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Content

EXPLORING DIVERSE FRONTIERS IN ECONOMICS AND BUSINESS – EDITORIAL SEEJ 19 (2)

Adnan Efendic, Ljiljan Veselinovic

The second 2024 issue of the *South East European Journal of Economics and Business* features nine articles, offering diverse empirical insights into various topics within economics and business. While the studies predominantly focus on Southeastern Europe and its neighboring regions, they also provide globally relevant implications. To assist readers in navigating this rich collection, we have grouped the contributions into six thematic categories: Financial Dynamics and Governance in Central and Eastern Europe, Labor Market Policies and Workplace Innovations, Regional Economic Dynamics and Business Performance, Sustainability, and Consumer Behavior. Each theme brings together related studies that explore different aspects of economics, finance, and business performance in the context of Central and Eastern Europe and the Western Balkans.

We provide a summary table with basic information on the papers published in this issue, while a more detailed overview of each manuscript is below. Each of these contributions adds depth to the discourse on contemporary economic and business challenges. The studies enhance our theoretical understanding but also offer practical recommendations for policymakers, business leaders, and researchers.

Authors	Title	Data Period	Methodology	Sample/Context
Jusufi and Skenderi (2024)	Beyond linear models: factors driving environmental action and circular economy transition in Western Balkan businesses	2022	Probability modell	Approximately 200 businesses per Western Balkan country
Bethlendi, Mérő and Orlovits (2024)	Shadow banking in Central and Eastern Europe: Specificities and drivers	2004-2019	Panel model	Central and Eastern European, EU member states
Bezeredi (2024)	Impact of in-work benefits on work incentives in Croatia: A microsimulation analysis	2019	EUROMOD, a microsimulation model of taxes and social benefits	Croatian non-employed persons
Zahirović, Marić and Husić-Mehmedović (2024)	The role of consumer knowledge in the privacy paradox of personalized advertising	2022	A quasi-experimental research, structural equation modelling	300 Millennials
Güngör and Güngör (2024)	The nexus between economic policy uncertainty and stock market volatility in the CEE-3 countries.	2006-2020	Dynamic regression	CEE-3 countries
Qerimi, Balaj and Krasniqi 2024.	The capital structure dynamics of SMEs in Kosovo: evidence using panel data.	2013-2018	A panel data methodology	90 SMEs
Lukić Nikolić and Labus (2024)	The relationship between workplace robots, employee exhaustion, and turnover intentions in the age of industry 5.0: research from four Southeastern European countries	2024	Structural equation modeling	582 respondents from four Southeastern European countries
Guillamón, Ríos and Prijaković (2024)	The impact of budget transparency on budget credibility: evidence from Croatian cities	2016-2021	System GMM	Croatian local governments
Erkul and Kırankabeş (2024)	Porter-type regional agglomerations, export performance, and inclusive regional policy: an empirical assessment of Turkish manufacturing sector	2008-2019	Fixed effects panel model	Turkish manufacturing sectors

Financial dynamics and governance in Central and Eastern Europe

Three papers explore the financial dynamics and governance in Central and Eastern Europe. *Bethlendi, Mérő, and Orlovits (2024)* investigate the structural drivers of shadow banking in Central and Eastern European (CEE) EU member states for the period 2004-2019, shedding light on the sector's unique characteristics and vulnerabilities. Unique characteristics of the CEE financial system include bank dominance, underdeveloped capital markets, foreign ownership, and earlier reliance on foreign interbank funding. Panel regression results highlight these regional traits as relevant for understanding shadow banking development. Meanwhile, *Güngör and Güngör (2024)* examine the relationship between economic policy uncertainty in Germany and the US and stock market volatility in the CEE-3 countries, emphasizing the implications of uncertainty on financial stability and investment decisions. In terms of economic stability, the study results show a one-period lagged impact of economic policy uncertainty on long-run stock market volatility. Finally, *Guillamón, Ríos, and Prijaković (2024)* investigate the link between budget transparency and budget credibility in Croatian cities, revealing systematic biases in revenue and expenditure estimations. Their study provides valuable lessons for improving public financial management systems and enhancing accountability at the local government level. The results show that cities with higher budget transparency tend to underestimate revenues and overestimate expenses, while less transparent cities overestimate revenues, underestimate expenses, and overspend.

Labor market policies and workplace innovations

By employing tax-benefit microsimulation model EUROMOD, *Bezeredi (2024)* evaluates the impact of in-work benefits on work incentives of non-employed persons and the poverty rate in Croatia. The findings indicate that the features and structure of in-work benefits play an important role, with the selection of the suitable type of benefit being determined by the specific policy goals. On the other hand, *Lukić Nikolić and Labus (2024)* provide insights into the interplay between workplace robots, employee emotional exhaustion, and turnover intentions, underscoring the potential of Industry 5.0 technologies to enhance employee retention. The study shows workplace robots reduce emotional exhaustion and turnover intentions, offering leaders and HR tools to improve employee retention.

Regional economic dynamics and business performance

Erkul and Kırankabeş (2024) analyze regional agglomerations in Turkey's manufacturing sector, uncovering the limited advantages of Porter-type agglomerations in export performance and stressing the need for inclusive technology policies. Furthermore, labor-intensive low-tech manufacturing sectors does not have agglomeration advantages in export performance compared to mid-tech sectors. *Qerimi, Balaj, and Krasniqi (2024)* explores the applicability of capital structure theories in the unique context of SMEs in Kosovo. Using dynamic panel data analysis, it examines how factors such as profitability, liquidity, size, and asset structure influence financial decisions. The findings align with the pecking order theory, showing that profitable SMEs rely more on internal funds than on debt financing.

Sustainability

Jusufi and Skenderi (2024) examine environmental sustainability and circular economy, they focus on the factors influencing businesses in the Western Balkans to adopt sustainable practices and transition to circular business models. Their findings emphasize the role of exporting, foreign ownership, innovation, and access to financing in driving environmental actions. The study highlights that being an exporting and loan-receiving company influence the belief that a shift to a circular business model is attainable.

Consumer behavior

Zahirović, Marić, and Husić-Mehmedović (2024) focus on personalized advertising, exploring how consumer knowledge of data types moderates the relationship between perceived invasiveness and purchase intentions. The study findings on the sample from millennials show that privacy concerns increase perceived invasiveness, but its effect on purchase intentions depends on consumers' data knowledge. For those aware of search history use, intrusiveness reduces purchase intentions, highlighting the context-specific nature of privacy calculus and offering insights for advertisers.

On behalf of Editorial Board

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BEYOND LINEAR MODELS: FACTORS DRIVING ENVIRONMENTAL ACTION AND CIRCULAR ECONOMY TRANSITION IN WESTERN BALKAN BUSINESSES

Nora Jusufi, Nagip Skenderi

Abstract

This article employs a probit model to analyze the determinants influencing businesses in the Western Balkans to mitigate their environmental impact and assess the feasibility of transitioning to a circular business model. It relies on primary survey data gathered in all Western Balkan countries by professional research agencies in 2022, with a representative sample of approximately 200 businesses per country. The findings reveal that factors such as being an exporting, foreign, innovative, and loan-receiving company increase the likelihood of businesses in the Western Balkans taking measures to reduce their environmental impact. Moreover, being an exporting and loan-receiving company emerges as influential in fostering the belief that a shift to a circular business model is attainable. These insights have profound implications for policymakers and businesses aiming to promote sustainable practices and circular economy initiatives within the Western Balkans. Additionally, this article contributes to policy development and knowledge on environmental and circular practices in developing economies.

Key words: *environmental economics, circular economy, business model, sustainability*

JEL Classification: *F18, F64, O13, P18*

1. Introduction

Circular economy has been gaining traction as a transformative approach to resource utilization, challenging conventional practices marked by excessive resource consumption (Murray, Skene, and Haynes 2017). Recognizing the critical role of resource efficiency in fostering economic growth has propelled a heightened focus on the circular economy concept (Lieder and Rashid 2016). Circular Economy (CE), as reviewed by Julianelli et al. (2020), signifies a substantial departure from traditional linear models of production and consumption. This departure underscores a profound shift towards circular systems, advocating for the elimination of waste and a reduction in material and energy wastage.

The European Green Deal stands as a landmark initiative, setting forth ambitious environmental

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goals and positioning the circular economy as a central tenet of EU environmental policies (European Commission 2023). This strategic emphasis underscores the imperative of integrating circular economy principles into the broader framework of environmental policymaking. Against this backdrop, the Western Balkans countries, each charting diverse trajectories on their journey toward EU membership, face the challenge of aligning their strategies with those outlined in the EU Green Deal.

A report by the Balkan Forum (2021) illuminates critical challenges impeding the Western Balkans' progression towards a circular economy. Despite its potential, the journey faces substantial hurdles, including infrastructure limitations, investment challenges, and outdated production processes. Securing financing for circular business models proves daunting due to a lack of green investment funds and minimal government support. Knowledge gaps hinder shift, with limited understanding across businesses, policymakers, and the public, exacerbated by a scarcity of skilled professionals in eco-design and circular business models. Policy hurdles add complexity, marked by inconsistent national strategies and fragmented waste management regulations causing uncertainty. Inadequate financial incentives and weak tax breaks fail to drive the shift from linear models, while limited collaboration hampers knowledge sharing and coordinated efforts. Cultural resistance to changing consumption habits and potential technological limitations in accessing advanced resource recovery technologies further complicate the transition.

While the Balkan Forum's report illuminates critical challenges impeding the Western Balkans' progression towards a circular economy, it is essential to note that existing research addressing these challenges is noticeably limited. Despite the evident barriers, the scarcity of research examining environmental impact reduction and the shift of circular business models in the Western Balkans is apparent. This research gap emphasizes the necessity for a substantive article to address the existing limitations in our understanding of how businesses in the region navigate the terrain of environmental sustainability and circular economy practices.

In response to this imperative, this article attempts to lay the groundwork for substantive research in the Western Balkans. The core aim is to investigate the complex factors shaping the decisions of businesses in the region concerning the reduction of their environmental impact. Furthermore, the article seeks to unravel the prevailing beliefs among these businesses regarding the feasibility of transitioning to circular business models. Thus, this paper aims to bridge existing gaps in knowledge but also to provide valuable insights that can inform policy decisions, strategic business practices, and contribute to the overarching goal of sustainable development within the Western Balkans.

The subsequent sections of the paper cover a thorough literature review, covering key concepts related to the circular economy and existing research. The core section covers a detailed research methodology, including the definition of hypotheses, sample distribution, as well as model and variable selection. The final section covers discussion of the results and conclusions of the findings, limitations, and implications.

2. Literature Review

This section comprehensively explores the concept of the circular economy (CE) and its profound implications for environmental sustainability and industrial economics. Businesses, as primary drivers of contemporary production across diverse sectors, face a critical responsibility to enhance sustainability. The circular economy emerges within this global context as a pivotal paradigm, offering a pathway to long-term economic growth while addressing the limitations of the linear "take-make-use-dispose" model with its regenerative "take-make-use-reuse" approach (Lieder and Rashid 2016).

While the historical roots of the circular economy lack a clear starting point, its prominence gained momentum in the 1990s, drawing inspiration from seminal works such as Boulding's "The Economics of the Coming Spaceship Earth" (1966) and Stahel and Reday-Mulvey's (1976) reference to a "closed-loop economy". Boulding's conceptualization of "spaceship earth" envisioned a cyclical ecological system, challenging the prevailing "cowboy economy" mindset that prioritizes throughput at the expense of resource depletion and pollution (Murray, Skene, and Haynes 2017). Boulding's. Pearce and Turner (1990) played a pivotal role in shaping the definition of the circular economic model, underscoring the intricate interconnection between the economy and the environment. According to their seminal work, the environment serves three distinct economic functions: providing resources, acting as a disposal location for waste and pollutants, and serving as a system to sustain life. This underscores the growing importance of transitioning to renewable energy sources and enhancing energy efficiency as integral components of the circular economy.

Conceptual discussions on the circular economy trace back to 1966, but a substantial surge in academic interest began post-2003 (Prieto-Sandoval, Jaca, and Ormazabal 2018), highlighting its increasing significance. China's active involvement in circular economy research and the EU's integration of circular economy principles in 2014 further bolstered research efforts. Leading journals focused on prevention, cleaner production, and environmental engineering have spearheaded discussions, emphasizing the global relevance and imperative of advocating sustainable practices (Prieto-Sandoval, Jaca, and Ormazabal 2018).

Ahmad et al. (2023) provide valuable insights by identifying three key streams within the landscape of business management research on the circular economy. These streams encompass organizational and strategic perspectives, business model innovation and value creation, and implementation and shift challenges. While these streams contribute significantly to our understanding, critical knowledge gaps persist, particularly in grasping the nuanced role of leadership, governance, and organizational culture in fostering circular economy shift.

