a lot of data is gathered by the organization's information systems. The process of gathering, evaluating, and interpreting vast volumes of data to produce insightful and useful information that can guide strategic decision-making within an organization is known as business intelligence (Kilanko, 2022).

The process of business intelligence starts with data collection, where relevant data is gathered from multiple sources, both internal (such as databases, enterprise systems, and transactional systems) and external (such as market research reports, social media, and customer feedback) (Zohuri and Moghaddam, 2020). After that, this data is processed through data integration, which unifies, cleans, and converts it into a format that is consistent and useful. Real-time analysis of this data enables businesses to detect emerging trends, identify potential issues, and make immediate adjustments to strategies or operations, which provides a competitive advantage in dynamic business environments (Kalathas, 2020).

When data volume increases, evaluation becomes more challenging, making the implementation of a decision-making methodology that can be characterized as real-time BI extremely burdensome and time-consuming (Doshi et al, 2023). Therefore, a more sophisticated intelligence system is required to improve daily operations and assist stakeholders in making more trustworthy decisions.

Data lakes are considered a viable answer to the challenge of storing and managing large volumes of data. A data lake is expected to offer the capabilities to efficiently perform analytics, batch processing, and real-time analysis on large amounts of data (Gupta and Ponnusamy, 2023).

To gain a competitive advantage and effectively run a business, companies need to rely on automated data mining tools that support their daily activities (Oussous et al., 2018). One such tool is the Microsoft Fabric platform which usefulness will be discussed within the scope of this paper. It can help organizations predict market fluctuations, identify seasonal trends and forecast demand patterns. As a result, supply chain management is streamlined, inventory levels are optimized and overstocking or understocking expenses are decreased (Bharadiya, 2023).

2. REVIEW OF ADVANCES IN BUSINESS INTELLIGENCE

Initially, BI tools were used for tasks like running queries and generating reports. These tools often struggled with unstructured or semi-structured data and experienced slow response times when handling real-time data velocity (Adewusi et al., 2024). In today's rapidly evolving business environment, the convergence of Big Data Analytics and modern Business Intelligence (BI) is revolutionizing how organizations collect, analyse, and extract valuable insights from large and varied datasets (Udeh et al., 2024). At the heart of Big Data Analytics is its ability to manage the three fundamental aspects: volume, velocity, and variety, so that it can handle massive datasets, process them quickly, and extract insights from a diverse range of data types (Mikalef et al., 2020). According to Psomakelis et al. (2020) companies should invest in scalable infrastructure, such as cloud-based solutions, to accommodate the growing volume of Big Data.

Modern BI platforms have evolved into powerful tools for data analysis. These solutions now offer advanced features, including machine learning, real-time data insights, and interactive

dashboards. The combination of advanced databases and BI tools is groundbreaking, enabling companies to develop policies and make decisions based on the most trustworthy information available (Hosen et al., 2024). These technologies help organizations predict market trends, track competitors, and identify opportunities or threats, making them essential for gaining a competitive edge and making informed strategic decisions in the digital age (Ali, 2023).

Microsoft Fabric brings a disruptive innovation to analytics services providing a comprehensive suite of services including Data Engineering, Data Factory, Data Science, Real-Time Analytics, Data Warehouse, and Databases, tailored for specific roles and tasks.

To provide comprehensive visibility and insights into usage and adoption across components for effective data management and analysis, Microsoft Fabric's architecture centres on a single data platform that unifies several data services, operating on a Software as a Service (SaaS) model.

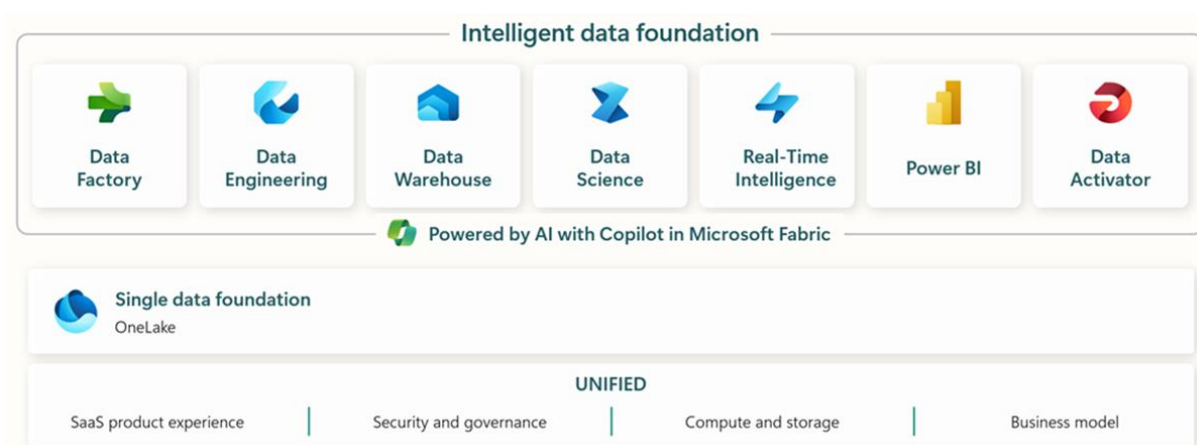


Figure 1: Microsoft Fabric architecture

Source: <https://learn.microsoft.com/en-us/fabric/get-started/microsoft-fabric-overview>

Microsoft Fabric's data factory offers a modern data integration platform that allows seamlessly ingestion, preparation, and transformation of data from a diverse range of sources. There are two primary high-level features Data Factory implements: dataflows and pipelines. Dataflows provides a low-code interface for ingesting data from hundreds of data sources and more intuitive and flexible way to transform data than any other tool — including AI-powered smart transformations. Data pipelines offer powerful capabilities to build complex and customizable ETL workflow at cloud-scale, that address the unique needs of the enterprise.

Microsoft Fabric's data engineering capabilities give users the ability to plan, create, and oversee the systems that let businesses effectively gather, store, process, and analyse vast amounts of data. Microsoft Fabric's features ensures that data is consistently high-quality, easily accessible, and organized.

Across the entire data science process wide range of activities can be completed - from data exploration, preparation and cleansing to experimentation, modelling, model scoring and serving of predictive insights to BI reports.

Real-time intelligence is a important service that handles data ingestion, transformation, storage, analytics, visualization, tracking, AI, and real-time actions, so that everyone in organization can extract insights and visualize their data in motion.

All these processes are powered by AI with Copilot. Copilot for Data Engineering and Data Science is an AI-powered toolset designed to assist data professionals throughout their workflow. Serving as an interactive assistant, it offers smart code suggestions, simplifies data warehousing tasks, aids in data exploration, and helps extract actionable insights.

During all this processes data remains protected, governed, and integrated across organization, seamlessly aligning with all Microsoft Fabric offerings.

The lake-centric warehouse is built on an enterprise grade distributed processing engine to deliver top-tier performance, optimize costs and reduce administrative overhead.

The company can decide between using a warehouse or a lakehouse based on its specific needs, data volume and type, and the context of its data management and analytics requirements.

A data warehouse is suitable for enterprise-scale solutions with an open standard format, consistent performance, and minimal setup, designed for semi-structured and structured data formats. A lakehouse is a better solution if a company needs a large repository of highly unstructured data from heterogeneous sources, leveraging low-cost object storage. The company can always add either option later if business needs change.

With Microsoft Fabric, organizations can tap into powerful data insights to fuel innovation and stay ahead of the competition. Whether streamlining business operations, uncovering new revenue opportunities, or improving customer experiences, Fabric enables companies to navigate the complexities of today's data landscape with flexibility and accuracy, driving long-term growth and success.

Borra (2024) points out that, with ongoing advancements in AI integration, connectivity expansion, user experience refinement, security enhancements, sustainability initiatives, and collaborative tools, Microsoft Fabric is poised to reinforce its leadership in the analytics landscape.

3. RESULTS AND DISCUSSION

To demonstrate effectiveness and capabilities of Microsoft Fabric platform for end-to-end analytics, the complete cloud-based BI solution was designed and deployed. The solution is based on a single, unified, logical data lake capable to processes large volumes of data from various sources. Several real-world datasets were integrated via Data Factory into the lake-centric Synapse data warehouse. Datasets that have been used are sourced from a companies that manufacture and sell sports equipment, operating in multiple regions globally.

After data loading, ETL process was used to obtain better data analysis. This process involves identifying and fixing any errors, inconsistencies or inaccuracies present in the data to make sure that it is correct and dependable, finding and eliminating duplicate or unnecessary information and filter out unwanted information so that analysis was conducted on accurate and relevant data.

The second step dealt with incomplete or missing data. Different procedures were performed, such as imputation and deletion. Records which contained too many missing fields or were

inconsequential were removed. The final stage was to verify the integrity and accuracy of the data. The data was reviewed for errors, including incorrect data. The dataset was inspected for inaccuracies, including wrong data types or values that do not meet certain minimum/maximum parameters and validation techniques like cross-validation & outlier detection was used to try and find them and correct any discrepancies.

ProductID	Date	Zip	Units	Revenue
1	1/20/2015	72618	1	254.5725
2	1/21/2015	47577	1	254.5725
3	1/28/2015	34653	1	254.5725
4	1/31/2015	84014	1	254.5725
5	2/1/2015	75070	1	254.5725
6	2/5/2015	87611	1	254.5725
7	2/8/2015	72019	1	254.5725
8	2/9/2015	72086	1	254.5725
9	2/9/2015	77089	2	509.145
10	2/9/2015	7649	1	254.5725
11	2/11/2015	79705	1	254.5725
12	2/14/2015	92624	1	254.5725
13	2/22/2015	8527	1	254.5725
14	2/22/2015	8816	1	254.5725
15	2/23/2015	24740	1	254.5725
16	2/24/2015	63023	1	254.5725
17	2/25/2015	32503	1	254.5725
18	2/25/2015	85523	1	254.5725
19	2/25/2015	90937	1	254.5725
20	2/28/2015	54139	1	254.5725
21	2/28/2015	64090	1	254.5725
22	2/28/2015	82216	1	254.5725
23	2/28/2015	82940	1	254.5725
24	3/1/2015	82801	2	509.145
25	3/1/2015	91862	1	254.5725
26	3/3/2015	53158	1	254.5725
27	3/3/2015	82845	1	254.5725
28	3/6/2015	55304	1	254.5725
29	3/9/2015	36869	1	254.5725

Figure 2: Data preparation

When the data preparation and transformation is completed, dataset is loaded. The model view allows creating relationships between tables. To conduct further analysis, more columns and measurements are added into tables.

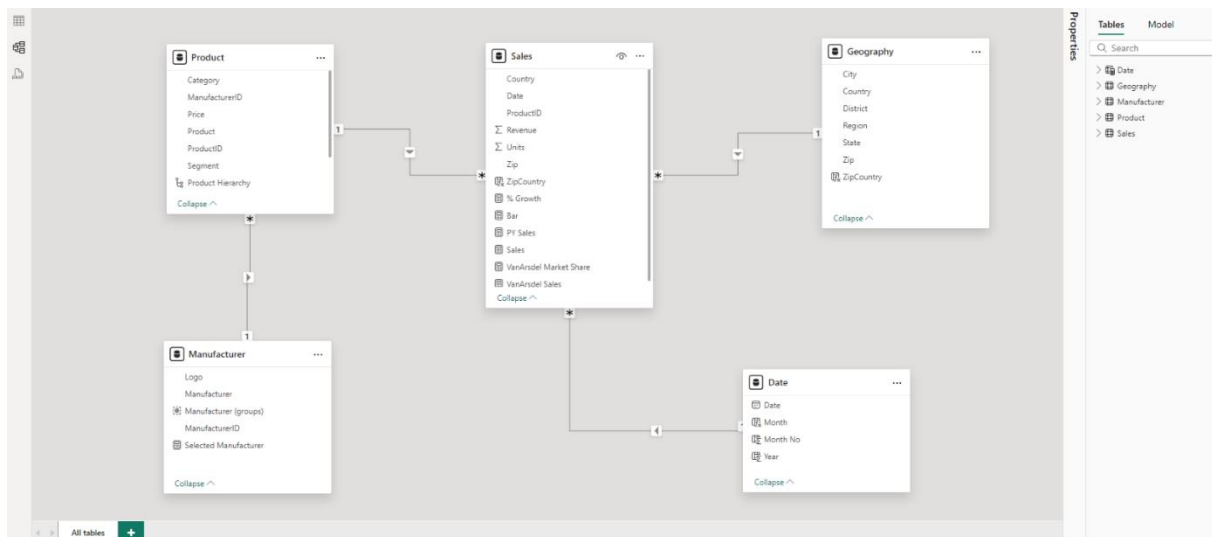


Figure 3: Relationships between tables

To equip business users with actionable insights, various dashboards, reports, and machine learning models are designed and deployed in cloud for collaborative analytics and decision making. To improve data analysis and better understand business dynamics, leveraging business intelligence and machine learning was essential. Beyond advanced analytics and knowledge extraction, it's crucial to deliver information to decision-makers in a timely and

accessible format. Reporting is carried out through Power BI, a cloud-based business intelligence service, enabling interactive visualizations and deeper insights.