In a comprehensive review of 221 articles, Kirchherr et al. (2023) identify core principles on circular economy. These principles advocate reducing resource consumption, maximizing material reuse, recycling materials for new products, and recovering energy from non-recyclable sources. Crucial for sustainable development, the circular economy offers solutions to mitigate pollution, conserve resources, foster employment, and enhance economic resilience against challenges such as resource scarcity and climate change.

Several studies contribute uniquely to the circular economy discourse from various perspectives. Julianelli et al. (2020) focus on the adverse environmental impacts of traditional production and consumption practices, providing a nuanced taxonomy for critical success factors in reverse logistics. Arruda et al. (2021) complement these insights by exploring the broader environmental challenges emphasizing the pivotal role of private companies and legislative strategies in advancing aspects of the circular economy. Ghisellini, Cialani, and Ulgiati (2016) offer a comprehensive review of circular economy literature, emphasizing its global origins and varied implementation strategies. Pieroni et al. (2019) shift the focus to business models, identifying approaches for circular economy-oriented business model innovation. Murray, Skene, and Haynes (2017) contribute a historical dimension to the literature, addressing tensions and proposing a refined definition aligning with sustainable development goals. Galvao et al. (2018)

find that the main barriers to the implementation of the circular economy include technological, policy and regulatory, financial and economic, managerial, performance indicators, customer, and social barriers, based on their review of 195 articles.

Building on these theoretical foundations, empirical studies provide valuable insights into the practical implications of circular economy principles.

2.1. Foreign Company Influence

Dornean, Chiriac, and Rusu (2021) and Marco-Lajara et al. (2023) explore the influence of international activities on environmental practices within firms. They propose that foreign direct investment (FDI) can lead to higher environmental standards. Their reasoning is that companies operating abroad may implement sustainable practices already established in their home countries, or in response to stricter environmental regulations in the host country. Marco-Lajara et al. (2023) further emphasize the connection between international engagement and environmental innovation. They argue that internationalized firms benefit from exposure to stringent environmental regulations and robust financial resources, fostering innovation in environmentally sustainable practices. This suggests that international activities can create a compelling environment for businesses to develop and adopt eco-friendly practices.

2.2. Financial Challenges and SMEs

Kuo and Chang (2021) find that larger firms tend to disclose significantly more circular economy information compared to smaller firms, particularly in environmentally-sensitive industries. Several studies (Demirel and Danisman 2019; de la Cuesta-González and Morales-García 2022; Takacs, Brunner, and Frankenberger 2022) highlight the unique financial challenges faced by SMEs in transitioning to a CE model, including substantial initial investments (Demirel and Danisman, 2019), regulatory risks, and market uncertainties (de la Cuesta-González and Morales-García 2022). These challenges can hinder their ability to secure external funding (Demirel and Danisman, 2019) and necessitate overcoming internal hurdles (Takacs, Brunner, and Frankenberger 2022). Regulatory risks and market uncertainties arise due to the evolving and often ambiguous regulatory landscape surrounding CE models, creating uncertainty for businesses planning long-term investments. Financial institutions may perceive higher risks during this transition due

to the lack of standardized frameworks and proven business models within the circular economy, leading to cautious lending and investment practices. While Aranda-Usón (2019) emphasizes the positive influence of financial resources in CE implementation, Gonçalves, de Carvalho, and Fiorini (2022) acknowledge that financial barriers affect smaller enterprises more significantly.

2.3. Technological Capabilities and Innovation

Internal resources and firm strategies play a crucial role in driving technological progress. Barney (1991) argues that a firm's capability to stand out competitively depends significantly on its efficient utilization of internal resources, including technological capabilities. Triguero, Moreno-Mondéjar, Davia (2013) underscore that financial and technological capabilities are crucial determinants influencing the adoption of environmental innovations across European firms as well as external knowledge networks in driving CE initiatives. The importance of technological capabilities in promoting the adoption of environmental technology-oriented practices is well-documented (Horbach 2008; Rehfeld, Rennings, and Ziegler al. 2007). Research and development activities and the knowledge they generate are crucial for facilitating the adoption of circular economy (CE) initiatives (Triguero, Moreno-Mondéjar, Davia 2013). While incremental technologies dominate environmental innovations, technological limitations have been identified as barriers hindering progress towards circular economy innovations (de Jesus and Mendonça 2018).

2.4. The Role of Industry and Trade Associations

Information and knowledge from industry and trade associations also play essential roles in facilitating CE implementation. These intermediaries contribute to open innovation schemes by fostering connections between producers and users through industrial and trade associations, enabling collaborative schemes (Baldwin and Von Hippel 2011). Particularly beneficial for SMEs, industrial associations help build trust among network actors in the context of open innovation (Lee et al. 2010). Indeed, even though some SMEs primarily focus on basic environmental management practices due to cost-saving and regulatory compliance, effective resource sharing and support from industrial networks, such as industrial associations,

are crucial for promoting industrial symbiosis and facilitating closed-loop material cycles, thereby overcoming barriers to Circular Economy implementation (Ormazabal et al., 2018).

This review has comprehensively examined the circular economy and its implications for businesses. By exploring the core principles, global significance, and practical challenges, this review provides a foundation for developing our research hypotheses.

3. Methodology

Based on theoretical and empirical evidence presented above, the hypotheses below were devised. To test the hypotheses, the article employs a quantitative approach to investigate the factors influencing companies in the Western Balkans to reduce their environmental impact and potential of shifting to a circular business model. A probit regression model is used, a well-established methodology for analyzing the relationship between a binary dependent variable (e.g., indicating a perceived shift towards circularity or not, and having taking environmental impact reduction steps) and independent variables (company characteristics, size, innovation, and financial decisions).

3.1. Hypotheses

Company Size:

H1: Companies with more than 50 employees are more likely to take measures to reduce their negative environmental impacts compared to smaller companies.
H2: Companies with more than 50 employees are more likely to endorse a shift to a circular business model compared to smaller companies.

Company Characteristics:

H3: Exporting companies are more likely to take measures to reduce their negative environmental impacts compared to non-exporting companies.
H4: Exporting companies are more likely to endorse a shift to a circular business model compared to non-exporting companies.
H5: Foreign-owned companies are more likely to take measures to reduce their negative environmental impacts compared to domestically-owned companies.
H6: Foreign-owned companies are more likely to endorse a shift to a circular business model compared to domestically-owned companies.

Innovation:

H7: Companies that introduced new products or services in the past 12 months are more likely to take measures to reduce their negative environmental impacts compared to companies without recent innovation.

H8: Companies that introduced new products or services in the past 12 months are more likely to endorse a shift to a circular business model compared to companies without recent innovation.

Financial Decisions:

H9: Companies that took out a loan in the past 12 months are more likely to take measures to reduce their negative environmental impacts compared to companies without recent loans.

H10: Companies that took out a loan in the past 12 months are more likely to endorse a shift to a circular business model compared to companies without recent loans.

H11: Companies planning to invest in the coming year are more likely to take measures to reduce their negative environmental impacts compared to companies with no planned investments.

H12: Companies planning to invest in the coming year are more likely to endorse a shift to a circular business model compared to companies with no planned investments.

3.2. Sample Distribution

This article uses data from the Regional Cooperation Council's (RCC) Business Balkan Barometer 2022 database, which was created using the Business Opinion Survey questionnaire and included around 200 businesses from each of the Western Balkan economies.

The Balkan Business Opinion Survey 2022 relied on face-to-face interviews to gather data from over 1,203 business leaders across six Western Balkan economies. Trained interviewers utilized a standardized

Figure 1. Conceptual Framework
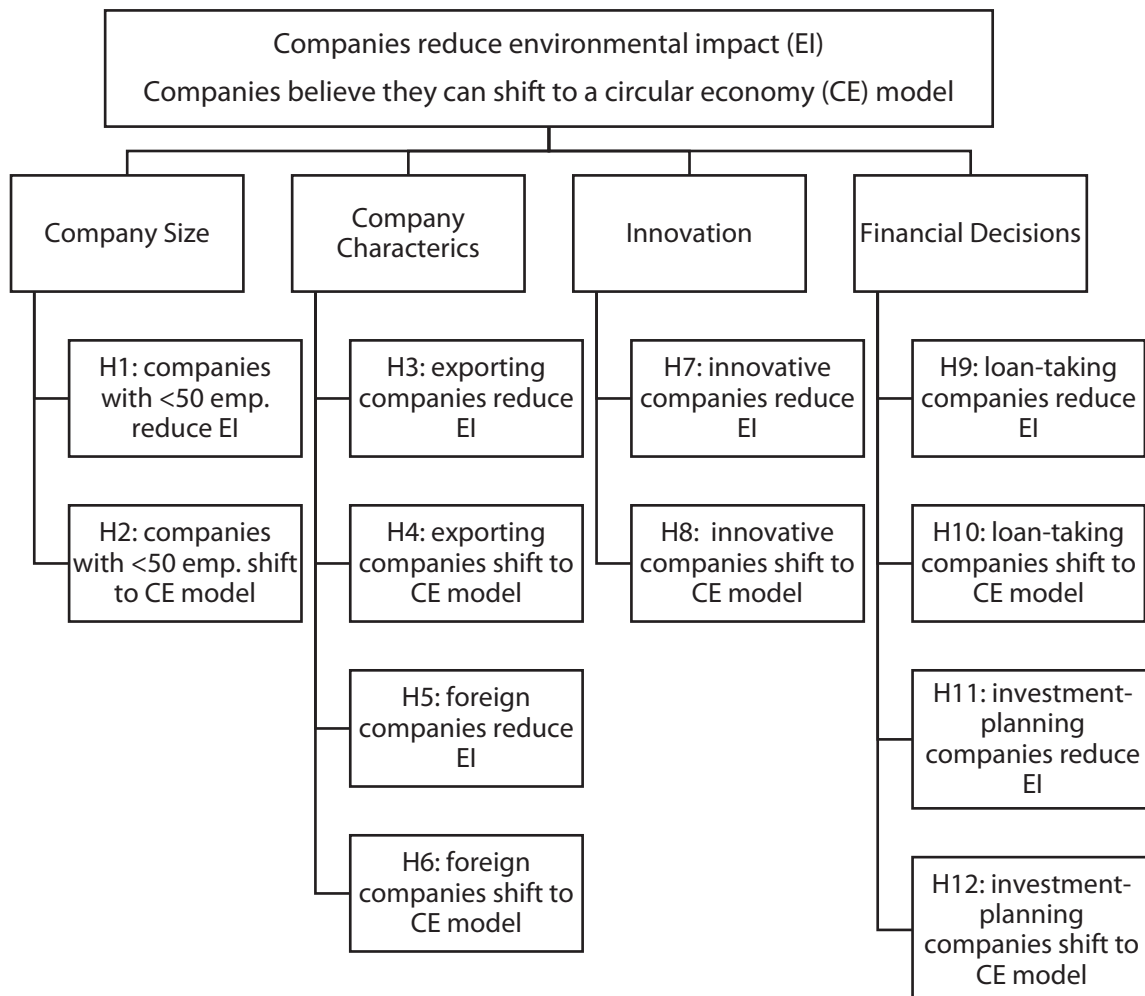
Source: Self-devised

approach, equipped with translated questionnaires and digital platforms for consistent data collection. To ensure a representative sample, rigorous selection methods drew upon official data, targeting companies across various sizes, sectors, regions, and ownerships. Additionally, telephone recruitment focused on reaching key decision-makers, ultimately leading to successful interview scheduling. This comprehensive approach, coupled with stringent quality control measures, generated reliable and accurate data, offering valuable insights into the perspectives and opinions of businesses across the Western Balkans (Zoric 2022).

Table 1 summarizes the sample distribution by economy, where we can see that each economy makes up about 17% of the entire Western Balkans business sample. Specifically: Albania (N=200), North Macedonia (N=202), Kosovo (N=200), Serbia (N=201), Bosnia and Herzegovina (N=200), and Montenegro (N=200), for a total of 1203 businesses in all Western Balkans. In terms of size, there are a total of 44% (N=524) micro businesses, 39% (N=467) small businesses, 15% N=179) medium businesses, and 3% (N=33) of large businesses. While, 64% (N=768) of the businesses operate in Transport, trade, tourism, and

catering industry, 26% (N=315) of the businesses operate in Industry, mining, and construction; and 7% (N=87) in Education, science, culture, and information.