Different visuals were developed to display the company's performance from 2014 to the present. The charts are grouped into two reports. The first report focuses on the company's market share, while the second is based on manufacturers. Figure 4 shows report Market Analysis, that describes the company's market share (47.53%), growth percentage by manufacturers (for example, Currus has a growth over 20%), revenue by countries, years, as well as by categories and segments, in the past 10 years.

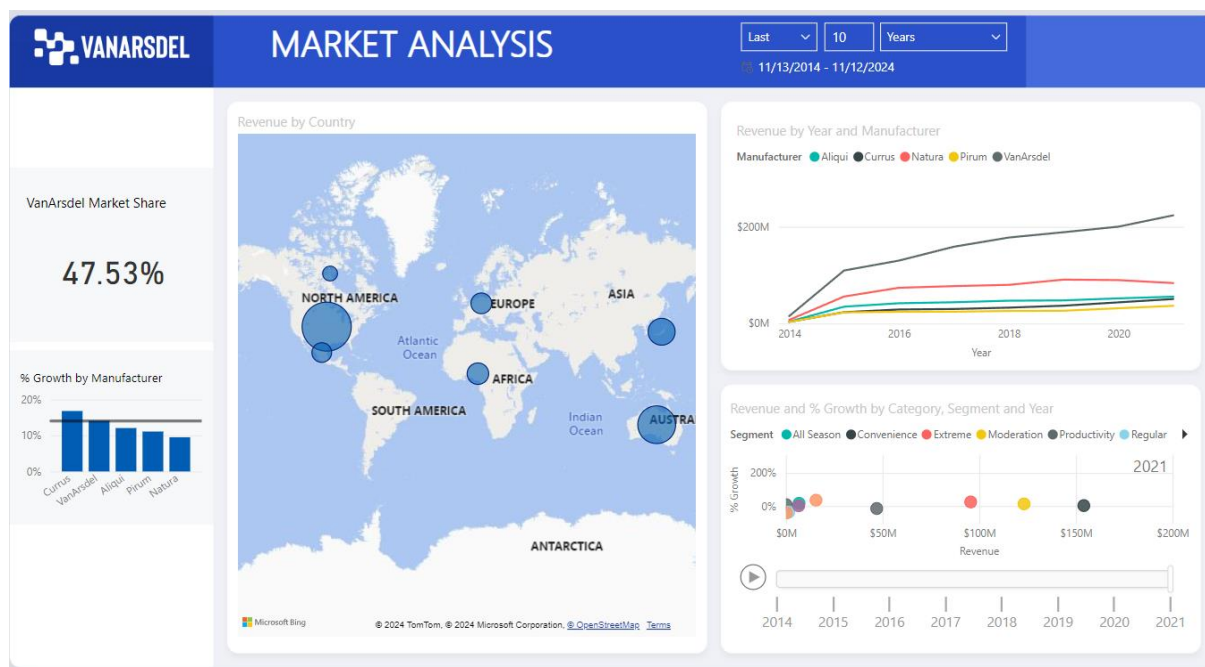


Figure 4: Market Analysis report

Drilling down option on the visual Revenue by country enables to go further into analysis and select specific market, for example Germany. As we select different options, we can see that the other visuals change (market share in Germany is 64.36%, % Growth by Manufacturer is 10% etc.)

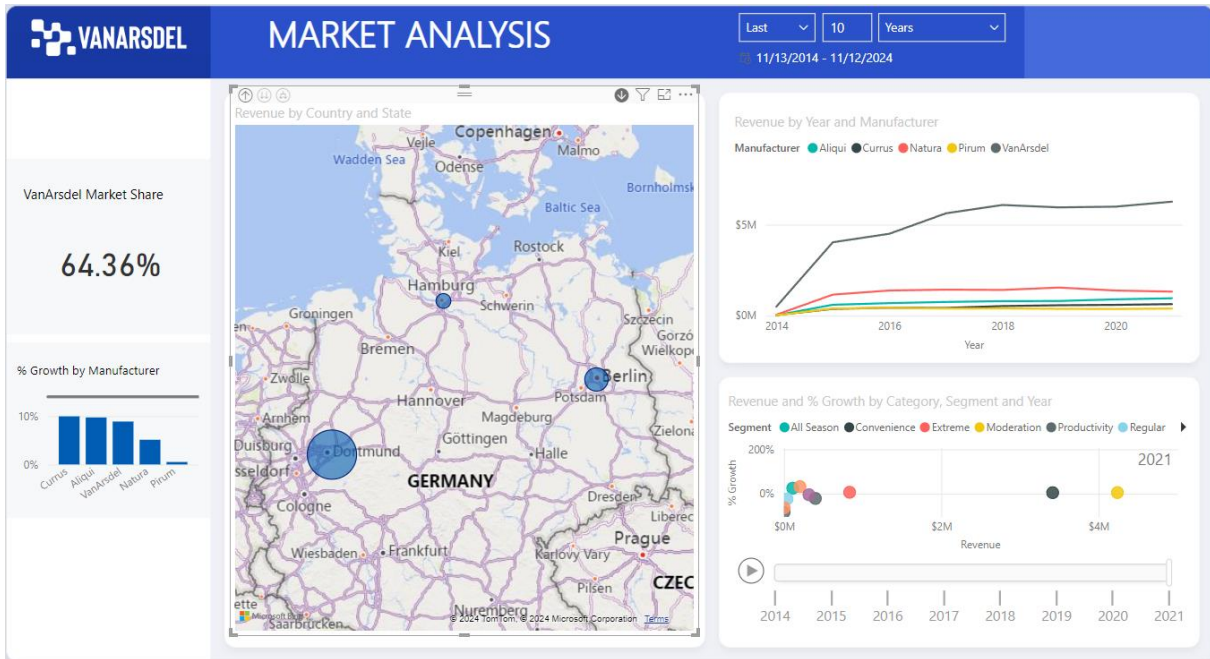


Figure 5: Market Analysis report

Figure 6 shows Key Indicator Performances for top Manufacturers in the past 10 years. Various visuals are added – Revenue and Sales per year, Revenue and Percent of growth, Revenue by Categories etc.

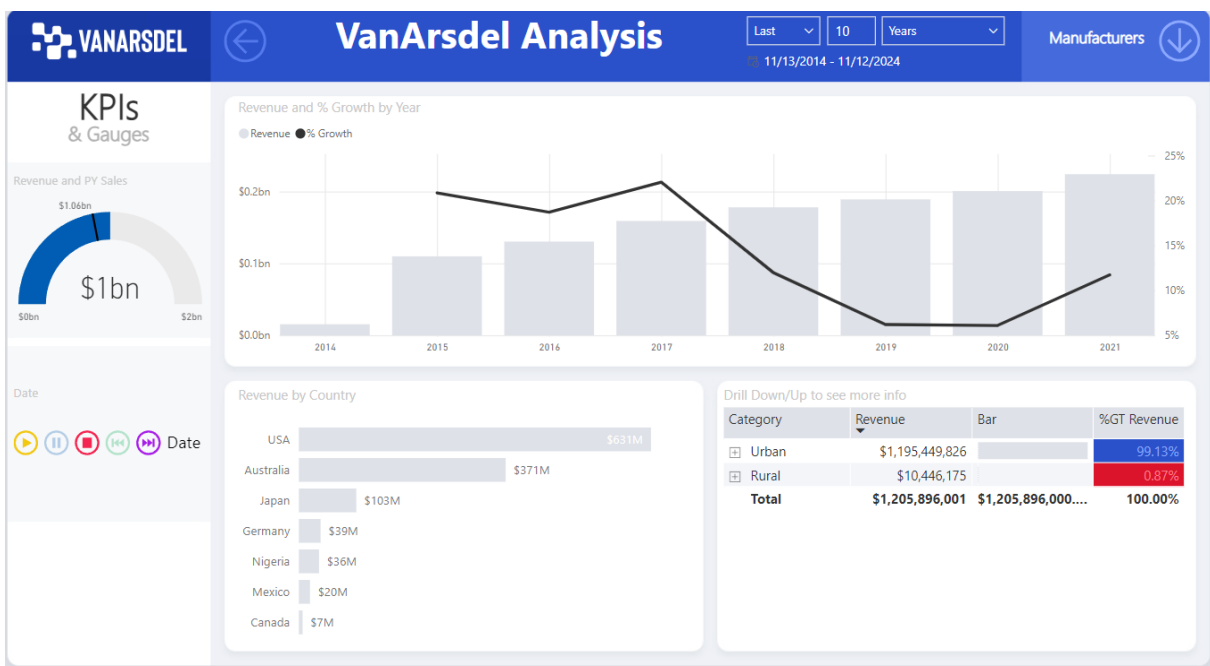


Figure 6: Key Indicator Performances for top Manufacturers in the past 10 years

Figure 7 shows a Market Share responsive mobile view report. The mobile application gives employees the ability to be kept on top of their KPIs and reports, view live dashboards and reports on their mobile devices with fast and fluid visuals that accelerate their time-to-insight.

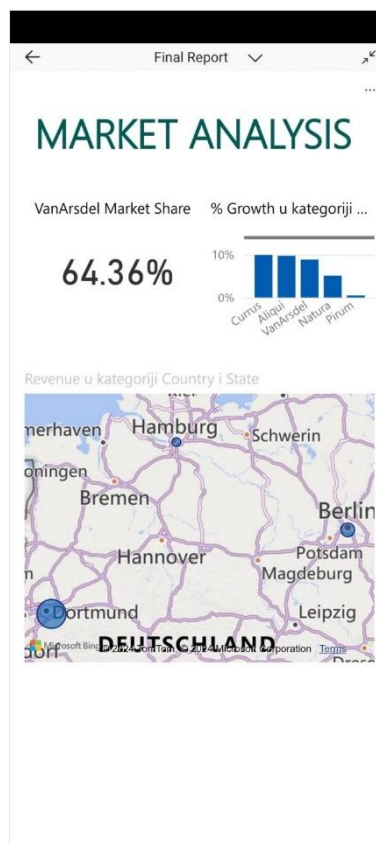


Figure 7: Market Share report on a mobile device

When teams work together, they need access to the same dashboards and reports so they can collaborate easily. Data-driven collaboration in organization can be increased by embedding Power BI reports in Microsoft Teams. Team can stay on track by using Microsoft Teams to track metrics, which encourages accountability, alignment and visibility. This way teams can collaborate and communicate efficiently within the organization. In the Power BI mobile apps for iOS and Android devices, a tile, report or visual can be annotated and then shared with anyone via email. All of this can help teams prioritize important data and develop skills for making agile decisions based on progress toward objectives. Cloud platforms and collaboration tools enhance information sharing, fostering an agile competitive intelligence framework.