3.3. Dependent and Independent variables

In this model, two binary dependent variables are utilized: 'Environmental Impact,' indicating whether companies have taken steps to reduce environmental impact, and 'Circular Economy,' reflecting the belief whether the current business model allows a shift to a circular business model. The specific definitions for these variables are as follows:

- *Environmental Impact* - a dichotomous variable with a value of 1 for a company that has taken steps to reduce environmental impact and a value of 0 for a company that did not take steps to reduce environmental impact
- *Circular Economy* - a dichotomous variable with a value of 1 for a company that perceives their current business model allowing to shift to a circular economy and a value of 0 for a company that does not perceive their current business model allowing to shift to circular economy

Table 1. Sample Distribution by Economy, Industry and Size

Economy	Percentage	Interviews
Albania	17%	200
Bosnia and Herzegovina	17%	200
Kosovo	17%	200
North Macedonia	17%	202
Montenegro	17%	200
Serbia	17%	201
Total	100%	1203
Size	**Percentage**	**Interviews**
Micro (0-9 employees)	44%	524
Small (10-49 employees)	39%	467
Medium (50-249 employees)	15%	179
Large (250+ employees)	3%	33
Total	100%	1203
Industry	**Percentage**	**Interviews**
Agriculture, hunting, fishing and forestry	3%	33
Industry, mining, construction	26%	315
Transport, trade, tourism, catering industry	64%	768
Education, science, culture, information	7%	87
Total	100%	1203

Source: Balkan Business Barometer 2022, Regional Cooperation Council (RCC)

The independent variables, also binary, are employed to test their influence on businesses regarding environmental impact reduction and belief in the potential of transitioning to a circular model. These variables are defined as follows:

– *Exporting company* - a dichotomous variable with a value of 1 for exporting companies and 0 for non-exporting companies
– *Foreign company* - a dichotomous variable with a value of 1 for foreign companies and 0 for domestic companies
– *Size* - a dichotomous variable with a value of 1 for companies that have 50+ employees indicating larger, meaning medium (49-249 employees) and large companies (250+ employees), and 0 for companies that have less than 50 employees indicating small (10-49 employees), and micro companies (0-9 employees)
– *Innovation* - a dichotomous variable with a value of 1 for companies that introduced new products/ services in the past 12 months and 0 for companies that did not introduce new products/services in the past 12 months

– *Loan* - a dichotomous variable with a value of 1 for companies that have taken a loan in the past 12 months and 0 for companies that have not taken a loan in the past 12 months
– *Investment* - a dichotomous variable with a value of 1 for companies who have invested abroad or plan to invest in the business in 12 months and 0 for companies who have not invested abroad nor plan to invest in the business in 12 months.

Table 2 provides an overview of both dependent variables (**Environmental Impact** reduction and **Circular Economy** potential shift) and the shared independent variables. The categorical variables underwent transformations to refine their analytical utility. Survey questions designed to capture categorical responses were reorganized into distinct 'yes' or 'no' categories, enhancing clarity and precision in our data analysis. Specifically, for categorical variables such as "Environmental Impact" (used B10), "Circular Economy" (used B11), "Exporting Company" (used UK3), "Foreign Company" (used UK5), "Size" (used UK2),

Table 2. Summarized list of dependent and independent variables

Dependent Variables	Description	Frequency		Percentage	
		Yes	No	Yes	No
Environmental Impact	1=company took steps to reduce environmental impact; 0= company did not take steps to reduce environmental impact	667	503	57%	43%
Circular Economy	1=business model allows shift to circular economy; 0=business model does not allow shift to circular economy	286	917	24%	76%
Independent variables	**Description**	**Frequency**		**Percentage**	
		Yes	No	Yes	No
Exporting company	1=exporting company; 0=non-exporting company	333	870	28%	72%
Foreign company	1=foreign company; 0=domestic company	54	1149	4%	96%
Size	1=company has 50+ employees; 0=company has up to 49 employees	212	991	18%	82%
Innovation	1=company introduced new products/ services in the past 12 months; 0=company did not introduce new products/services in the past 12 months	374	754	33%	67%
Loan	1=company took a loan in the past 12 months; 0=company did not take a loan in the past 12 months	247	857	23%	77%
Investment	1=company invested abroad or plans to invest in the business in 12 months; 0=company that has not invested abroad nor plans to invest in 12 months	84	1119	7%	93%

Source: Authors' own calculations

"Innovation" (used H55), "Loan" (used E31 and E31a), and "Investment" (used G37), responses were consolidated into binary formats to better represent the intended distinctions between positive and negative responses in the article. It shall be noted that due to the prevalence of small and medium-sized enterprises (SMEs) in the region (OECD 2022), this paper focuses on differentiating companies with 50+ or more employees or less than that.

Across all Western Balkan countries, 55% of businesses claim to have taken steps to reduce environmental impact, while 24% believe their business model could shift to a circular economy. Identified factors driving these actions include exporting, foreign ownership, larger size, innovation, loan uptake, and investment. Notably, 28% of companies export, 4% are foreign-owned, and 18% are large-sized. Additionally, 33% are innovative, 23% take out loans, and 7% invest.

4. Empirical Model

A probit model analysis was chosen and applied to answer the question on whether the aforementioned business characteristics increase the probability to reduce environmental impact or shift to a circular model. Probit analysis is a form of regression used to analyze dichotomous response variables. There are several ways to use a probit analysis, however the model in question was examined using the maximum likelihood method. Given the dependent variable is a binary variable as well as six explanatory variables are dichotomous as well, probit is an appropriate method for this analysis. The general analytical form is:

$$Pr\ (Y) = a + bX_i + \varepsilon$$

Where,

- **Pr (Y)** – Probability of the dichotomous binary variable to be '1'
- **X_i** – Independent variable
- **ε** – Error term
- **a** – Constant
- **b** – Coefficient of independent variable X

Model 1

Pr (business taking steps to reduce environmental impact) = f (businesses' characteristics)
$$\equiv$$
Pr ($EnvironmentalImpact$) = F ($\beta 0$ + $\beta 1 ExportingCompany$ + $\beta 2 ForeignCompany$ + $\beta 3 Size$ + $\beta 4 Innovation$ + $\beta 5 Loan$ + $\beta 6 Investment$)

Model 2

Pr (business' potential to shift to circular economy) = f (businesses' characteristics)
$$\equiv$$
Pr ($CircularEconomy$) = F (β_0 + $\beta_1 ExportingCompany$ + $\beta_2 ForeignCompany$ + $\beta_3 Size$ + $\beta_4 Innovation$ + $\beta_5 Loan$ + $\beta_6 Investment$)

5. Research Results

Table 3 reveals significant variations in the influence of different variables on both environmental impact reduction and the belief in adopting a circular business model.

- **Environmental Impact Reduction:** Companies engaged in exporting are 22.4% more likely to take steps towards reducing their environmental impact, not providing sufficient evidence to reject hypothesis H3.
- Foreign-owned companies demonstrate a 18.5% increased likelihood of implementing environmental reduction measures, not providing sufficient evidence to reject hypothesis H5.
- Companies with recent innovation, through introducing new products or services, are 15.1% more likely to engage in environmental action, not providing sufficient evidence to reject hypothesis H7.
- Taking a loan within the past year is associated with a 15.5% higher probability of implementing environmental impact reduction measures, not providing sufficient evidence to reject hypothesis H9.
- Neither the size of the company (H1) nor recent investments (H11) display statistically significant relationships with environmental action.

Shift to Circular Business Model:

- Exporting companies show a 13.9% increased likelihood of believing their current model facilitates a shift to a circular economy not providing sufficient evidence to reject hypothesis H4.
- Companies that took out loans within the past year are 25.3% more likely to believe they can transition to a circular model, not providing sufficient evidence to reject hypothesis H10.
- Similar to environmental impact reduction, innovation (H8), company size (H2), and recent investments (H12) do not exhibit statistically significant relationships with the belief in transitioning to a circular business model.

Table 3. **Probit Model of reduction of environmental impact and shift to circular economy**

Variables	Binary Outcome **Environmental impact**	Average marginal effects **Environmental impact**	Binary Outcome **Circular economy**	Average marginal effects **Circular economy**
Exporting company	0.620***	0.224***	0.462***	0.139***
	(0.101)	(0.344)	(0.101)	(0.030)
Foreign company	0.512**	0.185**	0.329	0.099
	(0.246)	(0.088)	(0.213)	(0.064)
Size	-0.034	-0.012	-0.202	-0.061
	(0.118)	(0.043)	(0.129)	(0.039)
Innovation	0.418***	0.151***	0.111	0.033
	(0.0892)	(0.035)	(0.095)	(0.028)
Loan	0.429***	0.155***	0.842***	0.253***
	(0.100)	(0.035)	(0.099)	(0.030)
Investment	-0.132	-0.048	0.126	0.038
	(0.172)	(0.062)	(0.171)	(0.051)
Constant	-0.248***		-1.098***	
	(0.0569)		(0.067)	
Observations	1,036	1,036	1,052	1,052
Mc Fadden R-Squared	7.83%		10.50%	
Percent correctly predicted	63.22%		78.71%	

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The findings suggest that exporting status, foreign ownership, innovation, and loan utilization are key factors influencing environmental action and the potential for circular economy adoption among businesses in the Western Balkans. Further research could explore the mediating mechanisms behind these relationships and investigate the role of additional variables not included in this article.

Goodness of fit measurements

Evaluating the goodness-of-fit in probit models is pivotal for reliable conclusions. Two widely used measures, McFadden's pseudo-R-squared and the percentage of correct predictions, offer distinct perspectives on model performance.

The pseudo-R-squared, ranging from 0 to 1, gauges the likelihood of an event occurring by comparing the log-likelihood of the estimated model with that of a restricted model. A value above 0.2 is generally considered indicative of a good model (McFadden 1973).

However, context is crucial, and the pseudo-R-squared alone might be relatively low, particularly in social science research.

In contrast, the percent correctly predicted focuses on the model's ability to accurately classify cases. In our research, the pseudo-R-squared values for both models are modest: 7.83% for the environmental impact model and 10.5% for the circular business model. However, assessing the percent correctly predicted reveals a different picture. Model 1 accurately predicts 63.22% of the data, while model 2 achieves an impressive 78.71% accuracy. Despite the moderate R-squared values, these results indicate the models' effectiveness in correctly classifying the majority of cases.

Both pseudo-R-squared and percent correctly predicted offer valuable insights into model fit, serving as complementary tools for performance evaluation. While the R-squared provides a relative measure of explanatory power, the percent correctly predicted assesses the model's accuracy in real-world application. In our case, despite moderate R-squared values,

the high percentage of correct predictions indicates that both models perform well in accurately classifying cases.

6. Discussion

This article explores the factors influencing decisions by Western Balkan businesses regarding environmental impact reduction and the potential for shifting to circular business models. Analyzing data from 1,203 firms provides valuable insights into this under-researched region, which is undergoing rapid economic integration and aligning with EU environmental goals.

The findings offer some interesting insights, but it's important to acknowledge that several hypothesized relationships were not statistically significant. While exporting status, foreign ownership, innovation, and loan utilization emerged as potential factors influencing environmental action and the potential for circular economy adoption, the hypotheses regarding company size (H1, H2) and recent investments (H11, H12) did not yield conclusive evidence.

Companies engaged in exporting and those with foreign ownership demonstrated a tendency for greater environmental action and belief in the potential for shifting to circular models. This aligns with existing research suggesting that exposure to international markets fosters sustainable practices (Marco-Lajara et al. 2023; Dornean, Chiriac, and Rusu 2021). Facing stricter environmental regulations and cleaner technologies in foreign markets, these firms may be motivated to adopt similar practices to enhance competitiveness. Additionally, foreign-owned companies often bring advanced technologies and sustainability expertise, influencing local firms to follow suit (Dornean, Chiriac, and Rusu 2021). This reinforces the benefits of attracting foreign direct investment with strong sustainability commitments to accelerate the region's circular transition.

A positive relationship was identified between recent innovation activities and both environmental action and the belief in potential circular model shifts. This supports established perspectives on the role of innovation in driving sustainability (Baldwin and Von Hippel 2011; Lee et al. 2010). The article highlights the importance of fostering an innovative culture and supporting research focused on circular solutions within the Western Balkans.

A novel finding is the link between access to finance and environmental action/circularity belief. This suggests potential financial challenges associated with implementing circular economy practices as well as the importance of financial access, as noted in previous research (Demirel and Danisman 2019; Aranda-Usón 2019; de la Cuesta-González and Morales-García 2022; Takacs, Brunner, and Frankenberger 2022). It underscores the need for tailored financial solutions and targeted incentives to support businesses transitioning to circular economies, aligning with calls for green finance instruments.

Company size and recent investments were not factors that influenced environmental action or the belief in potential for circular economy shifts. This finding warrants further exploration. It could reflect the specific context of the Western Balkans, where the majority of businesses are micro and small, or it may be due to data limitations. Future research could investigate these factors further, potentially disaggregating by industry or firm type.