4. CONCLUSION

Enterprises use large volumes of data in various formats to understand customers and make informed decisions, but managing and utilizing this data effectively can be challenging. Due to heterogeneity and data quality, the demand for effective and ideal large-scale data storage is constantly growing. The Azure data lake solution exhibits great promise in offering efficient solution to satisfy this need for large-scale storage. A data lake house like this would provide improved data governance, minimize data movement and redundancy and optimize time usage.

As the most comprehensive data analytics solution, combining a suite of services, such as data lake, data science, real-time analytics and business intelligence, into one environment, Microsoft Fabric platform makes much simpler and more cohesive management of the entire

organization's data infrastructure and therefore helps it achieve business goals and outpace the competition.

REFERENCES

- Adewusi, A. O., Okoli, U. I., Adaga, E., Olorunsogo, T., Asuzu, O. F., & Daraojimba, D. O. (2024). Business intelligence in the era of big data: a review of analytical tools and competitive advantage. *Computer Science & IT Research Journal*, 5(2), 415-431.
- Ali, W. (2023). Business Intelligence In The Digital Age: Tools And Techniques. *Competitive Research Journal Archive*, 1(03), 215-224.
- Gupta, P., Ponnusamy, S. (2023). Beyond Banking: The Trailblazing Impact of Data Lakes on Financial Landscape. *International Journal of Computer Applications*, 975, 8887.
- Bharadiya, J. P. (2023). Machine learning and AI in business intelligence: Trends and opportunities. *International Journal of Computer (IJC)*, 48(1), 123-134.
- Borra, P. (2024). Microsoft Fabric Review: Exploring Microsoft's New Data Analytics Platform. *International Journal of Computer Science and Information Technology Research*, 12(2), 34-39.
- Doshi, R., Hiran, K. K., Mijwil, M. M., & Anand, D. (2023). To that of artificial intelligence, passing through business intelligence. In *Handbook of Research on AI and Knowledge Engineering for Real-Time Business Intelligence* (pp. 1-16). IGI Global.
- Hosen, M. S., Islam, R., Naeem, Z., Folorunso, E. O., Chu, T. S., Al Mamun, M. A., & Orunbon, N. O. (2024). Data-Driven Decision Making: Advanced Database Systems for Business Intelligence. *Nanotechnology Perceptions*, 20(3), 687-704.
- Kalathas I, Papoutsidakis M, Drosos C. Business Intelligence and Machine Learning Methods for Predictive Maintenance in Greek railways. *Open Journal of Applied Sciences*. 2020;11(1):20-35.
- Kilanko, V. (2022). *Turning Point: Policymaking in the Era of Artificial Intelligence*, by Darrell M. West and John R. Allen, Washington, DC: Brookings Institution Press, 2020, 297 pp., hardcover 24.99, paperback 19.99.
- Mikalef, P., Krogstie, J., Pappas, I.O., & Pavlou, P. (2020). Exploring the relationship between big data analytics capability and competitive performance: The mediating roles of dynamic and operational capabilities. *Information & Management*, 57(2), 103169.
- Oussous, A., Benjelloun, F.Z., Lahcen, A.A. and Belfkih, S. (2018) Big Data Technologies: A Survey. *Journal of King Saud University-Computer and Information Sciences*, 30, 431-448. <https://doi.org/10.1016/j.jksuci.2017.06.001>
- Psomakelis, E., Nikolakopoulos, A., Marinakis, A., Psychas, A., Moulos, V., Varvarigou, T., & Christou, A. (2020). A scalable and semantic data as a service marketplace for enhancing cloud-based applications. *Future Internet*, 12(5), 77.
- Udeh, C. A., Orieno, O. H., Daraojimba, O. D., Ndubuisi, N. L., & Oriekhoe, O. I. (2024). Big data analytics: a review of its transformative role in modern business intelligence. *Computer Science & IT Research Journal*, 5(1), 219-236.
- Zohuri B, Moghaddam M. From business intelligence to artificial intelligence. *Journal of Material Sciences & Manufacturing Research*. SRC/JMSMR/102. 2020, 3.

HOUSING PRICE PREDICTION USING XGBOOST AND RANDOM FOREST METHODS

Ljiljana Matic*

University of Kragujevac, Faculty of Economics, ljiljana.matic@ef.kg.ac.rs,
ORCID number 0009-0002-0473-0214

Zoran Kalinić

University of Kragujevac, Faculty of Economics, zkalinic@kg.ac.rs,
ORCID number 0000-0001-8137-9005

Abstract: Real estate prices often experience significant variations due to various reasons such as shifts in land value and local infrastructure development. An application for predicting housing prices, taking into account the property and neighborhood characteristics and infrastructure, is essential for providing customers with accurate insights into where and when to invest in property. This research focuses on apartment price prediction in real estate market of Belgrade, employing advanced machine learning algorithms, XGBoost and Random Forest, to estimate property values. These algorithms are highly effective at processing large datasets and uncovering complex relationships among key predictors.

Data preprocessing plays a crucial role in ensuring model accuracy. This process includes data cleaning, handling missing values, and addressing outliers, while categorical features are transformed through one-hot encoding to enhance model performance. Both XGBoost and Random Forest models are applied to predict apartment prices, providing valuable insights into the most influential factors in the market. A comparative analysis of these methods not only highlights their respective strengths and effectiveness within the context of the Serbian real estate market but also demonstrates their utility in improving prediction accuracy.

The results of this study contribute to a more transparent and efficient real estate market in Belgrade, offering valuable tools for all stakeholders: sellers, prospective buyers, policymakers, local administration, etc. By integrating these advanced predictive models, this research also lays the groundwork for future advancements in real estate analytics, presenting a robust framework for market forecasting and strategic decision-making. Although applied to apartment price prediction, the models can be, with minor modifications, applied to price predictions of other types of real estate (houses, commercial, industrial, land plots, etc.). Additionally, the findings suggest potential areas for further research to refine prediction models and adapt them to evolving market conditions.

Keywords: Machine Learning, XGBoost, Random Forest, Housing Price Prediction, Real Estate

JEL Classification: C 38, R 31

* Corresponding author

1. INTRODUCTION

The real estate market is a cornerstone of the global economy, with significant impacts on economic stability and social welfare. Understanding its dynamics is essential for both academics and industry professionals, as property values and market trends are influenced by many complex factors. Artificial intelligence (AI) has introduced advanced analytical models that simplify real estate assessment, offering rapid, data-driven insights.

While clients rely on the expertise of real estate professionals, traditional analysis methods are often slow and limited by data-processing constraints. AI overcomes these challenges by processing large datasets quickly, generating accurate market forecasts and supporting well-informed investment decisions. Recent research in Serbia highlights AI's practical value in real estate, using data from a reputable real estate platform to predict apartment prices in Belgrade. By using powerful machine learning algorithms like XGBoost and Random Forest, this study shows how AI can capture complex market dynamics and deliver precise price predictions.

This research explores how AI is transforming real estate analysis, providing investors, sellers, policymakers, and local administrators with timely, data-based insights. The study emphasizes AI's role in creating a more transparent and efficient real estate market, setting a foundation for future advances in market forecasting and strategic planning. Although focused on apartment price predictions in Belgrade, these models can also be applied to other property types, underscoring their potential across various real estate segments.

2. LITERATURE REVIEW

Random Forest and XGBoost have made a significant impact in real estate valuation, offering robust tools for accurately predicting property prices.

Trends in property prices are indicative of economic conditions and significantly impact both buyers and sellers. Factors such as the number of bedrooms and bathrooms, location, and proximity to amenities (e.g., highways, malls, schools) strongly influence property values. Properties in rural areas, for instance, are generally less expensive than those in urban areas. Traditionally, real estate companies relied on manual methods for property price prediction, where teams analyzed past data; however, this process often resulted in an approximate 25% error rate, causing losses for stakeholders (Rawool et al., 2021).

The advent of machine learning (ML) has transformed real estate valuation by enabling the discovery of patterns and reliable predictions based on historical data (Zhou et al., 2017). ML algorithms are commonly categorized into supervised and unsupervised learning approaches (Ogunleye, 2021). Supervised learning, which uses labeled data to predict target variables, has proven highly effective in real estate valuation (Shobayo et al., 2023), while unsupervised learning uncovers hidden patterns in unlabeled data (Usama et al., 2019).

Data-driven modeling through ML techniques offers significant advantages over traditional regression methods by capturing complex relationships without needing explicit model definitions. Recent advancements in data collection have further driven the use of ML in academic research on real estate (Fan et al., 2006; Selim, 2009; Antipov & Pokryshevskaya,

2012; Čeh et al., 2018). As Fan et al. (2006) note, these methods can model both linear and non-linear relationships and explore hierarchical structures in determinants of property prices.

Several studies have highlighted the effectiveness of specific ML algorithms in real estate valuation. Artificial neural networks (ANNs) have shown improved accuracy over traditional hedonic models, as demonstrated by McCluskey & Anand (1999) and Verikas et al. (2002). Limsombunchai (2004) and Selim (2009) further found that ANNs offer a robust alternative to hedonic models for property valuation. Additionally, Park & Bae (2015) utilized algorithms like C4.5, RIPPER, Naïve Bayes, and AdaBoost to analyze real estate data, demonstrating ML's versatility in appraisal tasks.

Despite the widespread use of ML in real estate, few studies have specifically applied the Random Forest (RF) method for property valuation. RF, an ensemble technique that aggregates predictions from multiple decision trees, offers several benefits, such as reduced risk of overfitting and effective handling of categorical variables with many levels (Antipov & Pokryshevskaya, 2012). RF also performs well with incomplete data, leveraging completed sections of decision trees to make predictions. Its minimal hyperparameter tuning requirements, combined with its ability to handle non-linear relationships and varied variable influences, make it particularly suitable for mass appraisals (Antipov & Pokryshevskaya, 2012).

In recent studies, ML-based regression models have been utilized to predict house prices and identify future trends. For example, Zou (2023) applied CatBoost to 9,875 records from the Jinan city housing market in China, outperforming linear regression and RF models. Similarly, Hjort et al. (2022) introduced a squared percentage error (SPE) loss function to enhance XGBoost for predicting house prices in Norway, achieving an RMSE of 0.154. These studies demonstrate the potential of advanced ML algorithms, such as XGBoost, for improved accuracy in property valuation.

3. METHODOLOGY

Random Forest (Breiman, 2001) is a versatile machine learning algorithm effective in both classification and regression tasks. For regression, it combines multiple decision trees into an ensemble, producing robust predictions by averaging the outputs from each tree. Each tree in the forest is trained on a bootstrapped sample of the data, and at each split, only a random subset of predictors is evaluated, reducing overfitting and enhancing model stability. Unlike single regression trees, Random Forest provides a continuous range of predictions, allowing it to capture complex, non-linear relationships in the data. The algorithm also handles missing values effectively, as predictions can be made using only the available portions of the tree, thus eliminating the need for imputation. Its resilience to outliers, achieved through bagging, and its full-depth tree structure help capture intricate patterns without requiring pruning. Additionally, Random Forest can evaluate variable importance by averaging the reduction in residual sum of squares, making it highly suitable for regression applications like mass appraisal, where complex variable relationships are common (Antipov & Pokryshevskaya, 2012).

XGBoost, or eXtreme Gradient Boosting (Chen & Guestrin, 2016), is another powerful machine learning technique, widely used for both regression and classification tasks. This ensemble learning method combines Cause-Based Decision Trees (CBDT) with Gradient

Boosting Machines (GBM) to enhance predictive accuracy by iteratively adding models that correct the residuals or errors of previous models. XGBoost excels in processing large datasets with many features and complex classifications, consistently outperforming other machine learning algorithms in benchmark datasets (Friedman, 2001). Known for its speed, scalability, and accuracy, it has become popular among data scientists and is frequently used in machine learning competitions, such as those on Kaggle (Nielsen, 2016). A key advantage of XGBoost is its ability to parallelize, leveraging multi-core processors to efficiently handle large-scale datasets. Moreover, XGBoost is recognized for effectively balancing efficiency and accuracy in tackling complex optimization problems (Chen & Guestrin, 2016).

The data was collected from one of Serbia's largest and most significant online sales portals, which includes real estate listings across the country. The dataset was gathered from December 2023 to January 2024 and comprises 8,358 active apartment listings in Belgrade, posted within the past four years. Table 1 lists all parameters collected for each apartment.

The *price* parameter represents the listed sale price of the apartment. *Area* indicates the apartment's total area in square meters. *Rooms* specifies the total number of rooms, while *bathrooms* shows the total number of bathrooms in the apartment. *Floor* refers to the apartment's floor level, and *total floors* indicates the total number of floors in the building. *Construction* type describes the apartment's physical condition (e.g., Original condition, Renovated, Luxury, or For renovation). The *date* parameter indicates the year the listing was posted, covering the period from 2020 to 2024. *Heating* specifies the type of heating in the apartment, including options such as Central heating, Electric heating, Heat pumps, Gas, Floor heating, Norwegian radiators, Marble radiators, A/C unit, Central heating with a calorimeter, Tile stove, and Solid fuel stove. The *district* parameter identifies the municipality where the apartment is located, and *settlement* specifies its micro-location within the municipality. The district and settlement parameters are combined into a new parameter, *address*.

Table 1. *The real estate parameters*

Parameter	Data type
Price	Currency (in €)
Area	Number (in m ²)
Rooms	Number
Bathrooms	Number
Floors	Number
Total Floors	Number
Publishing year	Number
Construction type	String
Heating	String
District	String
Settlement	String
Address	String

Source: Dataset compiled by the author through web scraping, based on listings collected from December 2023 to January 2024

To ensure sufficient data, only neighborhoods with a minimum of 150 listings were included in the analysis, as the initial dataset did not provide adequate information for some neighborhoods and settlements in Belgrade. Duplicates and missing values were removed,

and categorical features like address, heating type, and construction condition were transformed through label encoding. Finally, all numerical data underwent Min-Max normalization. After filtering and processing, the reduced dataset contained 1,104 listings.

4. RESULTS AND DISCUSSION

In this study, machine learning models, specifically XGBoost and Random Forest, were applied to predict real estate prices in the Serbian market.

The XGBoost model was optimized using grid search, and its performance was evaluated on the test data. The Mean Absolute Error (MAE) was 17,431.69, reflecting the average magnitude of the errors in predictions. The Mean Absolute Percentage Error (MAPE) was 11.61%, meaning that the model's predictions deviated from actual prices by an average of 11.61%.

For the Random Forest model, grid search was also used to identify the optimal set of parameters. The Random Forest model achieved a Mean Absolute Error (MAE) of 17,857.81. The Mean Absolute Percentage Error (MAPE) for this model was 12.02%, indicating that the predictions deviated by an average of 12.02% from the actual prices.

Both models demonstrated reasonable accuracy in predicting real estate prices. The XGBoost model slightly outperformed the Random Forest model in terms of MAPE (11.61% versus 12.02%). However, both models provide valuable insights into the Serbian real estate market. These results highlight the potential of machine learning algorithms for forecasting real estate prices and supporting decision-making in the sector. The findings suggest that while there are minor differences in performance, both models are effective tools for property price prediction and can be adapted to other types of real estate data.

This study contributes to the growing body of research on machine learning applications in the real estate market, offering a foundation for future improvements in predictive modeling. Machine learning models offer significant potential to revolutionize the real estate sector by enhancing transparency, increasing the accuracy of price predictions, and supporting applications such as urban planning, financial decision-making, and tax assessment. These tools empower stakeholders—buyers, sellers, investors, and policymakers—with data-driven insights, fostering a more efficient and equitable market.

However, implementing these models in practice presents several challenges. Reliable and up-to-date data is essential for accurate predictions but is often scarce or inconsistent in certain markets. The Serbian real estate market, characterized by seasonal trends and localized factors, requires careful model adaptation to ensure precision. Additionally, successful application demands expertise in both machine learning and real estate to fine-tune algorithms and interpret results effectively. Legal and ethical issues, particularly concerning data privacy and security, also pose critical considerations that must be addressed to build trust and ensure compliance.

Table 1. Performance Metrics for XGBoost and Random Forest Models

Metric	XGBoost	Random Forest
MAE	17431.69	17857.81
MAPE	11.61%	12.02%

Source: Analysis results from the author's model training process

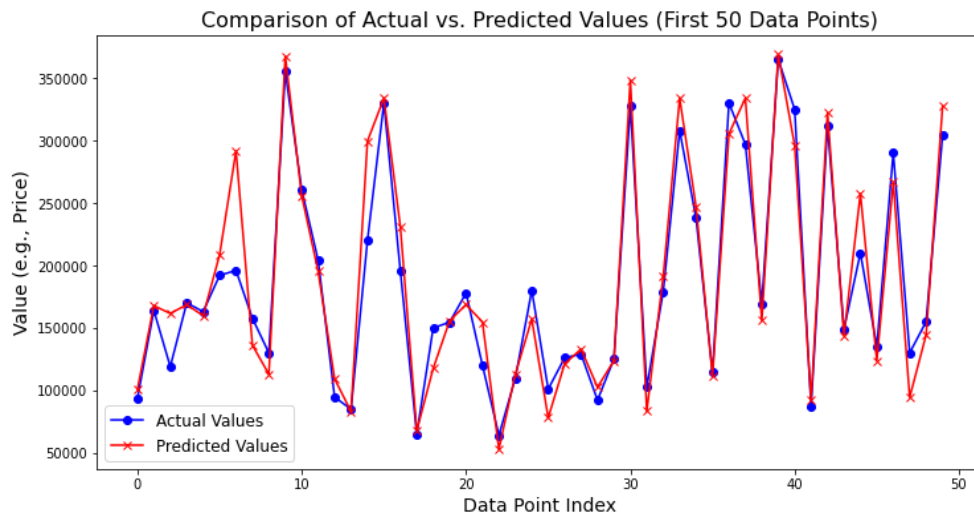


Figure 1: Comparison of Actual vs. Predicted Values Using a XGBoost Model (First 50 Data Points)

Source: Author's results from the comparison of actual and predicted values

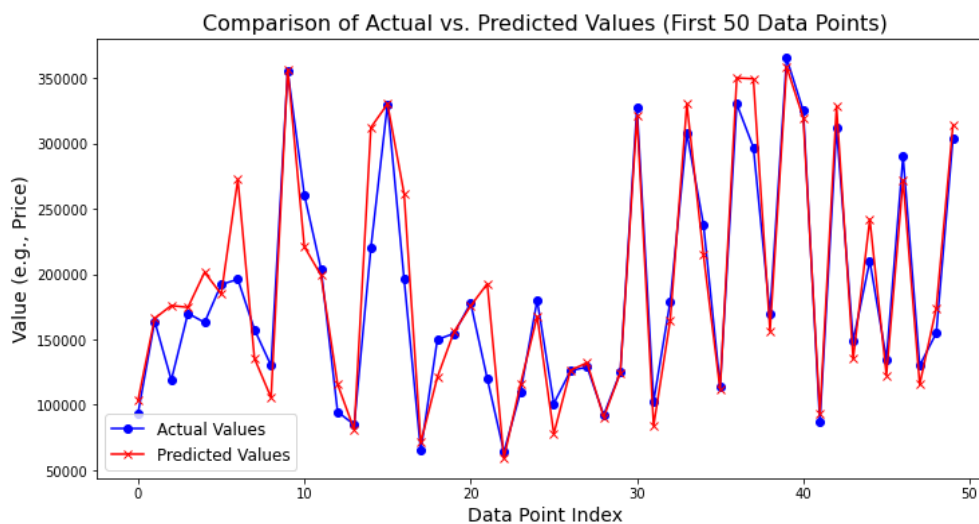


Figure 2: Comparison of Actual vs. Predicted Values Using a Random Forest Model (First 50 Data Points)

Source: Author's results from the comparison of actual and predicted values

5. CONCLUSIONS AND RECOMMENDATIONS

The study examined the potential of predicting real estate sales prices in Belgrade, Serbia, using machine learning techniques, specifically Random Forest and XGBoost. Models were developed based on prior research by Antipov & Pokryshevskaya (2012), Zou et al. (2023), and Hjort et al. (2022), with the objective of reducing prediction error rates. The XGBoost model, optimized through grid search, achieved a Mean Absolute Percentage Error (MAPE) of 11.61%, while the Random Forest model reached a MAPE of 12.02%. These error rates demonstrate reasonable accuracy, with XGBoost slightly outperforming RF in price predictions, aligning with findings from studies like Zou et al. (2023) where ensemble methods showed enhanced predictive performance.

This research illustrates that both Random Forest and XGBoost can provide effective property price predictions. While XGBoost achieved a lower MAPE, both models offer valuable insights into the Serbian real estate market, reinforcing the potential of machine learning to improve decision-making for buyers, sellers, and policymakers.

The limitations of this study also offer avenues for future research. The current models were developed for apartment sales in Belgrade, so further adaptation would be necessary for other property types, like commercial buildings or land. Additionally, expanding the study to other regions could provide a more comprehensive perspective. Our analysis used listing prices, which can introduce bias; future studies could benefit from using official sales data, where available, to reduce discrepancies.

Finally, while RF and XGBoost proved effective, exploring other machine learning models, such as Support Vector Machines (SVM), AdaBoost, or Artificial Neural Networks (ANN), could reveal further improvements. Implementing ANN models, in particular, could provide insights into non-linear relationships among variables, which could enhance the predictive accuracy for more complex datasets.

REFERENCES

- Antipov, E. A., & Pokryshevskaya, E. B. (2012). Mass appraisal of residential apartments: An application of Random Forest for valuation and a CART-based approach for model diagnostics. *Expert Systems with Applications*, 39(2), 1772–1778. <https://doi.org/10.1016/j.eswa.2011.08.077>
- Amal Asselman, M., Khaldi, M., & Aammou, S. (2021). Enhancing the prediction of student performance based on the machine learning XGBoost algorithm. *Interactive Learning Environments*. 31(6), 3360–3379, <https://doi.org/10.1080/10494820.2021.1928235>
- Breiman, L. (2001). *Random forests*. *Machine Learning*, 45(1), 5–32.
- Čeh, M., Kilibarda, M., Lisec, A., & Bajat, B. (2018). Estimating the performance of random forest versus multiple regression for predicting prices of apartments. *ISPRS International Journal of Geo-Information*, 7(5), 168. <https://doi.org/10.3390/ijgi7050168>
- Chen, T., & Guestrin, C. (2016). XGBoost: A scalable tree boosting system. *Proceedings of the 22nd ACM SIGKDD International Conference on Knowledge Discovery and Data Mining*, 785–794. Association for Computing Machinery. <https://doi.org/10.1145/2939672.2939785>
- Fan, G. Z., Ong, S. E., & Koh, H. C. (2006). Determinants of house price: A decision tree approach. *Urban Studies*, 43(12), 2301–2315. <https://doi.org/10.1080/00420980600990928>
- Friedman, J. H. (2001). Greedy function approximation: A gradient boosting machine. *Annals of Statistics*, 29(5), 1189–1232. <https://doi.org/10.1214/aos/1013203451>
- Hjort, A., Pensar, J., Scheel, I., & Sommervoll, D. E. (2022). House price prediction with gradient-boosted trees under different loss functions. *Journal of Property Research*, 39(4), 338–364. <https://doi.org/10.1080/09599916.2022.2073874>
- Limsombunchai, V. (2004). House price prediction: Hedonic price model vs. artificial neural network. *New Zealand Agricultural and Resource Economics Society Conference*, 25–26.