7. Conclusion

In conclusion, this article identifies exporting status, foreign ownership, innovation, and access to finance as crucial factors influencing environmental action and the belief in potentially adopting circular economy practices among businesses in the Western Balkans. These findings highlight significant pathways for promoting sustainability within the region.

By focusing on the specific context of the Western Balkans, this article contributes into understanding why businesses in developing regions adopt environmentally responsible practices and consider shifting to circular business models. The positive relationship between international exposure (exporting and foreign ownership) and both environmental action and belief in circular economy potential aligns with existing literature. Additionally, the discovery of a link between access to finance and these factors provides a novel contribution to the field.

Despite its contributions, this article acknowledges limitations, including reliance on self-reported data and the potential for unexplored variables such as industry-specific factors, consumer preferences, and regulatory environments. Future research could address these gaps through longitudinal studies to examine the sustained impact of different strategies on environmental outcomes and business performance. By addressing these limitations and continuing to investigate these relationships, researchers can further advance our understanding and support the transition to sustainable practices in the Western Balkans.

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SHADOW BANKING IN CENTRAL AND EASTERN EUROPE: SPECIFICITIES AND DRIVERS

András Bethlendi, Katalin Mérő, Zsanett Orlovits

Abstract

The paper analyses the specificities and drivers of the shadow banking (SB) system in eleven Central and Eastern European (CEE) EU member states for 2004-2019. It contributes to the understanding of the CEE SB in terms of how the structural features of the financial and banking system determine its development. The SB system of the region is much smaller, and its structure is less complex and significantly different from that of developed European countries: the role of capital market intermediaries is smaller, while the role of nonbank lenders is larger. Specific features of the CEE financial system include the dominance of banks, the relative underdevelopment of capital markets, the dominance of foreign ownership, and, until the mid-2010s, the reliance on foreign interbank funding in several countries. Indeed, as the results of our panel regression show, regional specificities in the structural characteristics of financial systems are key for the development of the SB.

Key words: *Central and Eastern Europe, shadow banking, market-based finance*

JEL Classification: *G20, G23, G28*

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1. Introduction

This paper analyses the specificities and drivers of the shadow banking system in the eleven Central and Eastern European EU member states (CEE11) that joined the EU in 2004 or later, namely Bulgaria, Croatia, Czechia, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, and Slovenia.

According to the widely used definition of the Financial Stability Board (FSB 2011), the shadow banking system refers to 'The system of

credit intermediation that involves entities and activities outside the regular banking system' (p. 2). Shadow banking (SB) emerged in the early 2000s in the United States (Pozsar et al. 2010, Adrian and Ascraft 2012, Gorton and Metric 2010). Similar to traditional banking, SB activity based on maturity transformation creates leverage and takes credit risk, though without strict prudential regulations and a government-backed safety net (Adrian and Ascraft 2012, Claessens and Ratnovski 2014, Thiemann 2018). Accordingly, prior to the global financial crisis (GFC), regulatory arbitrage played an important role among the reasons for increased SB activities (Adrian and Ascraft 2012, Lysandrou and Nesvetailova 2015). The business model of financial intermediation through the SB system also gained ground in the EU (Bakk-Simon et al. 2012, Malatesa et al. 2016) and contributed to systemic risk in the member states. The EU has made a serious effort to reduce SB risk and transform it into stable market-based finance, but it has had limited success so far. In its Spring 2023 Financial Stability Review, the ECB identified SB risk as a key factor of vulnerability in the European financial system (ECB 2023).

In line with the less developed and highly bank-based financial system of CEE11, shadow banking plays a less dominant role throughout the CEE region. Hodula (2022) highlights that the CEE SB sector is relatively simple compared to that of developed countries. Nevertheless, different types of SB activities have emerged in the region that could also contribute to systemic risk. However, relatively little research has focused on the characteristics and drivers of the CEE SB system.

Our contribution to the existing research is to analyze the SB of the CEE region from the perspective of how the structural characteristics of the financial and banking system determine its development. The previous literature also includes banking system variables in the analysis of SB, but these are general banking system variables, not CEE-specific. The specificities of the financial intermediation system in the CEE region include the dominance of banks, the relative underdevelopment of capital markets, the dominance of foreign ownership, and, in several countries until the mid-2010s, the reliance on foreign interbank finance. Since foreign banks typically passed on the market-based funds they had raised (i.e., the shadow banking funds of their own country), a so-called secondary shadow banking system could develop in these countries, as Bethlendi and Mérő (2024) demonstrate in the case of Hungary. Based on these specialties, the structure of the CEE SB is also different from the SB structure in developed EU countries: the role of capital market intermediaries and intermediation is

smaller, while the role of nonbank lenders and lending is larger. The empirical part of our analysis also follows this logic: we look at the impact of several explanatory variables that capture specific structural elements of the CEE region.

Indeed, as our econometric analysis shows, regional specificities in the structural characteristics of financial systems are key for the development of the SB system in CEE11.

The structure of the article is as follows. The next section presents a brief overview of the literature on the European and CEE SB systems. Section 3 describes the data and methodology we used. In Section 4, we present the main structural characteristics of CEE SB system. Section 5, based on a panel regression, analyses the determinants of CEE SB developments, with special emphasis on regional specificities of the banking sector. We close the article with conclusions and policy implications in Section 6.

2. Literature review

The general characteristics of SB are well-researched topics (Pozsar et al. 2010, Adrian and Ashcraft 2012, Classens and Ratnowski 2014, Thiemann 2018). With regard to the financial stability implications of shadow banking, it should be stressed that due to increased lending capacity, the emergence of SB has resulted in rapid credit expansion (Moreira and Savov 2017, Özgür 2021). However, as the excessive lending took place outside the regulated banking industry, the risks taken by the SB system and the risk transfer mechanism among the different organizations within the system were highly opaque (Acharya et al. 2013, Gennaioli et al. 2013, Culp and Neves 2018, Thiemann and Tröger 2021). The lack of bank-like regulations resulted in wide-scale regulatory arbitrage (Adrian and Ashcraft 2012, Thiemann 2018, Adrian and Jones 2018) and also in bad incentive structures (Lysandrou and Nesvetailova 2015; Ban and Gabor 2016).

Despite the basic bank-based characteristics of most EU countries' financial systems, market-based finance has been gaining ground over traditional bank lending for decades, first of all in the old member states of the EU, but there are significant differences among member states (Hartman et al. 2003). Besides, as Hardie et al. (2013) demonstrate, the nature of banking has become more market-based; that is, there is a convergence between banking, capital markets, and SB. The European SB started to grow rapidly before the 2008 crisis and growth continued into the 2010s. As a result, by 2016, the euro area SB system was somewhat larger than that of the US (FSB 2020, Graph

1-4, p.12). Pires (2019) has also demonstrated the rapid growth of EU SB after the GFC and its increasing role in European financial intermediation, especially in lending. She draws attention to the related structural vulnerabilities, especially to the increasing leverage of investment funds and the high interconnectedness of different segments of the financial sector. As a result, the level of SB assets in the euro area reached 40% of total financial assets by 2018 (Petkovski at al. 2023).

Hodula et al. (2020) identified the following growth factors for EU SB: real GDP growth, the demand of institutional investors, tightening capital requirements of banks and the financial development of EU member states. Hodula (2022) analyzes the SB of old and new EU member states separately. In his analysis, the new member states are defined as those that joined the EU in 2004 and in 2007, including the post-communist CEE member states, as well as Malta and Cyprus. The main conclusion of the analysis is that whereas SB fulfills more of a complementary role to traditional banking in old member states, it functions more as a substitute in new member states.

Petkovski et al. (2023) also investigate the drivers of SB, comparing the old and new EU member states for the 1999-2020 period. However, they excluded Luxembourg, as an international financial center, from the group of old member states and reclassified Cyprus and Malta from the new to the old group due to their financial sector characteristics. They analyzed a wide range of explanatory variables, including a number of financial systems and institutional indicators (see Table 1). In contrast to Hodula (2022) they found that the CEE SB was also rather complementary to traditional banking.

Grillet-Aubert et al. (2016) complement the entity-based approach to European SB analysis with an activity-based approach. They draw attention to the need for more granular data for proper risk assessment of SB. The interconnectedness of SB and other parts of the financial system for the euro area is analyzed by Giron and Matas (2017). Using the ECB's who-to-whom data, they analyze the flow of funds between different categories of financial institutions. The interconnectedness of EU banks and SB has been analyzed by Abad et al. (2017). They highlight the high interconnectedness of EU banks and the global SB, especially that of the US.

In addition to these comprehensive analyses, there are other papers that focus on different market segments of European SB. European money market funds are analyzed by Bengtsson (2013); the investment fund sector by Doyle et al. (2016); the repo market by Ban and Gabor (2016); the money market funds and asset-backed commercial papers by Endrejat and

Thiemann (2020); and the interaction between macroprudential policies and SB by Hodula and Ngo (2024). The latter also examines the old and new EU member states separately but finds no meaningful difference between the two groups.

Apart from the studies mentioned above comparing the SB in old and the new EU Member States, only a few studies deal with the shadow banking system in the CEE region. Ghosh et al. (2012) on the SB of emerging markets include three CEE countries (Bulgaria, Romania, and Croatia) for the 2003-2011 period. They argue that despite the low level of SB in these countries, the significant increase in SB activities in recent years, and their interconnectedness with the traditional financial system, may pose systemic risks. Apostoaie and Bilan (2020) focused on the macro determinants of SB dynamics in CEE11 between 2004 and 2017. They conclude that from a low base in 2004, the SB of the CEE11 increased more than the euro area countries between 2004 and 2007. The main macroeconomic drivers they identified were the following: economic growth, global liquidity conditions, search for yield of investors, demand from institutional investors, and the complementarity with the rest of the financial system.

Kjosevski et al. (2021) analyzed the drivers of SB growth in CEE for the period of 1999-2019. They identified economic growth as the main driver of SB. In their analysis, they divided the 11 CEE countries into three more homogeneous groups: the Baltics, the Visegrad countries, and the Balkans. According to their results, the SB of the subgroups differs most in how they were affected by the global financial crisis. In contrast to Hodula (2022) their results indicate complementarity between the development of SB and the rest of the financial system.

The geographical coverage, the time horizon, and the explanatory variables used in the literature for determining the drivers of CEE SB growth are summarized in Table 1.

3. Data and methodology

3.1. Data

One of the difficulties of analyzing the CEE shadow banking system is the lack of reliable data. Throughout our analysis, we relied on the dataset of Bethlendi and Mérő (2022). Besides the CEE, this dataset includes comparable data for three West European countries, Austria, France, and Germany, which are the most important home countries of several major CEE financial institutions. In this article, we also use these three

Table 1. Drivers of SB development used in the literature covering the CEE region.

	Apostoaie and Bilan, 2020	Ghosh et al., 2012	Hodula, 2022	Kjosevski et al., 2021	Petkovski at al., 2023
SB variable	Broad: including all non-monetary financial institutions, excl. insurance corporations and pension funds Narrow: broad without investment funds, other than money market funds	Nonbank financial intermediaries	Investment funds (IF) incl. money market funds and other financial intermediaries (OFI)	Other financial intermediaries (OFIs)	Other financial intermediaries (OFIs)
Geographical coverage	CEE11	Emerging markets, including three CEEs	New EU member states, including Cyprus and Malta, excluding Croatia	CEE11	CEE11 and other EU countries, excluding Luxembourg
Time horizon	2004-2017	2002-2011	2004-2019	1999-2019	1999-2020
Method	Econometric	Descriptive statistics	Econometric	Econometric	Econometric
Macroeconomic	Real GDP growth		Real GDP growth	Real GDP growth Inflation rate	Real GDP per capita Size of the economy Inflation rate
Financial sector	Growth rate of total assets of monetary and financial institutions Growth rate of total financial assets of insurance corporations and pension funds;	Total assets of banks per GDP	Traditional banking growth; WB Financial Development index Growth rate of total financial assets of insurance corporations and pension funds;	Total assets of banks per GDP Insurance companies' assets per GDP; WB Financial Development index Institutional cash pools;	Total assets of banks per GDP; Asses of insurance companies per GDP WB Financial Development index
Market indicators	Growth rate of total reserves, excluding gold		Short-term interest rate	Interest spread of banks Credit margin	Financial market index
Maturity transformation	Term spread Money market rate				Interest rate spread
Crisis (2007-2008)			Crisis dummy	Crisis dummy	Crisis dummy
Institutions			Macroprudential policy dummy Capital regulation		Regulatory quality Rule of law

countries as benchmarks for CEE analysis. The structure of the dataset is based on the subsectors of the European System of Accounts (ESA). These subsectors are as follows: money market funds (MMFs), non-MMF investment funds (non-MMFs), other financial institutions (OFIs), financial auxiliaries, and captive financial institutions. The OFI subsector consists of financial vehicle corporations engaged in securitization (FVCs), security and derivative dealers, financial corporations engaged in lending (FCLs), and specialized financial corporations. The authors corrected Eurostat data and complemented missing data with other national sources. All data sources are presented in Annex 1.