- Lu, S., Li, Z., Qin, Z., Yang, X., & Goh, R. S. M. (2017). A hybrid regression technique for house prices prediction. *Proceedings of the 2017 IEEE International Conference on Big Data*, 2585–2590. <https://doi.org/10.1109/BigData.2017.8258232>
- McCluskey, W., & Anand, S. (1999). The application of intelligent hybrid techniques for the mass appraisal of residential properties. *Journal of Property Investment & Finance*, 17(3), 218–239. <https://doi.org/10.1108/14635789910270495>
- Nielsen, D. (2016). Tree Boosting with XGBoost-Why Does XGBoost Win Every Machine Learning Competition? (Master's thesis, NTNU).
- Ogunleye, B. O. (2021). Statistical Learning Approaches to Sentiment Analysis in the Nigerian Banking Context (Ph.D. thesis, Sheffield Hallam University)
- Park, B., & Bae, J. K. (2015). Using machine learning algorithms for housing price prediction: The case of Fairfax County, Virginia housing data. *Expert Systems with Applications*, 42(6), 2928-2934. <https://doi.org/10.1016/j.eswa.2014.11.040>
- Rawool, A. G., Rogye, D. V., Rane, S. G., & Bharadi, V. A. (2021). House price prediction using machine learning. *Iconic Research and Engineering Journals*, 4(11), 29–33.
- Selim, H. (2009). Determinants of house prices in Turkey: Hedonic regression versus artificial neural network. *Expert Systems with Applications*, 36(2), 2843–2852. <https://doi.org/10.1016/j.eswa.2008.01.044>
- Shobayo, O., Zachariah, O., Odusami, M. O., & Ogunleye, B. (2023). Prediction of stroke disease with demographic and behavioral data using random forest algorithm. *Analytics*, 2, 604–617. <https://doi.org/10.3390/analytics2020034>
- Usama, M., Qadir, J., Raza, A., Arif, H., Yau, K. L. A., Elkhatib, Y., & Al-Fuqaha, A. (2019). Unsupervised machine learning for networking: Techniques, applications, and research challenges. *IEEE Access*, 7, 65579–65615. <https://doi.org/10.1109/ACCESS.2019.2918193>
- Verikas, A., Lipnickas, A., & Malmqvist, K. (2002). Selecting neural networks for a committee decision. *International Journal of Neural Systems*, 12(5), 351–361. <https://doi.org/10.1142/S0129065702001229>
- Zhou, L., Pan, S., Wang, J., & Vasilakos, A. V. (2017). Machine learning on big data: Opportunities and challenges. *Neurocomputing*, 237, 350–361. <https://doi.org/10.1016/j.neucom.2016.04.061>
- Zou, C. (2023). The house price prediction using machine learning algorithm: The case of Jinan, China. *Highlights in Science, Engineering, and Technology*, 39, 327–333.

ARTIFICIAL INTELLIGENCE AND CYBERSECURITY IN BANKING SECTOR: OPPORTUNITIES AND RISKS

Ana Kovačević*

Faculty of Security Studies, University of Belgrade, kana@fb.bg.ac.rs,
ORCID number 0000-0003-4928-9848

Sonja D. Radenković

Belgrade Banking Academy – Faculty of Banking, Insurance and Finance, Union University
Belgrade, sonja.radenkovic@bba.edu.rs,
ORCID number 0000-0001-6830-7533

Dragana Nikolić

Institute of Nuclear Sciences Vinca, University of Belgrade, anikol@vinca.rs,
ORCID number 0000-0003-2568-7729

Abstract: *The rapid advancements in artificial intelligence (AI) have presented new opportunities for enhancing efficiency and economic competitiveness across various industries, especially in banking. Machine learning (ML), as a subset of artificial intelligence, enables systems to adapt and learn from vast datasets, revolutionizing decision-making processes, fraud detection, and customer service automation. However, these innovations also introduce new challenges, particularly in the realm of cybersecurity. Adversarial attacks, such as data poisoning and evasion attacks, represent critical threats to machine learning models, exploiting vulnerabilities to manipulate outcomes or compromise sensitive information. Furthermore, this study highlights the dual-use nature of AI tools, which can be used by malicious user. To address these challenges, the paper emphasizes the importance of developing machine learning models with key characteristics such as security, trust, resilience and robustness. These features are essential to mitigating risks and ensuring secure deployment of AI technologies in banking sectors, where the protection of financial data is paramount. The findings underscore the urgent need for enhanced cybersecurity frameworks and continuous improvements in defensive mechanisms. By exploring both opportunities and risks, this paper aims to guide the responsible integration of AI in the banking sector, paving the way for innovation while safeguarding against emerging threats.*

Keywords: *Artificial Intelligence, Machine Learning, Cyber Security, Adversarial Attacks, Banking*

JEL Classification: *C63, O33, G21*

* Corresponding author

1. INTRODUCTION

Artificial intelligence is reshaping the banking industry, offering unparalleled opportunities for innovation and efficiency. According to Gartner (2024b), 50% of respondents in the banking sector reported having already implemented AI, while the adoption of generative AI, although growing, remains less common (40%). Furthermore, the prediction is that by 2027, over 50% of enterprises will employ industry-specific generative AI models, a significant increase from the 1% that utilised such models in 2023 (Sau et al., 2024).

Generative Artificial Intelligence (Generative AI) refers to large-scale models trained on billions of parameters to generate diverse media types. However, this transformative technology also introduces new security challenges, making cybersecurity a very important priority. Organisations plan to significantly increase their investments in 2025 compared to 2024, prioritising cybersecurity (89%), generative AI (90%), and broader AI applications (85%) (Gartner, 2024b). Overall, the report emphasises a clear trend: organisations in the banking industry recognise the importance of adopting advanced technologies on the need to innovate services, and stay competitive while also bolstering security measures to address an increasingly complex threat landscape. Cybersecurity remains one of the top priorities as the sector seeks to protect sensitive financial data, prevent cyber attacks, and ensure compliance with stringent regulatory requirements. This underscores the urgent need for robust security measures to address an increasingly complex threat landscape.

One of the biggest reasons the banking sector is usually targeted by most cyber-attacks is the monetary gain (Chin, 2024). Given that financial data is the core of the banking sector, any attack on the system might incapacitate a company and decrease customer trust in the company. In 2024, Kaspersky (2024) data revealed a significant global rise in mobile financial threats, with the number of affected users doubling compared to 2023. Further, more upward trend will persist into 2025.

2. APPLICATION OF AI IN THE BANKING SECTOR

The competitive environment in the banking sector is progressively influenced by digital-first entities, including fintech companies and digital banks, rather than conventional banks with significant branch networks. This transition underscores the necessity to examine the impact of artificial intelligence (AI) on the banking industry, especially in facilitating digital transformation (Aithal, 2023). AI has become a crucial technology transforming banking operations via new solutions that improve scalability, efficiency, and customer experience.

Integrating AI in banking centres on four key digital disruptors: advanced data analytics, robots, embedded banking, and intelligent infrastructure. These improvements facilitate several uses, including as AI-driven chatbots for customer service, robo-advisors for investment advice, predictive analytics, improved cybersecurity, automated credit assessment, and direct financing.

Implementing AI in digital banking can be classified into three sequential tiers (Radenković et al., 2023). The initial stage entails utilizing machine learning to discern patterns and enhance digital banking operations. The second level presents “general intelligence” that can replicate human interactions so successfully that customers and workers may be unaware they are engaging with a machine. The third and most sophisticated level includes AI systems that exceed human banking personnel in intellect and decision-making capabilities.

The integration of AI has significant advantages, although it is a complicated, protracted process necessitating the satisfaction of multiple operational and regulatory requirements. The emergence of AI in banking also induces considerable labour transformations. Conventional roles are anticipated to diminish while emerging positions—such as data scientists, behavioural psychologists, and experience designers—are increasingly crucial for enabling the shift to AI-driven digital banking. This trend highlights the dual impact of AI: it undermines the existing paradigm while fostering chances for innovation and growth in the financial sector.

3. CYBER SECURITY

Cybersecurity is a complex, computing-based discipline integrating technology, people, information, and processes to protect systems from unauthorised access or attacks (Joint Task Force on Cybersecurity, 2018). However, growing concerns exist about the potential risks of deploying AI in security-critical areas. Security remains a top priority for corporate boards when considering AI adoption (Gartner, 2024a). The risks associated with AI failures or misuses are real and could lead to severe consequences, particularly in sensitive sectors such as banking. These concerns are particularly pressing given the current environment, where cyber attacks are growing in both frequency and sophistication, leading to significant costs for organisations in defence measures and mitigation of potential harm. Preventing such attacks is especially important, as their disruption can profoundly affect security and functionality of banking sectors.

With the rapid advancements in artificial intelligence (AI), a pressing question emerges: will AI serve as a tool to address cybersecurity challenges, or will it make (generate) new, sophisticated attack vectors? The rise of generative AI has already showcased its dual-use potential, offering both defensive capabilities and opportunities for malicious exploitation. Hazell (2023) conducted a hypothetical experiment to demonstrate how generative AI like GPT-3 and GPT-4 could automate the creation of spear-phishing campaigns. The process involved gathering personalised biographical data from online sources, crafting customised email messages based on this data, and embedding malware within those emails. This highlights a critical concern: how will malware and cyber attacks evolve with AI support? Will these tools enable attackers to launch more dangerous and sophisticated campaigns? WormGPT exemplifies this threat. Built on the open-source GPT-J framework, WormGPT has been trained specifically on data related to malware and phishing emails. Unlike ethical models like ChatGPT, WormGPT operates without safeguards, enabling the efficient generation of malicious content. Beyond WormGPT, other tools such as AutoGPT, ChatGPT with DAN prompts, FreedomGPT, FraudGPT have emerged, each offering various capabilities to generate harmful content. These developments underscore the inherent dual-use nature of AI technologies, highlighting the urgent need for comprehensive regulatory frameworks and ethical guidelines to mitigate their potential misuse.

Moreover, research conducted by Oracle &KMPG (2019) highlights a significant shortage of cybersecurity experts. Given the rise in cyberattacks and the shortage of skilled personnel, there is a growing need to automate threat detection and response processes where AI can offer significant support (Kocher and Kumar 2021; Kovačević 2023).

4. ARTIFICIAL INTELIGENCE

With advancements in hardware and software and the generation of large amounts of data, artificial intelligence has been experiencing rapid expansion. Machine learning is a subset of artificial intelligence. It refers to a software system's ability to generalise based on prior experience, where experience is defined as a dataset concerning the phenomena/entities that are the subject of learning.

Based on the type of decision-making process, machine learning can be categorised as supervised learning, unsupervised and reinforcement learning (Kovačević 2023). In cases where humans have achieved better results, machine learning has been observed to improve accuracy with increased training, which is not the case for humans. It has proven highly effective in analysing large volumes of data and detecting previously unknown patterns, as well as making it helpful in detecting and blocking cyber attacks (Kovačević 2023), such as identifying and preventing system intrusions or detecting malicious code. Additionally, it can investigate attacks on targeted systems, analyse entry possibilities, and uncover vulnerabilities. Machine learning can also detect unusual activities that indicate cyber attacks or system misuse.

4.1. Machine learning in analyzing cyber security attacks

Detecting cyber attacks remains a substantial challenge, often requiring months or even years to identify an intrusion (Sobers, 2022). Given the vast and growing data volume in modern computing environments, machine learning offers a powerful approach to improve cyber attack detection. Zero-day vulnerabilities, in particular, are increasingly central to advanced cyber operations; leveraging machine learning to detect these new vulnerabilities could significantly enhance cybersecurity defences.

Machine learning systems are particularly valuable for identifying software vulnerabilities within complex codebases, which can contain millions of lines of code. This complexity makes manual analysis time-consuming and prone to human error. By training machine learning models to recognise these vulnerabilities, the process can be effectively automated, enabling faster and more accurate detection. As machine learning systems continuously improve through experience and training data, the potential for precise increasing vulnerability detection grows (Saavedra et al., 2019).

The application of machine learning is equally promising in developing advanced intrusion detection systems (IDSs). Different machine learning methodologies - supervised, unsupervised, and reinforcement learning - bring distinct advantages to IDSs. Supervised learning effectively identifies well-documented attacks with low false favourable positive rates, though it struggles with unknown threats (Shaukat et al., 2020; Pinto et al., 2023). Unsupervised learning holds the potential for detecting zero-day attacks; however, it often results in a higher rate of false positives (Almalawi et al., 2020). Reinforcement learning, if given sufficient training time, has the potential to adapt dynamically to evolving cyber threats, providing a robust defence (Nguyen & Reddi, 2023). The integration of these advanced techniques has led to notable improvements in the accuracy and responsiveness of IDSs, further advancing the field of cybersecurity.