3.2. Variables

We use the following variables to capture the development and characteristics of the CEE financial sector:

1. Capital market depth, as measured by stock- and non-financial corporate bond market capitalization-to-GDP ratio (Market cap). Our expectation is that due to underdeveloped financial intermediation (Cojocaru et al. 2016, Mérő and Bethlendi 2022), capital market depth and the shadow banking system are in positive correlation with each other.

2. Depth of banking (Bank to GDP). The region has a heavily bank-based character of the CEE financial sector (Allen and Gale 2001, Demirgüç-Kunt and Levine 2004, Mérő 2004, Bethlendi and Mérő 2020). Our expectation is that the indicators for the depth of banking (Bank to GDP) and SB intermediation (SB to GDP) are in a positive correlation with each other (co-development / complementary hypothesis).

3. The share of domestic bank ownership (Domestic). We expected a positive correlation between domestic bank ownership and the size of the SB system. It is more typical for a domestic banking group to have nonbank subsidiaries and to enter into business relationships with domestic nonbank service providers (ones not belonging to the banking group) more actively. In a predominantly foreign-owned banking sector, the proportion of cross-border activities is higher for foreign banks. These are primarily in asset-management-related services, where the parent banks' home market is much deeper and, consequently, has cheaper investment fees.

4. The banking sector's credit-to-deposit ratio (Bank credit to deposit). Due to limited market-based finance in the region, the importance of parent banks' interbank lending to their CEE subsidiaries was decisive (Kurach 2010, Epstein 2014, Király 2020). From pre-GFC to the mid-2010s, several CEE banks relied heavily on the interbank funding of parent banks to allow them to operate with high credit-to-deposit ratios. Foreign interbank lending is a special type of market-based banking that transfers market funds from foreign banks to CEE banks (Bethlendi and Mérő 2024). This meant that the high credit-to-deposit ratio did not reflect to the development of CEE capital markets by raising market funds. We therefore expect a negative relationship between banks' credit-to-deposit ratio and the size of SB.

5. The banking sector's return on equity (ROE). Due to pre-GFC outstandingly high profitability of the CEE's banking sector and a more mixed profitability trend post-GFC (Raiffeisen Research 2013, 2016, 2020), one of the most important motives of securitization has been to increase banking sector profitability according to Pozsar et al. (2010). It follows that there are fewer incentives to expand the SB activities in a highly profitable banking sector. Accordingly, we expect a negative relationship between the ROE and SB.

Other variables:

6. The country risk premium (CountryRisk). Country risk can significantly impact the flow of investment within a country (Muzindutsi and Obalade 2020) and, subsequently, the development of market-based finance. The country risk reflects well the inflation and yield pattern of an emerging country. Higher country risk can set back shadow banking penetration through several channels, including the crowding-out effect of the government securities market, stronger competition of traditional bank deposit products (offering higher yields), and increasing reliance on foreign service providers in the field of savings. Therefore, we expect a negative relationship between country risk and SB.

7. The GDP per capita. The relatively lower level of economic development, which might be more important than the economic growth indicator (Demirgüç-Kunt 2006, Demetriades and Law 2006), is expected to have a positive effect on SB development.

3.3. Methodology

Our methodology consists of two approaches. First, we do a structural analysis that applies descriptive statistical methods. The time horizon of this analysis is 2004-2019, which means that it covers the period from EU accession of most of the countries of the region to the final year prior to the outbreak of the Covid pandemic. Second, we use panel econometric methods to look for determinants of CEE shadow banking development. Banking system indicators in Poland and the Czechia for the beginning of the period under review are lacking, so we run models for a shorter period from 2010 to 2019 to get a balanced panel. In this way, our panel analysis investigates the recovery period after the GFC.

4. Structural characteristics of shadow banking in CEE region

Both the banking and the SB assets of the CEE11 lag far behind those of the three core EU benchmark countries. However, there are significant differences between CEE countries (Figure 1).

Before the GFC, there was a slight convergence between the depth of financial intermediation of the CEE region and the core EU countries. During the 2010s, as a result of the post-GFC deleveraging of the banks' assets, there was a fall in the assets-to-GDP ratio in most European countries, while the SB-to-GDP ratio either stagnated or increased. In the CEE region, this was due to both the depressed lending landscape, and to the fact that banks sold huge amounts of non-performing loans to debt-collecting companies that belonged to SB institutions (Bethlendi and Mérő 2020). Nevertheless, there are significant country-specific differences. The SB-to-GDP increased most

significantly in Czechia, while the most significant decrease took place in Hungary, where traditional banking activities also shrunk.

Not only the size but also the structure of the CEE SB differs significantly from that of the benchmark countries. As a common characteristic, we can mention the weak and decreasing role of MMFs. The marginalization of MMFs is dominantly due to the efforts to make the regulation of MMFs much stricter in 2012 (Endrejat and Thiemann 2020) and re-regulating them in 2017. After the post-GFC re-regulation process, the role of MMFs remained non-negligible in France – though significantly decreased – but this was not the case in any CEE countries. (Figure 2).

We define the non-MMF investment funds segment of SB as non-MMFs minus their equity holding. These are less significant in the CEE region than in developed countries in general, and in the benchmark countries in particular. The capital markets and the asset management industry in CEE were highly

Figure 1. Comparing the size of banks and shadow banks per GDP
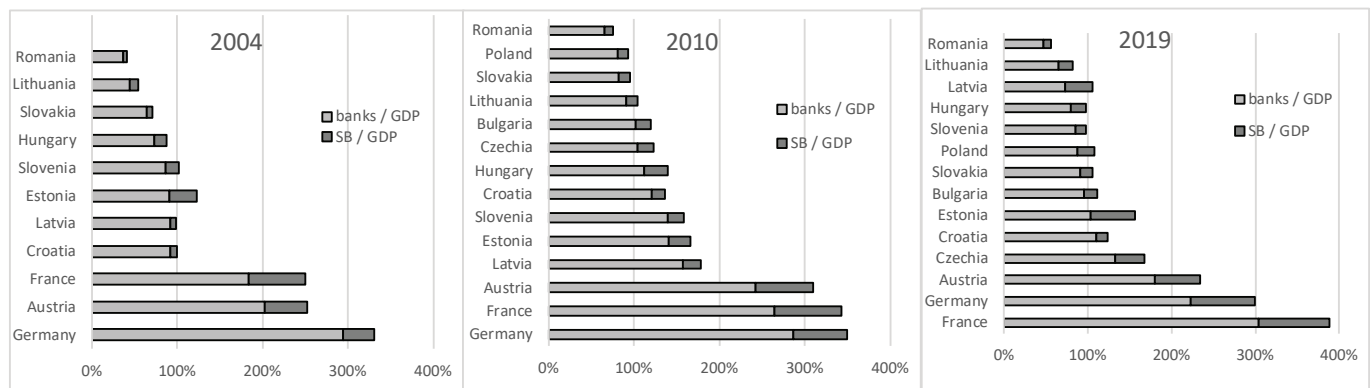
Source of data: Bethlendi and Mérő (2022)

Note: Data from 2004 are not available for some CEE countries.

Figure 2. The structure of SB in CEE and in benchmark countries (total SB=100%)
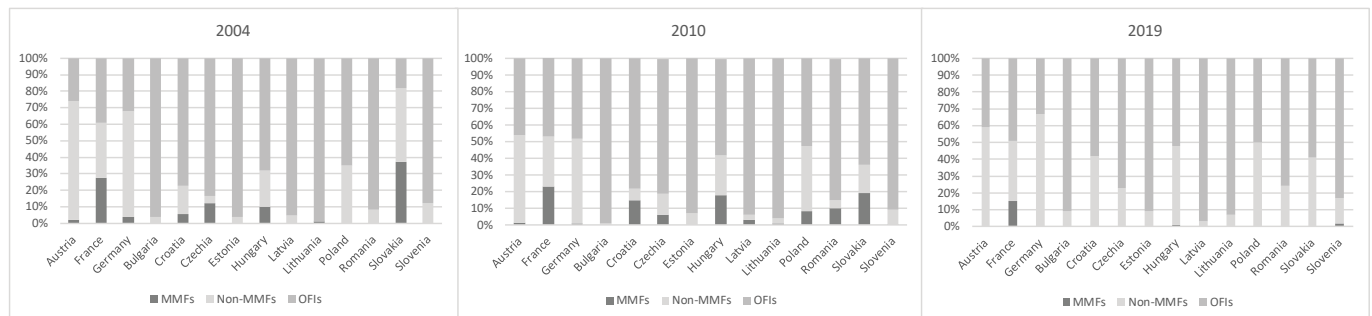
Source of data: Bethlendi and Mérő (2022)

Note: on a standalone basis, MMF data are not available for Bulgaria, Estonia, Poland, Romania, and Slovenia for 2004; nor for Bulgaria and Estonia for 2010; nor for Estonia for 2019.

underdeveloped both pre-and post-GFC. We see a degree of catching up only after the GFC. The non-MMFs are dominated by bonds and multi-asset funds (EFAMA 2022), while in some countries (especially in Hungary) real estate funds also play an important role. Among the non-MMFs' assets, the proportion of bonds created by securitization is negligible in the region. In other words, the most typical SB assets of developed countries are missing from the investment funds portfolio composition. According to a survey by the World Bank (2019), there was no residential real estate loan securitization in the region at all between 2011 and 2016. The SME loan securitization was also minimal in the region. According to the EIB (2017), there was some SME securitization in Bulgaria, Czechia, and Poland, but not in the other eight CEE countries. The first SME securitization deal was a joint issue of the Czech and Polish Raiffeisen banks in 2006 (David and Sebesta 2007). A special market segment of securitization emerged in Poland, where, instead of selling non-performing assets to debt-collecting companies, banks partly securitized their non-performing assets and sold them to specialized investment funds (Buszko and Krupa 2016).

Since the asset management industry is underdeveloped in the region, OFIs dominate the CEE SB. Specific to this region, OFIs are dominated by finance companies engaged in lending (FCLs), which includes lease-, factoring-, lending-, and debt-collecting companies. OFIs not only represent a more significant segment of SB in the region but are also much more engaged in lending. In the benchmark core-EU countries, the loans provided by FCLs were 5% of the loans provided by the banking sector in 2010 and 7% in 2019, while the relevant proportions for the average of 11 CEE countries was 11% for 2010 and 14% for 2019. In other words, the proportion of FCL loans to banking loans is twice as high in the region as in the benchmark countries (Bethlendi and Mérő 2022).

Out of the CEE11, only eight countries publish specific data on FCLs. Based on this sub-sample, FCLs play a dominant though decreasing role in the total SB sector of the region. (Figure 3).

5. Determinants of CEE shadow banking development[1]

We run panel regressions to analyze to what extent the development of the CEE SB system is determined by the regional specificities of financial structures (banking sector dominance, foreign ownership) and the level of economic development and riskiness of the countries under review.

Figure 3. Share of FCLs in the total assets of the SB sector.
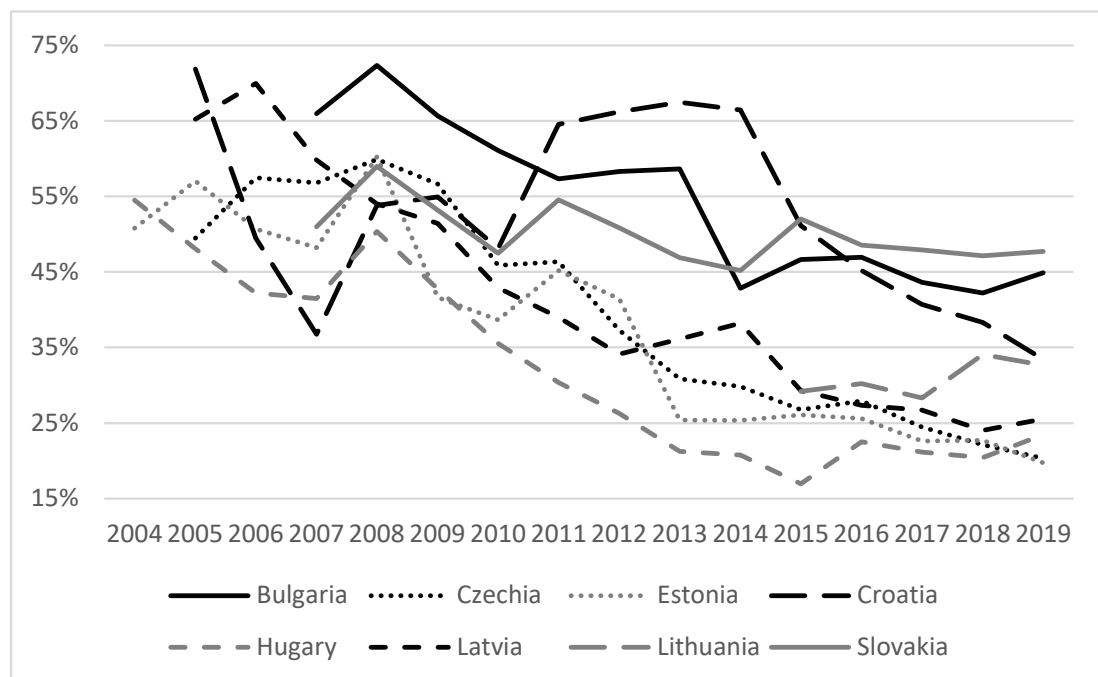
Source of data: Bethlendi and Mérő (2022)

Note: For Lithuania, FCL data are available only from 2015.