4.2. Attacks on machine learning models

The development of machine learning models requires the collection of large amounts of data. It can and can be very costly, mainly due to the time needed for the development, tuning, and validation of the models. Attackers may exploit vulnerabilities in these models to gain unauthorised access to sensitive information. Attacks on machine learning can also significantly reduce the effectiveness of these technologies, leading to devaluation of the investments made in them and delayed implementation (Koball et al., 2024).

By analysing threat vectors in the context of attacks on machine learning, the following types of attacks are identified (Koball et al., 2024):

- **Data Extraction:** The attacker attempts to uncover the data on which the model was trained, which is particularly dangerous if the model uses sensitive data.
- **Data Poisoning:** The attacker manipulates the training data, introducing false examples to make the model produce inaccurate predictions. Due to the inherent nature of the model, minimal changes in input data, imperceptible to humans, can lead to misclassification.
- **Model Extraction:** The attacker obtains information about the internal structure of the model.
- **Evasion attack:** The attacker forces the model to make incorrect predictions and avoids detection by generating adversarial examples.
- **Data poisoning and evasion attacks influence machine learning output, while data extraction and model extraction are passive attacks.** An example of a data poisoning attack occurred in a financial institution where attackers manipulated training data for fraud detection, resulting in the system approving fraudulent transactions as legitimate.

We can consider a hypothetical scenario in which a machine learning model detecting security incidents, such as unauthorised access or breaches. In this scenario, attacker could insert manipulated data into the training set. This could alter the model's ability to detect security incidents accurately, potentially allowing unauthorised individuals or malicious activities to go unnoticed. Furthermore, an example of a data poisoning attack occurred in a financial institution where attackers manipulated training data for fraud detection, resulting in the system approving fraudulent transactions as legitimate.

The widespread use of machine learning algorithms has led to malicious manipulations known as adversarial attacks. These attacks impact the decision-making process in machine learning, resulting in outcomes that benefit the attacker (Goodfellow et al., 2014a; Goodfellow *et al.*, 2014b). The way neural networks perform data classification differs from human perception, so even a small change in just a few pixels can significantly alter the classification result, even if a human cannot perceive the difference (Goodfellow et al., 2014b). Additionally, a change in the position of an object can lead to misclassification (Alcorn et al., 2019), while Li et al., (2019) demonstrated how a facial recognition system can produce incorrect results even with minimal object shifts. Based on the level of access to the machine learning model, attackers can target systems in the following categories (Kobal et al., 2024):

- *Black Box*: the attacker does not have insight into the model's details but uses input and output data to analyse vulnerabilities.
- *White Box*: the attacker has complete knowledge of the model's architecture, enabling them to create precise perturbations to exploit its weaknesses.
- *Gray Box*: these attacks grant the attacker partial access to information, somewhere between full access in white-box attacks and the limited data available in black-box attacks.

On the other hand, if a machine learning model is trained on confidential data, model inversion can allow an attacker to reveal key characteristics of the underlying data used for training the system (Buchanan, 2021).

A machine learning model must possess several key characteristics, especially in areas of great importance to society: security, trust in the model, robustness, and resilience (Khadka et al., 2024). Robustness refers to the model's ability to function even during crises, while resilience is the system's ability to return to normal functioning within a reasonable time after a disruption. These characteristics are crucial in demanding domains, as their absence can have serious consequences, particularly in critical infrastructures. Achieving resilience and robustness can significantly improve trust and security within the system.

To achieve security, trust in the model, resilience, and robustness, various strategies can be applied, as suggested by Khadka et al., (Khadka et al., 2024), such as: understanding and simulating different types of attacks, detecting adversarial attacks, training robust models and/or understanding the weaknesses and vulnerabilities of the system.

Some defensive strategies are implemented during the training phase, while others are used during the testing phase. Adding adversarial data to the training set can help the model become more resilient to adversarial perturbations during training. Based on the available literature, Khadka et al. (2024) mention some of the most commonly used strategies for adversarial training, such as brute-force adversarial training, data randomisation, gradient masking, and more.

Machine learning security is crucial as machine learning-assisted methods become more widespread. Research indicates a significant gap in understanding the full extent of attack success rates against these systems. Addressing this gap is essential to developing robust defences and improving the resilience of machine learning models in practical applications.

5. CONCLUSION

As a core element of modern artificial intelligence systems, machine learning finds broad application in banking, delivering numerous benefits, such as enhanced efficiency, improved decision-making, trend prediction, anomaly detection, and security monitoring. However, one evident trend is that machine learning's integration will add complexity to traditional attack vectors, increasing the risk of cyber operations and reshaping the nature of cyber threats. The expansion of machine learning introduces specific security challenges, such as adversarial attacks or data/system extraction. These threats, posed through white, grey, or black box methods, seriously endanger system privacy and data integrity. As a result, it is imperative to assess machine learning technologies thoroughly within sensitive systems, recognising that

they come with distinctive risks and advantages. Ongoing research into potential attack methods and their effects on machine learning models is critical.

This research must include developing defence strategies encompassing vulnerability assessments, attack simulations, and training of robust models. The resilience and robustness of machine learning models, key traits enabling them to function effectively under threat, are essential to building trust in these technologies. Continuous improvement of defensive mechanisms through research and testing is needed to ensure the secure use of machine learning in the banking sector. It is essential to carefully evaluate the deployment of machine learning in sensitive environments like banking, where unique risks tied to this technology may also emerge. While machine learning is not inherently more dangerous than human action, it can operate at computational speeds and scales beyond human capacity, amplifying its benefits and potential risks. Banking institutions should prioritize investment in adversarial training and robust model validation to mitigate risks associated with AI vulnerabilities.

In particular, ensuring generative AI systems' security and robustness is vital to responsibly leveraging their capabilities the security and robustness of generative AI systems is vital to leveraging their capabilities responsibly, especially in critical areas with significant societal impact. Machine learning holds considerable promise in vulnerability detection and cyber attack prevention. However, crucial questions remain: will machine learning accelerate or resolve cyber attacks? Will attackers benefit more from its application, or will it fortify defences? Achieving a comprehensive understanding of machine learning's capabilities and limitations is crucial to mitigating misuse. Future research should focus on the regulatory framework for AI use in critical sectors, ensuring a balance between innovation and security.

REFERENCES

- Aithal, P. S. (2023). An Analytical Study of Applications of Artificial Intelligence on Banking Practices. *International Journal of Management, Technology and Social Sciences (IJMTS)*, 8(2), 133-144.
- Alcorn, M. A., Li, Q., Gong, Z., Wang, C., Mai, L., Ku, W.-S., & Nguyen, A. (2019). Strike (With) a Pose: Neural Networks Are Easily Fooled by Strange Poses of Familiar Objects. *2019 IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR)*, 4840–4849. <https://doi.org/10.1109/CVPR.2019.00498>
- Almalawi, A., Fahad, A., Tari, Z., Khan, A. I., Alzahrani, N., Bakhsh, S. T., Alassafi, M. O., Alshdadi, A., & Qaiyum, S. (2020). Add-On Anomaly Threshold Technique for Improving Unsupervised Intrusion Detection on SCADA Data. *Electronics*, 9(6), Article 6. <https://doi.org/10.3390/electronics9061017>
- Buchanan, A. B. (n.d.). *A National Security Research Agenda for Cybersecurity and Artificial Intelligence CSET Issue Brief*.
- Chin, K. (2024). “Why is the Finance Sector a Target for Cyber Attacks?”, UpGuard. Online: <https://www.upguard.com/blog/finance-sector-cyber-attacks>
- Gartner. (2024a, a). *2024 Board of Directors Survey: Elevate Sustainability Value*. Gartner. <https://www.gartner.com/en/documents/5533395>
- Gartner, b. (2024b). *2025 Gartner CIO and Technology Executive survey*. Gartner, Inc.
- Goodfellow, I. J., Shlens, J., & Szegedy, C. (2014). Explaining and harnessing adversarial examples. *arXiv Preprint arXiv:1412.6572*.
- Goodfellow, I., Pouget-Abadie, J., Mirza, M., Xu, B., Warde-Farley, D., Ozair, S., Courville, A., & Bengio, Y. (2014). Generative Adversarial Nets. *Advances in Neural Information*

- Processing Systems*, 27. https://proceedings.neurips.cc/paper_files/paper/2014/hash/5ca3e9b122f61f8f06494c97b1afccf3-Abstract.html
- Hazell, J. (2023). *Spear Phishing With Large Language Models* (arXiv:2305.06972). arXiv. <https://doi.org/10.48550/arXiv.2305.06972>
- Joint Task Force on Cybersecurity. (2018). *Cybersecurity Curricula 2017: Curriculum Guidelines for Post-Secondary Degree Programs in Cybersecurity*. ACM. <https://doi.org/10.1145/3422808>
- Kasperski (2024). *Kaspersky predicts quantum-proof ransomware and advancements in mobile financial cyberthreats in 2025*. (2024, November 14). /. <https://www.kaspersky.com/about/press-releases/kaspersky-predicts-quantum-proof-ransomware-and-advancements-in-mobile-financial-cyberthreats-in-2025>
- Khadka, A., Sthapit, S., Epiphaniou, G., & Maple, C. (2024). Resilient Machine Learning: Advancement, Barriers, and Opportunities in the Nuclear Industry. *ACM Computing Surveys*, 56(9), 1–29. <https://doi.org/10.1145/3648608>
- Koball, C., Wang, Y., Rimal, B. P., & Vaidyan, V. (2024). Machine Learning Security: Threat Model, Attacks, and Challenges. *Computer*, 57(10), 26–35. <https://doi.org/10.1109/MC.2024.3396357>
- Kocher, G., & Kumar, G. (2021). Machine learning and deep learning methods for intrusion detection systems: Recent developments and challenges. *Soft Computing*, 25(15), 9731–9763. <https://doi.org/10.1007/s00500-021-05893-0>
- Kovačević, A. (2023). Mašinsko Učenje i Sajber Bezbednost. *Zbornik Radova Sa Konferencije Strateški i Normativni Okvir Republike Srbije Za Reagovanje Na Savremene Bezbednosne Rizike*. <https://scholar.google.com/scholar?cluster=5529511828921685811&hl=en&inst=10367705725260204636&oi=scholar>
- Li, Y., Yang, X., Wu, B., & Lyu, S. (2019). Hiding faces in plain sight: Disrupting ai face synthesis with adversarial perturbations. *arXiv Preprint arXiv:1906.09288*.
- Nguyen, T. T., & Reddi, V. J. (2023). Deep Reinforcement Learning for Cyber Security. *IEEE Transactions on Neural Networks and Learning Systems*, 34(8), 3779–3795. <https://doi.org/10.1109/TNNLS.2021.3121870>
- Oracle & KPMG. (2019). *Defining Edge Intelligence: Closing Visibility Gaps with a Layered Defense Strategy ORACLE AND KPMG CLOUD THREAT REPORT 2019 Oracle and KPMG Cloud Threat Report 2019 2*.
- Pinto, A., Herrera, L.-C., Donoso, Y., & Gutierrez, J. A. (2023). Survey on Intrusion Detection Systems Based on Machine Learning Techniques for the Protection of Critical Infrastructure. *Sensors*, 23(5), Article 5. <https://doi.org/10.3390/s23052415>
- Radenković, S. D., Hanić, H., & Bugarčić, M. (2023). Applying Artificial Intelligence in the Digital Transformation of Banking Sector. *Proceedings*, 85(1), Article 1. <https://doi.org/10.3390/proceedings2023085019>
- Saavedra, G. J., Rodhouse, K. N., Dunlavy, D. M., & Kegelmeyer, P. W. (2019). *A Review of Machine Learning Applications in Fuzzing*. <http://arxiv.org/abs/1906.11133>
- Sau, M., Cribbs, J., & Hoeppe, A. (2024, November 8). *How industries are implementing AI use cases*. <https://webinar.gartner.com/652327/home>
- Shaukat, K., Luo, S., Varadharajan, V., Hameed, I. A., & Xu, M. (2020). A Survey on Machine Learning Techniques for Cyber Security in the Last Decade. *IEEE Access*, 8, 222310–222354. <https://doi.org/10.1109/ACCESS.2020.3041951>
- Sobers, R. (2022). *Data Breach Response Times: Trends and Tips*. <https://www.varonis.com/blog/data-breach-response-times>

ACKNOWLEDGEMENT

This work was supported by the Science Fund of the Republic of Serbia under Grant 7749151 within the Framework of the IDEAS Program—Management of New Security Risks Research and Simulation Development, NEWSiMR&D.

APPLICATION OF BUSINESS INTELLIGENCE METHODS AND TECHNIQUES IN THE ANALYSIS OF TREATMENT OF PATIENTS WITH DIABETES

Vukašin Vasiljević

University of Kragujevac, vukasin.vasiljevic@gmail.com

Nenad Stefanović*

Faculty of Economics, University of Kragujevac, nenad@ef.kg.ac.rs,
ORCID number 0000-0002-0339-3474

Abstract: *Diabetes is a well known medical condition characterized by elevated blood glucose levels that needs personalized treatment and continuous monitoring for patients. Recent advancements in artificial intelligence (AI) have significantly transformed how we treat diabetes. This paper examines the application of business intelligence (BI) methods and techniques in optimizing patient care for diabetes. We will begin by exploring the theoretical foundation of diabetes as a disease, its types, complications, and global statistics. The study highlights how BI in combination with AI can be used to process large datasets, forecast outcomes, and personalize treatments. With carefully analyzing patient data such as glucose levels, physical activity, and diet, BI methods can identify risk factors, early intervention strategies, and more accurate diagnoses. Moreover, the use of BI supports the development of dynamic, real-time dashboards that allow healthcare professionals to monitor patient progress and adherence to treatment plans efficiently. The integration of AI-driven algorithms within BI platforms enhances the predictive capability for detecting early signs of complications. This research also emphasizes the operational and cost advantages of BI in improving patient monitoring in clinical settings. The insights underline the importance of BI in healthcare systems, reducing costs, and ensuring better health outcomes for diabetes patients.*

Keywords: *Business Intelligence, Diabetes, Artificial Intelligence, Healthcare Optimization, Personalized Treatment*

JEL Classification: *I12, I19, C38*

* Corresponding author

1. INTRODUCTION

Diabetes is a major global health issue with millions of individuals affected, putting pressure on healthcare systems. This chronic disease can be divided into two different types: Type 1, which is associated with autoimmune destruction of pancreatic β -cells, and Type 2, which mainly features insulin resistance along with relative insufficiency in insulin production. Both types should be managed effectively, and poor management may lead to complications such as cardiovascular disease, kidney damage, and nerve damage which can considerably compromise well-being and raise medical cost.

The financial costs of diabetes treatment are highlighted in figure 1, showing the total spending on insulin between 2007 and 2017 for federal program in the United States of America (Medicare Part D) which provides prescription drug coverage. The spending saw an astonishing 840% increase during the analyzed period and by this, insulin has become a substantial contributor to healthcare spending over the years.

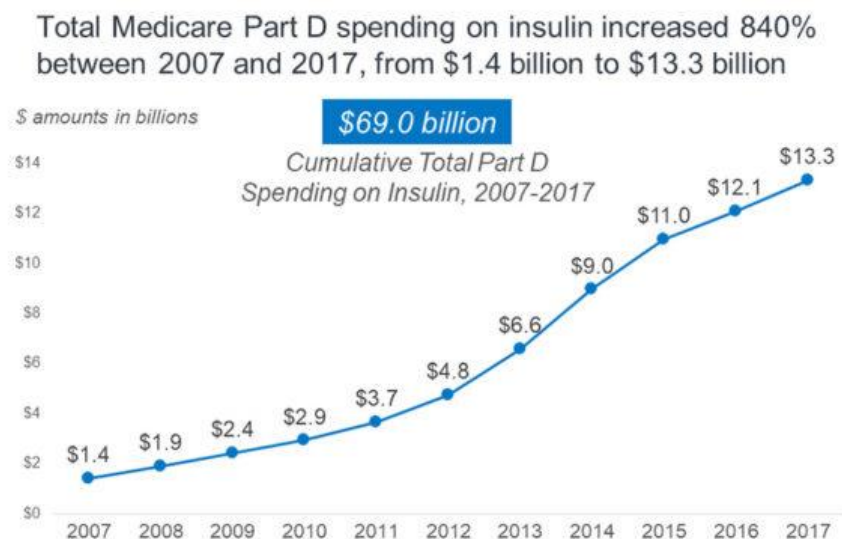


Figure 1. Total spending on insulin by Medicare Part D

Source: Databyte via Juliette Cubanski et al., *How Much Does Medicare Spend on Insulin?* Kaiser Family Foundation, 2 Apr. 2019.

With diabetes being on the rise, technology — especially AI (artificial intelligence) — is inevitable in healthcare. In early diagnosis, risk prediction and personalized care are crucial to diabetes treatment, and because of advancements in AI we are now able to detect diabetes much earlier than by utilizing only traditional methods. AI methodologies and processes can find patterns and trends by analyzing large amount of patient history data, alongside patient's glucose levels, diet and activity, and thus improve treatment overall. AI tools such as wearables, IoT and continuous glucose monitors give real time data and insights, and encourage patients to take control of their health. Business intelligence (BI) has shown great promise in diabetes care. BI allows healthcare providers to aggregate and analyze large amounts of data, make better decisions, optimize resources, and monitor patient outcomes. By using these BI systems, healthcare professionals can faster identify risk factors, measure treatment effectiveness, and customize unique treatment for individual patients, resulting in better clinical outcomes and lower costs. This paper investigates the application of BI

techniques in diabetes treatment, focusing on their role in improving care quality, optimizing healthcare efficiency, and supporting personalized medicine.

The purpose of this paper is to:

- Explore the implementation and adaptation of business intelligence in healthcare.
- Assess the application of specific BI methods and techniques in diabetes care.
- Demonstrate application that leverages AI methods that can improve treatment of diabetes.

The study highlights how data-driven methodologies can help the global diabetes epidemic by improving patient care and advancing business intelligence use in healthcare systems.

2. LITERATURE REVIEW

Business Intelligence refers to the technologies, strategies and processes that organizations, companies or individuals can use to analyze and interpret data in order to better understand its underlying patterns, which can lead to better decision-making. Using BI methods, companies can create reports, monitor performance, forecast trends, and analyze markets. Utilizing BI into our business, we can improve efficiency, improve decision-making, and adapt to changes by better understanding customer needs, reducing risks, costs, and optimizing business operations.

Information and Communication Technology (ICT) refers to the tools and systems used to handle digital information such as computers, but software and networks as well. Nowadays, businesses are generating large amounts of data, making it difficult to process and analyze this data using traditional tools such as Excel. This problem can be addressed by BigData, a concept that can help companies effectively process and optimize supply chains, predict customer behavior, detect early potential risks, and address them accordingly.

2.1 Application of Big Data and Business Intelligence in Healthcare

The integration of BigData and BI within healthcare systems has improved the ability to interpret complex patient data. These technologies have been applied across various domains, including research, diagnostics, treatment, and health system management. Key applications of big data and BI in healthcare include:

- **Personalized Treatment:** By analyzing patient history data—such as genetic information, medical history, and laboratory results.
- **Epidemic Tracking:** Real-time data analysis allows health authorities to monitor disease spread and take prompt action to control outbreaks.
- **Predictive Analytics:** Machine learning algorithms can predict disease risks and complications, enabling early diagnosis.
- **Healthcare System Optimization:** BI identifies inefficiencies in hospitals, clinics, and pharmacies, leading to cost reduction and process improvements.
- **Drug and Therapy Research:** Big data analytics accelerates pharmaceutical discoveries by identifying effective treatment targets through patient and drug reaction data.

- **Electronic Health Records:** Centralized databases improve information sharing between facilities, minimize errors, and enhance patient care.
- **Wearable Devices:** Data from health-monitoring sensors and wearables supports chronic disease management and early detection of health anomalies.

These innovations significantly enhance the prevention, diagnosis, and treatment of diseases. For example, BI plays a crucial role in diabetes management by supporting real-time patient monitoring, ensuring better personalized therapies. Figure 3 illustrates a BI framework for healthcare applications, showcasing its components and processes.



Figure 2. Example of the modern healthcare data pipeline

Source: <https://www.cloudgeometry.com/blog/beyond-big-data-for-health-care-with-data-science-pipelines>

2.2 Business Intelligence in Diabetes Care

BI methods enhance the management of diabetes by enabling healthcare providers to to:

1. **Monitor Treatment Effectiveness:** Regular analysis of glycemic control and therapy outcomes supports adjustments for personalized care.
2. **Predict Complications:** Predictive models identify patients at high risk for complications, facilitating timely interventions.
3. **Optimize Healthcare Resources:** By focusing on high-risk individuals, resources can be allocated more efficiently, reducing costs while improving patient outcomes.

For example, real-time patient monitoring through BI allows for immediate adjustments in therapy, reducing the risk of complications and improving long-term disease management.

2.3 Artificial Intelligence in Diabetes Readmission Prediction

Artificial Intelligence can be viewed as a significant contributor to readmission prediction in hospitals, which is considered an important issue, especially for diabetes management. It consists of the AI-supported tools which use patient history, lab results, and treatment records from large datasets to predict the likelihood of readmissions. Techniques such as machine learning (ML) and deep learning are particularly effective in identifying patterns and predicting risks:

- **Machine Learning:** Analyzes past data to predict patient outcomes, enabling targeted preventive strategies.
- **Deep Learning:** Processes complex datasets, including medical images, to provide more nuanced insights.

2.3 Challenges and Future Directions

While the benefits of big data and BI in healthcare are immense, challenges remain:

- **Data Privacy:** Protecting patient information while enabling its widespread use for analysis.
- **Interoperability:** Standardizing data formats across systems to facilitate integration.
- **Ethical Concerns:** Balancing AI-driven decision-making with patient autonomy and clinician oversight.

Addressing these challenges is critical to realizing the full potential of BI in healthcare, particularly for chronic diseases, where its application can significantly reduce the global burden.

3. METHODOLOGY

This study applies machine learning techniques to analyze diabetes patient data and predict hospital readmission probabilities. The methodology focuses on data preparation, feature engineering, and implementing machine learning models for effective prediction and decision-making.

3.1 Data Preparation and Analysis

The dataset has 101,766 records with 50 variables, showing different patient demographics, medical histories, and treatment details. Preprocessing the data was a crucial step in preparing the data for the model, which consists of:

1. **Handling Missing Data:** Columns with high percentages of missing values (e.g., weight, payer_code, medical_specialty) were excluded. Remaining missing values were imputed using the most frequent value or set to zero.
2. **Feature Engineering:** Relevant features were created to enhance predictive power, such as:
 - service_utilization: Summarizing inpatient, outpatient, and emergency visits.
 - num_med_changes: Total medication changes per patient.

3. **Categorical Encoding:** Binary encoding and categorization of variables such as change (medication adjustment) and ICD diagnoses were applied for better model compatibility.

3.2 Machine Learning Models

In order to predict 30-day hospital readmission probabilities, the following models were developed and evaluated:

1. **Logistic Regression:**

- Used for its simplicity and interpretability in binary classification tasks.
- The model predicts the probability of readmission based on a logistic function.

2. **Random Forest:**

- An ensemble method combining multiple decision trees.
- Suitable for handling nonlinear relationships and capturing complex interactions among features.