5.1. Basic statistics and tests

Throughout this section, we used only the CEE11 data from 2010 to 2019. The following table shows the basic statistics of our dataset.

The next table shows the pairwise correlation coefficients (Pearson) of the variables.

Heterogeneity across countries and times can be shown by a line plot (Figure 4). The blue line connects the mean values of SB to GDP, using all available years across countries (left figure). The same holds for the time dimension. Here, the blue line connects the mean values of SB to GDP, using all available countries across years (right figure).

Table 2. Summary Statistics

Variable	N	Mean	Std. Dev.	Min	Pctl. 25	Pctl. 75	Max
SB to GDP	110	0.19	0.09	0.09	0.14	0.23	0.53
Bank to GDP	110	0.97	0.23	0.47	0.82	1.14	1.57
ROE	110	0.06	0.12	-0.90	0.05	0.11	0.23
Domestic	110	0.26	0.20	0.02	0.09	0.41	0.74
CountryRisk	110	0.02	0.01	0.01	0.01	0.03	0.05
Bank credit to	110	1.02	0.29	0.68	0.82	1.11	2.16
Market cap	110	0.18	0.12	0.03	0.10	0.22	0.47
GDP per capita	110	15.60	4.65	6.81	12.91	18.65	26.10

Source: own calculation

Table 3. Correlation coefficients

	Bank to GDP	ROE	Domestic	CountryRisk	Bank credit to deposit	Market cap	GDP per capita
SB to GDP	0.383***	0.091	0.091	-0.394***	-0.002	-0.056	0.239***
Bank to GDP	1	-0.137	0.08	-0.012	0.412***	0.295***	0.239**
ROE		1	-0.392***	-0.416***	-0.346***	-0.006	-0.036
Domestic			1	0.141	0.13	-0.017	0.206
CountryRisk				1	0.118	0.172	-0.476***
Bank credit to deposit					1	-0.235**	-0.019
Market cap						1	-0.106
GDP per capita							1

Note: Signif. codes: *** 0.001 ** 0.01 * 0.05 . 0.1

Source: own calculation

Figure 4. Visualization of heterogeneity
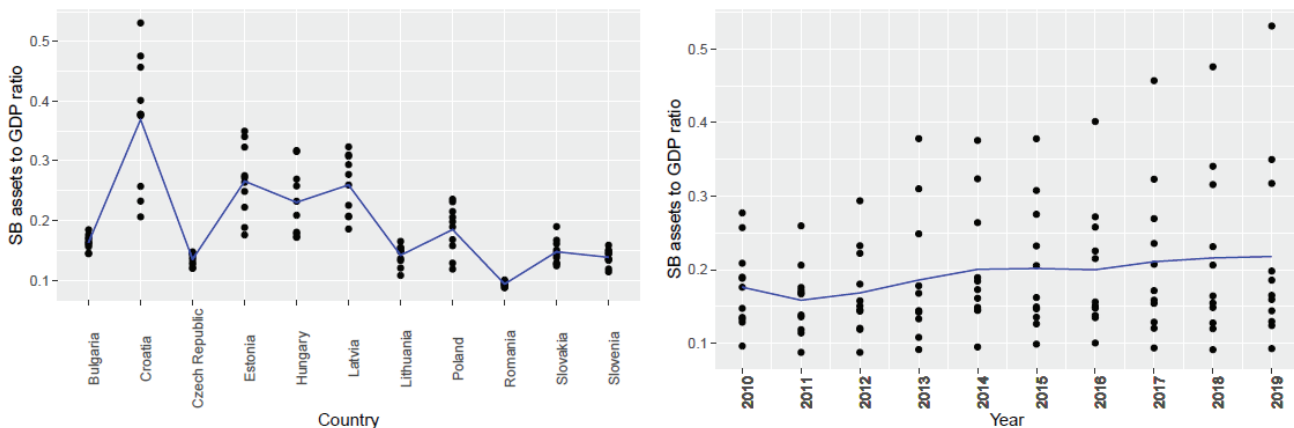
Source: own calculation

To analyze the relationship between SB to GDP and the potential determinants, we first tested whether a cross-sectional dependency existed. Then a panel cointegration test was carried out to see whether there was a long-term relationship among the variables. Finally, to test whether there was a causal relationship among the variables, a panel causality test was performed.

First, we used a diagnostic test for the cross-section dependence in the panels, specifically the Pesaran cross-dependence test (Pesaran, 2007). The null hypothesis of the test indicates the existence of cross-independence, while the alternative hypothesis assumes cross-dependence across the countries observed. Table 4 gives the results of the Pesaran test for cross-sectional dependence.

Table 4. Test for cross-sectional dependence

Variable	Pesaran CD test	p-value
SB to GDP	8.87	0.00
ROE	11.39	0.00
Domestic	-0.58	0.56
Country Risk	9.86	0.00
Bank credit to deposit	13.24	0.00
Market cap	12.46	0.00
GDP per capita	21.56	0.00

Source: own calculation

For all the considered variables (except for Domestic), we can reject the null hypothesis at a 1% level of significance, so the variables generally showed cross-dependence between the countries.

Second, we can also apply Pedroni (1999)'s cointegration test to reveal any underlying relationships between the variables. This test takes into account heterogeneity by using specific parameters that are allowed to vary across individual members of the sample and which consist of four statistics for testing panel data cointegration. Out of these seven statistics, four are based on the 'within' dimension (Table 5), and the remaining three deal with the 'between' dimension (Table 6). All the statistics are for testing the null hypothesis of no cointegration.

Table 6. Test for cointegration; Alternative hypothesis: common AR coefficients (between-dimension)

	Statistics	prob.
Group rho-statistic	4.458	1.000
Group PP-Statistic	-5.589	0.000
Group ADF-Statistic	-2.035	0.021

Source: own calculation

Since four out of seven statistics indicate that the null hypothesis of no cointegration can be rejected at a 1% significance level, we conclude that the variables are cointegrated.

Third, we examined the causal relationship between the shadow banking variable and the individual determinants using the panel Granger causality test performed by Dumitrescu and Hurlin (2012). The results are shown in Table 7.

Table 7. Test for causality

Variable	Granger causality test	p-value
SB to GDP causes Bank to GDP	2.358	*0.018*
Bank to GDP causes SB to GDP	1.503	0.133
SB to GDP causes ROE	7.056	*0.000*
ROE causes SB to GDP	24.024	*< 2.2e-16*
SB to GDP causes Domestic	0.893	0.372
Domestic causes SB to GDP	2.770	*0.006*
SB to GDP causes Country Risk	7.641	*0.000*
Country Risk causes SB to GDP	5.394	*0.000*
SB to GDP causes Bank credit to deposit	11.265	*< 2.2e-16*
Bank credit to deposit causes SB to GDP	4.782	*0.000*
SB to GDP causes Market cap	12.903	*< 2.2e-16*
Market cap causes SB to GDP	0.917	0.359
SB to GDP causes GDP per capita	1.885	*0.059*
GDP per capita causes SB to GDP	-0.619	0.536

Source: own calculation

Table 5. Test for cointegration; Alternative hypothesis: common AR coefficients (within-dimension)

	Statistics	prob.	weighted stat.	prob.
Panel v-statistic	-2.531	0.994	-3.179	0.999
Panel rho-statistic	2.881	0.998	2.722	0.997
Panel PP-Statistic	-0.894	0.186	-3.847	0.000
Panel ADF-Statistic	-0.764	0.223	-2.515	0.006

Source: own calculation

According to the results, a bidirectional causal relationship was found between shadow banking assets and ROE, Country risk, and Bank credit to deposit. In all other cases there is a unidirectional causal relationship. There is a causal effect of SB to GDP on Bank to GDP, Market capitalization, and GDP per capita. There is an opposite effect of Domestic ownership on shadow banking.

5.2. Estimation methods

As a first step, we estimated the data-generating process by a simple pooled OLS model using the individual determinants as explanatory variables. The results show that there is a causal relationship between shadow banking assets and some explanatory variables (Bank to GDP, Country risk, Bank credit to deposit, and MarketCap). A better choice would be to use the so-called least squares dummy variable (LSDV) approach or fixed effects (FE) model (also called within estimator), which allows the inclusion of dummy variables in the model for all countries. The F test for individual effects can test for fixed effects with the null hypothesis that pooled OLS is better than the fixed effects model. The test result (F = 4.338 with p = 0.03996) shows that the fixed effects model provides a better fit than OLS. Alternatively, this test can be carried out by jointly assessing the significance of the dummy variables in the LSDV approach. The results are identical.

The FE model can be applied with a time-fixed effect. The resulting model is not significant (almost all the coefficients are nonsignificant). There is also a possibility of testing whether time fixed effects are needed. The null hypothesis is that the coefficients are together zero for all years, and hence, no time-fixed effects need to be taken into account. The test results (F = 0.83229, df1 = 12, df2 = 84, p-value = 0.6172) show that there is no evidence that time-fixed effects should be taken into account.

We also examined that any variation between entities is random and not correlated with the regressors used in the estimation model. If there are reasons to believe that differences among countries influence the dependent variable, a random effect (RE) model should be preferred. A decision between a fixed and random effects model can be made with the Hausman test, which checks whether the individual error terms are correlated with the regressors. The null hypothesis states that there is no such correlation (RE). The alternative hypothesis is that a correlation exists (FE). The results ($\chi 2$ = 126.58, df = 3, p-value < 2.2e – 16) show that a correlation exists, so the fixed effect model would be preferred.

We incorporated the past values of our dependent variable to capture the persistence of the time series. In economic terms, it means that a larger shadow-banking sector in the previous period is likely to affect its present size. The results of the FE model are presented in Table 8. Besides the lagged dependent variable, four explanatory variables remained significant (narrow model).

The GDP per capita and Bank to GDP variables were significant only at 10%. In their case, the Granger causality test showed the opposite direction than expected; namely, there was no causal relationship between these variables and the SB to GDP. Thus, we omitted these two variables from the final model. Table 9 presents the results of the final model. According to this model, Domestic and Bank credit to deposit variables are the most important determinants of shadow banking development in the CEE region.

The goodness-of-fit statistics tell us how well a particular model fits the data. The most common diagnostic tool is the residuals. Figure 6 shows some useful plots of the residuals. The first plot presents the normality assumption of the residuals using a QQ-plot. The second plot depicts residuals versus fitted values plotted by observation number. The third graph is the so-called scaled-location (or spread-location) graph used to check the homogeneity of variance of the residuals (homoscedasticity). Since there is no pattern in the residuals, we can conclude that the residuals are homoscedastic.

Table 8. The full and narrow model

	Full model				Narrow model			
	Estimate	Std. Error	t-value	p-value	Estimate	Std. Error	t-value	p-value
lag(SB to GDP, 1)	0.354	0.057	6.175	1.876e-08***	0.368	0.056	6.531	3.425e-09***
Bank to GDP	0.104	0.050	2.059	0.042*	0.091	0.049	1.880	0.063 .
ROE	-0.039	0.037	-1.052	0.296				
Domestic	0.104	0.054	1.951	0.054 .	0.113	0.053	2.140	0.035 ∗
Country Risk	0.267	0.840	0.318	0.751				
Bank credit to deposit	-0.081	0.028	-2.924	0.004∗	-0.067	0.025	-2.641	0.0097 ∗∗
Market cap	-0.109	0.114	-0.950	0.345				
GDP per capita	0.005	0.003	1.703	0.092 .	0.004	0.002	1.799	0.075 .