3. **XGBoost (Extreme Gradient Boosting):**

- Optimized for speed and accuracy.
- Utilizes gradient boosting to refine predictions iteratively.

2. **CatBoost:**

- Designed for datasets with categorical features.
- Reduces overfitting and improves predictive accuracy, especially for imbalanced datasets.

4. RESULTS AND DISCUSSION

The performance of four machine learning models used in training: Logistic Regression, Random Forest, XGBoost, and CatBoost—has been evaluated using four key metrics: Accuracy, Precision, Recall, and F1 Score. These metrics provide insights into the models' effectiveness in predicting the target variable, which in this case is the likelihood of patient readmission within 30 days.

- **Accuracy** measures the proportion of correctly predicted cases over the total number of cases.
- **Precision** measures how many of the positive predictions made by the model are correct.
- **Recall** indicates how well the model identifies actual positive cases.
- **F1 Score** is the harmonic mean of Precision and Recall, offering a balance between the two metrics.

As shown in Figure 3, accuracy is significantly higher for all models compared to the other metrics. This discrepancy likely stems from an imbalance in class distribution within the dataset. The "No Readmission" class constitutes over 60% of the data, while the "Readmission within 30 days" class accounts for only about 8%. This class imbalance leads to high accuracy as most predictions focus on the dominant class, skewing overall performance.

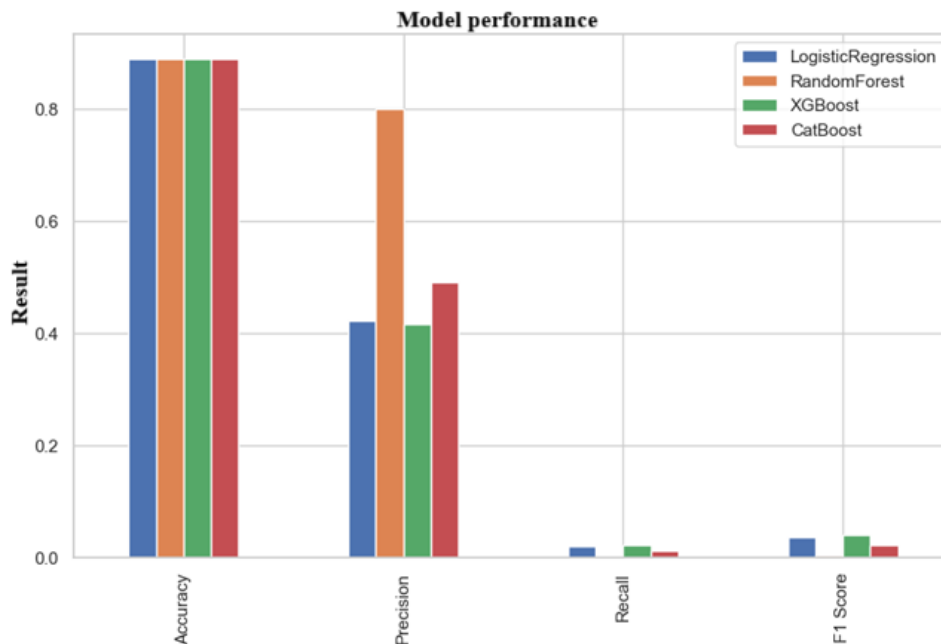


Figure 3. Model performance

Despite the higher precision of the Random Forest model, it exhibits a considerably lower Recall and F1 Score compared to the other models. This suggests that the Random Forest model may be overfitting, particularly by focusing on the dominant class and failing to generalize well to the minority class.

Additionally, low correlation between the target variable and predictors contributes to lower Precision and F1 Scores. Weak correlations hinder the model's ability to predict positive cases accurately, leading to higher rates of false positives and false negatives.

In Figure 4, the feature importance chart for the Random Forest model reveals the most influential variables in making predictions. The top three features that contribute most to the model's decision-making are:

1. **service_utilization**: This feature reflects the total number of services utilized by a patient and is the most significant predictor. It suggests the complexity of the patient's health status, where frequent medical service usage may indicate a higher risk of readmission.
2. **num_lab_procedures**: The number of laboratory procedures is another important feature, indicating the patient's level of engagement in their treatment process. A higher count of lab tests may suggest more severe health conditions requiring frequent medical assessments.

- num_medications:** The number of medications a patient is prescribed is a crucial indicator, with a higher count often signifying a more complex medical history and an increased risk of readmission.

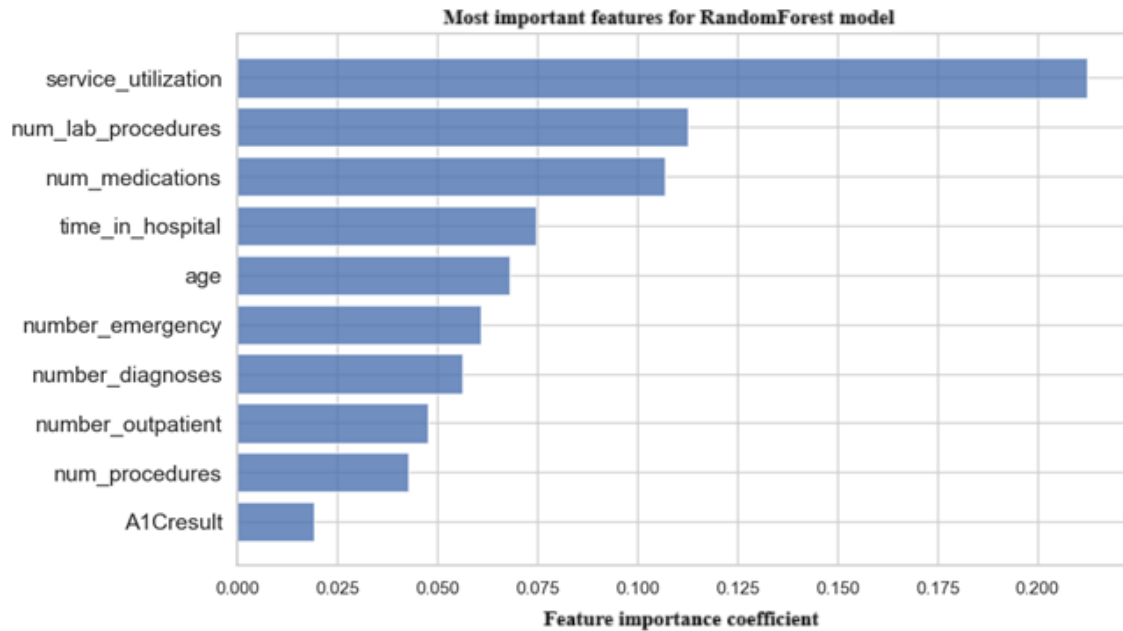


Figure 4. *Feature importance for RandomForest model*

These features provide valuable insights into patient care. Service utilization, lab procedures, and medications reflect the intensity of medical interventions a patient is receiving, which can directly impact their likelihood of readmission. Understanding these factors can help healthcare providers allocate resources and plan interventions to reduce readmissions.

4.1 Recommendations for Model Improvement

To enhance model performance, one should focus on techniques such as class balancing to address the class distribution imbalance and improve Recall and F1 Scores. Additionally, further exploration and engineering of features that strengthen the relationship between predictors and the target variable will help improve predictive accuracy.

In summary, while the Random Forest model provides useful feature importance insights, model performance can be significantly improved by addressing class imbalance.

4.2 Deployment

The final model, selected based on comprehensive evaluation, was integrated into a Streamlit application, enabling user-friendly interaction and practical application for healthcare providers. This integration supports real-time predictions and aids in resource allocation and intervention planning.

5. CONCLUSIONS AND RECOMMENDATIONS

This study demonstrates the potential of integrating Business Intelligence and Artificial Intelligence techniques to enhance diabetes care. By leveraging large datasets and predictive models, healthcare professionals can gain valuable insights into patient behavior, optimize treatment regimens, and reduce the burden of diabetes-related complications. The application of BI methods in diabetes care, such as personalized treatment plans, risk prediction, and resource optimization, presents a significant improvement over traditional approach.

The research also highlights the effectiveness of machine learning models in predicting diabetes-related hospital readmissions, a use case for diabetic treatment prevention, with Random Forest, XGBoost, and CatBoost outperforming traditional methods. These models have shown that predicting readmission risks can help healthcare providers identify high-risk patients early. However, challenges related to data privacy, interoperability, and ethical considerations must be addressed to fully realize the potential of BI and AI in diabetes care.

REFERENCES

- Galunić, A. (2023). *Dijabetes i prehrana – Završni rad*. Bjelovar: Veleučilište u Bjelovaru.
- Ivanović, D. (2018). *Inteligentni softverski sistemi za dijagnostiku metaboličkog sindroma*, (Doktorska disertacija). Novi Sad: Faculty of Technical Sciences.
- Majanović, K., & Kloć, S. (2018). Diabetes and obesity – a vicious circle. *Medicus*, 27(1), 33–38.
- Machine learning for managing diabetes: 5 current use cases. Available at: <https://emerj.com/ai-sector-overviews/machine-learning-managing-diabetes-5-current-use-cases/>. Accessed on August 3, 2023.
- Račić, Ž. (2009). Poslovna inteligencija. *Zbornik radova Ekonomskog fakulteta u Istočnom Sarajevu*, 3, 95–113.
- Rihai, Y. (2018). Big data and big data analytics: Concepts, types, and technologies. In J. Doe (Ed.), *Innovations in computing technologies*. Academic Press.
- Shang, Y., Jiang, K., Wang, L., Zhang, Z., Liu, Y., Dong, J., & Wu, H. (2020). The 30-days hospital readmission risk in diabetic patients: Predictive modeling with machine learning classifiers. *BMC Medical Informatics and Decision Making*. <https://doi.org/10.1186/s12911-020-01245-4>
- Taylor-Sakylis, K. (2016). Big data: Understanding Big Data. *Journal of Data Science*, 5(2), 112–119.
- Zekavica, A. (2018). *Uloga i značaj fenomena Big Data sa aspekta marketinških istraživanja*, (Doktorska Disertacija). Novi Sad: Faculty of Economics and Engineering Management.
- Živolić, S. (2021). Rudarenje podataka i napredne analitičke teorije i metode. *Zbornik radova Fakulteta tehničkih nauka*, 36(3), 1–10. Information on diabetes pandemic, available at: <https://www.hzjz.hr/wp-content/uploads/2022/05/Dijabetes-u-Hrvatskoj-i-svijetu-2021.pdf>. Accessed on July 30, 2023.

CIP - Каталогизација у публикацији
Народна библиотека Србије, Београд

005(082)
339.9(082)
336(082)
330(082)
658.8(082)
004(082)

**INTERNATIONAL Scientific Conference EBM - Contemporary Issues in
Economics, Business and Management (8 ; Kragujevac ; 2024)**

[Eighth International Scientific Conference] Contemporary Issues in
Economics, Business and Management [EBM 2024], [December 16th-17th,
2024] / [organizer] Faculty of Economics, Kragujevac ; editors Dejana
Zlatanović, Aleksandra Stevanović. - Kragujevac : Faculty of Economics,
2025 (Kragujevac : InterPrint). - [12], 443 str. : graf. prikazi, tabele ; 30 cm

Tiraž 100. - Str. [5-6]: Preface / editors. - Bibliografija uz svaki rad.

ISBN 978-86-6091-165-2

1. Zlatanović, Dejana, 1977- [уредник] [аутор додатног текста]
а) Менаџмент -- Зборници б) Глобализација -- Зборници в) Економија --
Зборници г) Финансије -- Зборници д) Маркетинг -- Зборници њ)
Информациона технологија -- Зборници

COBISS.SR-ID 163321353



ebm 2024

**CONTEMPORARY ISSUES IN
ECONOMICS, BUSINESS
AND MANAGEMENT**

ISBN: 978-86-6091-165-2



**FACULTY OF ECONOMICS
UNIVERSITY OF KRAGUJEVAC**

www.ekfak.kg.ac.rs
ebm@kg.ac.rs