Note: Signif. codes: ∗∗∗ 0.001 ∗∗ 0.01 ∗ 0.05 . 0.1

Source: own calculation

Table 9. The full and final model

	Full model				Final model			
	Estimate	Std. Error	t-value	p-value	Estimate	Std. Error	t-value	p-value
lag(SBassetsGDP, 1)	0.354	0.057	6.175	1.876e-08***	0.392	0.056	6.948	4.62e-10***
Bank to GDP	0.104	0.050	2.059	0.042*				
ROE	-0.039	0.037	-1.052	0.296				
Domestic	0.104	0.054	1.951	0.054 .	0.167	0.049	3.444	0.0009 ***
Country Risk	0.267	0.840	0.318	0.751				
Bank credit to deposit	-0.081	0.028	-2.924	0.004*	-0.043	0.014	-2.986	0.0036 ***
Market cap	-0.109	0.114	-0.950	0.345				
GDP per capita	0.005	0.003	1.703	0.092 .				

Note: Signif. codes: ∗∗∗ 0.001 ∗∗ 0.01 ∗ 0.05 . 0.1

Source: own calculation

Table 10. Additional statistics to the estimated models (full and final)

	Full model	Final model
Total Sum of Squares:	0.214	0.214
Residual Sum of Squares:	0.096	0.105
R-Squared:	0.553	0.512
Adj. R-Squared:	0.463	0.445
F-statistics:	F (8, 90) = 13.8921 (p-value: 5.9153e-13)	F (3, 95) = 33.1588 (p-value: 9.4089e-15)

Source: own calculation

Figure 5. Model fitting by country

Source: own calculation

Figure 6. The goodness-of-fit
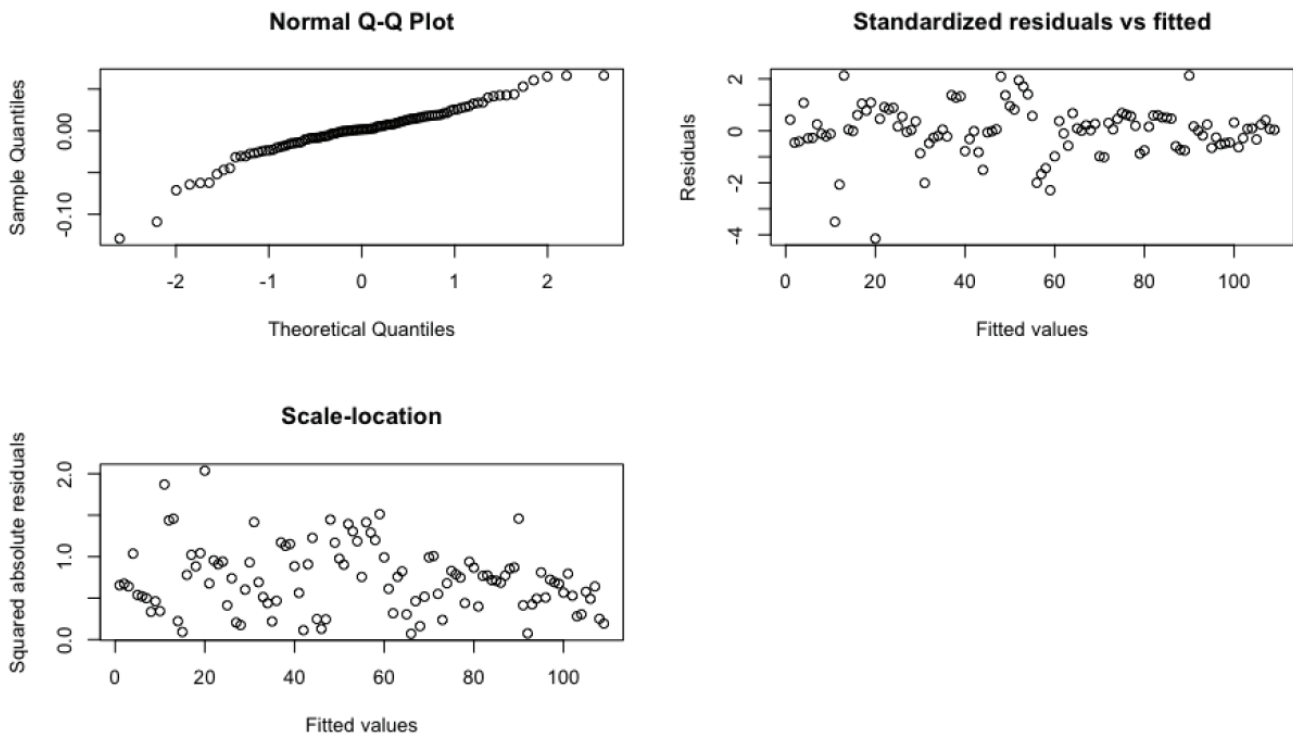
The normality of the residuals can be tested by the Shapiro-Wilk normality test. The results (W = 0.93107, p-value = 2.711e-05) show that the series of the residuals are consistent with the assumption of normality. We also tested the presence of autocorrelation in the residuals. According to the Durbin-Watson test (DW=1.75303 with p-value=0.180581), there is no serial correlation in idiosyncratic errors. The Woolridge test shows the same conclusion.

5.3. Results and discussion

Table 9 contains the results of the final model. In the following, we compare our expectations on the indicators with our results.

1. Contrary to our expectations, capital market depth did not play a significant role in SB intermediation after the GFC period.
2. We detect that the banking and SB systems developed in tandem, supporting the complementary hypothesis (Petkovski et al., 2023). Contrary to the results of Hodula (2022), who found that SB is more of a substitute for traditional banking in new member states.

3. In line with our expectations, we find that domestic ownership in banking has a positive effect on SB development. Thus, it is more general for a domestic banking group to have nonbank subsidiaries and to enter into business relationships with domestic nonbank service providers. At the same time, foreign-owned banks rely more on the service of home banking groups or other foreign service providers.
4. Also, in line with our expectations, we find a negative relationship between banks' credit-to-deposit ratio and the size of SB. This means that the high credit-to-deposit ratio did not contribute to the development of market-based finance in the CEE region. We suspect that the foreign interbank funds of parent banks allowed them to operate with high credit-to-deposit ratios. This and the previous results could be considered our main contributions to the literature and general understanding of the CEE financial / SB system.
5. Contrary to our expectations, the superior profitability of the CEE banking sector compared with that of developed countries does not explain the underdevelopment of CEE SB.
6. Also, contrary to our expectations, the country risk premium does not explain the differences in CEE SB developments.

7. The level of economic development has a positive effect on SB development according to the narrow model in keeping with our expectations and the literature (Apostoaie and Bilan, 2020; Hodula, 2022; Kjosevski et al., 2021).

6. Conclusions

In this paper, we have analyzed the specificities and drivers of the shadow banking evolution in eleven CEE countries. Based on the literature and our structural analysis, we used several explanatory variables in our panel regression, which reflects the special structural characteristics of CEE. In this respect, we get two main findings. Firstly, we detect a positive relationship between the rate of domestic ownership in the banking sector and the size of the SB system, which might be explained by the fact that domestic banks complement their activities to a lesser extent with cross-border (SB) activities, but instead have domestic service providers to do them. However, CEE countries' small domestic capital markets are not sufficiently size- and scope-efficient, which means that cross-border services are typically provided as part of the asset management activity of large international banks. Secondly, we discover a negative relationship between banks' credit-to-deposit ratio and the size of SB. Foreign-owned banks disbursed funds raised in their home markets in the form of interbank financing and not through local SB structure. This meant that the higher credit-to-deposit ratio did not develop the CEE capital markets by raising local market funds, which contributed to the underdevelopment of the SB and local capital markets.

The phenomenon of higher domestic bank ownership with wider SB activities also draws attention to the fact that, while the risks associated with the dependent nature of financialization are mitigated, at the same time, new risks might arise with the development of a larger-scale SB system.

We found that the banking and SB systems essentially developed in tandem, supporting the complementary hypothesis (Petkovski et al. 2023). According to the same model, the real GDP per capita, that is, the level of economic development – in keeping with our expectations and the literature – displayed a positive relation to the SB system.

Capital market capitalization, the banking sector's earnings (ROE), and country risk factor did not play a significant role in SB intermediation after the GFC period.

As regards the policy implications of the article, we stress that significant structural differences in the financial system of the CEE11 and the core EU member states, as well as the underdeveloped SB system might also constrain the region's participation in the advantages of Capital Markets Union (CMU). The growth of European SB is encouraged by the Action Plan for Building a CMU (EU Commission 2015, 2020), as almost all the tools of the Action Plan promote the growth of market-based finance and belong to the toolkit of SB (Pires 2019). However, due to their less developed financial system, CEE countries are less able to utilize these opportunities (Piroska and Mérő 2021, Piroska and Epstein 2022). This means that the underdeveloped CEE region also results in missed opportunities.

Endnotes

1   All of the calculations and graphs are made with RStudio 2022.

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Annex 1. Financial structure and macroeconomic data

Variable	Definition	Source
GDP	Gross domestic product	Eurostat
Shadow banking asset to GDP ratio	SB to GDP	numerator: see Bethlendi and Mérő (2022) denominator: Eurostat
Total banking asset to GDP ratio	Banking to GDP	numerator: see Bethlendi and Mérő (2022) denominator: Eurostat
Stock and bond market capitalisation to GDP	Stock and bond market capitalisation to GDP ratio = stock + bond market capitalisation	
	Stock market capitalisation	WB Financial Development and Structure Dataset: https://www.worldbank.org/en/publication/gfdr/data/financial-structure-database Own calculation based on Reuters
	Bond capitalisation	BIS Debt securities statistics: https://www.bis.org/statistics/sec-stats.htm For Czechia 2017: CNB
Share of domestic banks in the total banking assets	Ratio of domestic bank assets to total bank assets	WB Global Financial Development Database: 2004-2007/2010. https://www.worldbank.org/en/publication/gfdr/data/global-financial-development-database ECB: 2007/2010-2018
Bank credit to deposits	Private credit by deposit money banks as a share of demand, time and saving deposits in deposit money banks.	WB Financial Development and Structure Dataset: https://www.worldbank.org/en/publication/gfdr/data/financial-structure-database
Country risk	Calculated from the default spreads based on Moody's ratings	Damodaran: http://pages.stern.nyu.edu/~adamodar/
GDP per capita	GDP per capita (current US$)	WB Global Financial Development Database: https://www.worldbank.org/en/publication/gfdr/data/global-financial-development-database

IMPACT OF IN-WORK BENEFITS ON WORK INCENTIVES IN CROATIA: A MICROSIMULATION ANALYSIS

Slavko Bezeredi

Abstract

Generous social benefit systems reduce work incentives, which has prompted more than half of the EU countries to introduce some sort of make work pay policies. Previous research for Croatia has shown that certain types of households have very low work incentives. Therefore, this paper aims to analyse the impact of in-work benefits on work incentives of non-employed persons and the poverty rate in Croatia. Using the tax-benefit microsimulation model EUROMOD, which is based on the EU-SILC 2020 data, three hypothetical types of in-work benefits are simulated. The results show that the characteristics and the design of in-work benefits are essential, and the choice of the appropriate type of benefit depends on the policy objectives. This paper is the first to analyze the impact of in-work benefits on the work incentives of all non-employed persons in Croatia.

Keywords: *work incentives, in-work benefit, microsimulation, Croatia*

JEL classification: *C15, D31, H31, I30*

1. INTRODUCTION

Although a generous social benefit system may substantially reduce the poverty of the working-age population, this often comes at cost of diminished financial work incentives which consequently leads to a decrease in employment. According to Bargain and Orsini (2006), the primary goal of social policy-making is to provide a level of income that ensures a minimum living standard for non-employed persons, but tax-benefit policies implemented should not reduce work incentives excessively. Therefore, it is vital to analyse the effects of fiscal policies on work incentives of vulnerable groups of non-employed persons, especially the long-term unemployed, couples with children, single parents, etc. The analysis should also consider introducing make work pay policies, such as in-work benefits. In-work benefits may help reduce

the exclusion of vulnerable groups from the labour market and reduce government spending on social protection programs. Their purpose is to increase the income of low-wage workers and encourage the employment of persons with low-earning capacity.

There are several studies on the financial work incentives for non-employed persons in Croatia. The

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studies by Bejaković et al. (2012) and Bezeredi (2019) exposed very low work incentives for some types of hypothetical households such as single parents and one-earner couples with children. Bezeredi (2021) analysed work incentives on the extensive margin of labour supply in Croatia using EUROMOD and microdata. The study found that non-employed persons with a larger number of dependent children, persons with lower market incomes of other household members and those with a lower level of education are more likely to be affected by low work incentives. Finally, Bezeredi et al. (2019) examined the impact of introducing two types of in-work benefits (family- and individual-based benefits) on the labour supply of Croatian couples. The results have shown that individual-based in-work benefit increases the overall labour supply of couples, while family-based benefit reduces it.

Since joining the European Union, Croatia has been among the five countries with the lowest employment rate.[1] Therefore, low employment combined with the fact that there are families in Croatia with low financial work incentives suggests that it would be essential to make an empirical analysis of the potential introduction of in-work benefits in Croatia. The aim of this paper is therefore to analyse the impact of in-work benefits on work incentives at the extensive margin and on the poverty rate in Croatia. Work incentives at the extensive margin are measured by the participation tax rate (PTR), which represents a portion of gross employment income lost by a household owing to changes in taxes and benefits following the transition from non-employment to employment.

PTR and poverty rate are first calculated for the baseline scenario, reflecting actual Croatian tax-benefit systems in 2019. Subsequently, three reform scenarios are introduced, in which we implement three hypothetical types of in-work benefits. The first type is a family-based in-work benefit grounded on the British Working Tax Credit (WTC). Since such types of policies have negative effects on work incentives for the secondary earners in couples, we introduce two additional types of in-work benefits so as to resolve the mentioned problem. Accordingly, the second is the individual-based in-work benefit, whose features are also borrowed from the British WTC. However, the disadvantage of such type of benefit is that they

may be awarded to low-paid individuals in wealthy households. To suppress potential disincentive effects on secondary earners, the third type of in-work benefits are introduced which is family-based in-work benefit with a premium for the secondary earners in couples. This seeks to preserve the main advantages of family-based benefits, which is targeting the poorest families, while mitigating potential negative work incentives for the second earners. Calculations are made using EUROMOD, a tax-benefit microsimulation model for the European Union (EU). Data used are those from the EU-SILC (Statistics on Income and Living Conditions) for 2020, with the income variables referring to 2019.

This paper contributes to the existing literature in the following ways. This is the first paper which analyzes the impact of the potential implementation of in-work benefits on work incentives for all non-employed persons on an extensive margin of labour supply for Croatia. Second, the paper analyzes the introduction of an innovative type of family-based in-work benefit with a premium for the second earners. Such policies have been rarely analyzed in the literature. To the best of our knowledge, the analyzes were made in the case of Italy (De Luca, Rossetti, and Vuri 2014) and Poland (Kurowska, Myck, and Wrohlich 2017). Third, the paper analyzes the impact of different types of in-work benefits on the poverty rate. Fourth, this paper provides an up-to-date analysis of work incentives at the extensive margin in Croatia.

The paper is composed of five sections. Section 2 provides a short overview of the literature. Section 3 describes the research method and data. Section 4 analyses the impacts of the introduced in-work benefits on work incentives and poverty rate. Section 5 concludes.

2. IN-WORK BENEFITS IN THE LITERATURE

The impact of taxes and benefits on labour market participation is usually at the centre of public debates concerning the effectiveness of the social security system. Disposable income depends on various factors, such as wage levels, social insurance contributions, personal income taxes and social benefits. All these

factors influence individuals' choices, both on an extensive (decision to work or not) or intensive (decision on the number of working hours for those currently working) margin of labour supply. In the most typical case of "non-employment to employment transition", the net financial effect is usually lower than the gross wage earned on the labour market. This is because a part of the gross wage is lost due to taxes and social insurance contributions. At the same, unemployment benefits may be terminated, whereas subsistence benefits are partially reduced or entirely lost.

As suggested by theoretical literature and empirical results, the main factor that determines financial work incentives is the tax-benefit system. Redistributive instruments such as taxes and benefits and their potential disincentive effects on labor supply are particularly emphasized in the scientific literature and political circles. The redistribution of financial resources towards the needy, in the form of directing financial resources towards those who do not work, can create negative work incentives for these persons, as well as for their family members. For example, generous social transfers during non-employment reduce the net financial effect of employment (Björklund et al. 1991; Snower 1995). Non-employed persons may lose the motive for employment and fall into the unemployment or inactivity trap. According to Carone et al. (2004), an individual decides whether "work pays or not" depending on many factors, the most important being the features of the personal income tax (personal deductions, tax bracket thresholds and marginal tax rates) and the social benefit systems.

In the optimal tax theory, work incentives at the extensive margin are summarised by PTR and by the marginal effective tax rate at the intensive margin (Saez 2002). Theoretically, a higher PTR rate lowers employment and labour force participation rates. This theory has been verified by empirical studies. For example, Collado (2018) showed that the increase in PTR negatively affects the likelihood of employment of the long-term unemployed in Belgium. Dockery, Ong, and Wood (2011) also reveal the negative correlation between PTR and the likelihood of transition of non-employed persons into employment in Australia. Bartels and Pestel (2016) pointed out that a decrease in PTR significantly increases the likelihood of entering employment in Germany.

When designing a tax-benefit system, the main concern is how to reallocate resources from high- to low-income persons while maintaining strong work incentives (Figari 2015; Immervoll and Pearson 2009). Achieving the goals of equality and fairness may have direct costs in the form of increased funds for social protection programs, but also indirect costs in the form of a reduction in the labor supply. To meet the goals of efficiency and equity by implementing social protection instruments, more than half of OECD countries have introduced make work pay policies to increase work incentives, i.e., to reduce poverty and promote the employment of low-productive persons. In-work benefits are the most prevalent type of these policies and are generally understood as cash transfers awarded to low-income employees (Matsaganis and Figari 2016). The main feature of in-work benefits is that they simultaneously strive to achieve two goals: 1) increase employment; 2) alleviate poverty rates (Leppik 2006; Immervoll and Pearson 2009). Employment is increased because additional financial incentives motivate low-wage persons to accept low-wage jobs and help sustain such persons' employment. Poverty is alleviated because low-wage employees receive income both from their own earnings and social benefits.

In-work benefits are usually income-tested. Depending on the assessment unit, we differentiate between two types of in-work benefits: (a) family-based, where the income test is based on the total income of the family; (b) individual-based – only individual's income enters the income test. In the former case, the benefit amount depends on the family's structure and the incomes of all members. In the latter case, the benefit amount only depends on an individual's characteristics and income. The impact of in-work benefits on work incentives at the extensive margin of labour supply critically relies on the benefit type. Between these two types, the family-based in-work benefit is substantially more poverty-reducing because it targets the lowest-income families more effectively. However, the effect of family-based in-work benefit on work incentives is disputed since this kind of benefit positively impacts incentives in one-earner families but negatively in two-earner families. In contrast, individual-based in-work benefit positively impacts work incentives among individuals across all

types of families. However, its weakness is reflected in its reduced impact on decreasing poverty because it does not effectively target vulnerable individuals. Specifically, the individual-based in-work benefit can be received by low-wage persons ranked in the middle or at the top of the income distribution according to disposable household income.

The first countries to introduce in-work benefits were the United States, with the Earned Income Tax Credit (EITC), and the United Kingdom, with the Working Tax Credit (WTC). Both of these benefits are family-based benefits. It is shown that WTC negatively impacts work incentives in two-earners families, but it encourages employment in one-earner families (Blundell 2000; Blundell and Hoynes 2004; Eissa and Hoynes 2004; Brewer et al. 2006). The absence of negative impact on work incentives is the most likely reason why individual-based benefits have become popular in recent years in continental Europe (Belgium, Finland, Hungary, the Netherlands, Sweden) (Immervoll and Pearson 2009). Given this, individual-based benefits can be an effective alternative to family-based benefits. However, Bargain et al. (2010) argue that even with individual-based benefits there are several open questions regarding the optimal structure of such a policy. That is, individual-based benefits can negatively affect work incentives at the intensive margin of labour supply, while most individual-based benefits combine positive effects at the extensive and adverse effects at the intensive margin of labour supply.

Much interest has been devoted to analysing hypothetical reforms on work incentives. Figari (2010) examined hypothetical family and individual-based in-work benefits in Portugal, Greece, Italy, and Spain. WTC was used as an archetype for the former benefit type, while the latter is simulated as a wage subsidy. The results reveal that individual-based benefits are more effective in improving work incentives than family-based benefits. This was particularly evident for women in France and Italy who live in couples and whose employment rate is far below the EU average. Vandelannoote and Verbist (2020) analysed the impact of different in-work benefits on poverty and work incentives in Belgium, Italy, Poland, and Sweden. They showed that existing and hypothetical in-work benefits generally have a positive impact on the extensive

margin of labour supply, but this impact is more robust for individual-based benefits than for family-based benefits. Their results imply that the effects are quite heterogeneous across countries with more pronounced effects in Belgium and Sweden, while the effects in Poland were negligible. The impact on the poverty rate varies depending on the benefit design; family-based in-work benefits cause a greater reduction in the poverty rate than individual-based in-work benefits.

Using a sample of couples in Italy, De Luca, Rossetti, and Vuri (2014) analysed the introduction of two in-work benefits based on the EITC and WTC. However, in addition to the standard design of these two benefits, a premium for the employment of a second spouse was introduced. The mentioned premium was introduced to overcome the potential negative impacts of the family-based benefits caused by the employment of the second spouse. The study showed that, simulated in-work benefits could significantly improve the redistributive effects and work incentives of working couples in Italy, provided that an appropriate amount of premiums for the second employed spouse is introduced. Additionally, the redesigned EITC is more effective than the WTC in boosting employment, while the redesigned WTC is more effective in reducing poverty. Similar research was conducted by Kurowska, Myck, and Wrohlich (2017), who explored the impact of increasing the generosity of existing in-work benefits and introducing a premium for the second employed spouse in Poland. They showed that the redesign of existing in-work benefits, targeting families with children and low incomes, can effectively increase female employment rates. Furthermore, they confirmed that introducing a premium for the second employed spouse in the family, which would be granted to low-income families, could successfully reduce child poverty resulting from direct financial support and greater parental activity in the labour market.

To the best of our knowledge, the only empirical analysis of in-work benefits in Croatia was done by Bezeredi et al. (2019). They analysed the impact of two types of in-work benefits on the labour supply of couples. The first is the family-based in-work benefit, inspired in design by WTC, and the second is the individual-based benefit, founded on the Slovakian Employee Tax Credit. Their results showed that only

individual-based in-work benefit increased the labour supply of couples, while family-based benefit had an overall negative impact due to the adverse effect on the two-earner couples.

This new paper will extend the above-mentioned analysis. Accordingly, this paper analyzes the impact of three types of in-work benefits on work incentives for all non-employed persons and analyzes the impact of in-work benefits on the poverty rate. The methodology and results are presented in the following sections.

3. METHODS AND DATA

3.1. Participation tax rate

The unit of observation is a person i, who lives in a single- or multi-member household. The incomes of every person i in the states $s = \{0,1\}$ are observed, where 0 and 1 denote pre-transition and post-transition status, respectively. The total gross income of a person i's household in the state s is divided into employment income earned by the person i, denoted by E_i^s, and all the remaining household income, denoted by Z_i^s. Taxes paid and benefits received by person i's household are denoted by T_i^s and B_i^s, respectively. The disposable income of the person i's household in the state s is obtained as $Y_i^s = E_i^s + Z_i^s + B_i^s - T_i^s$.

Suppose that the person i undergoes a transition from state 0 to state 1, which consists of changing the employment status from non-employment to employment. That is to say, the non-employed person i becomes employed. The change of employment income, $\Delta E_i = E_i^1 - E_i^0$, triggers the change in household disposable income, $\Delta Y_i = Y_i^1 - Y_i^0$. The following indicator puts these two changes into relation:

$$PTR_i = \frac{\Delta E_i - \Delta Y_i}{\Delta E_i} = 1 - \frac{Y_i^1 - Y_i^0}{E_i^1 - E_i^0} \qquad (1)$$

$$PTR_i = \frac{\Delta B_i - \Delta T_i}{E_i^1 - E_i^0} = \frac{(T_i^1 - T_i^0) + (B_i^0 - B_i^1)}{E_i^1 - E_i^0} \qquad (2)$$

This is the popular indicator for measuring work incentives on the extensive margin– the participation tax rate (PTR), where it is assumed that $Z_i^e = Z_i^n$. When a non-employed person gets employed, employment income increases $(E_i^1 - E_i^0 > 0)$. Consequentially, taxes typically rise $(T_i^1 - T_i^0 > 0)$, whereas benefits typically decline $(B_i^0 - B_i^1 > 0)$. Accordingly, PTR shows the proportion of increased earnings lost due to increased taxes and decreased social benefits in the transition from non-employment to employment.

3.2. Definition of employed and non-employed persons

To calculate PTR, we select particular subpopulations of persons, employed and non-employed persons. Following Bezeredi et al. (2019) and Bezeredi (2021), "flexible" persons are first defined as females aged 18 to 60 and males aged 18 to 65, who have been in one of the following three statuses for all 12 months during the reference income year: employed, unemployed or inactive. The inactive group excludes some types, traditionally called "inactive", such as pensioners, students, and persons with disabilities. Effectively, inactive persons primarily include "persons fulfilling domestic tasks and care responsibilities". Flexible individuals do not necessarily have to be in the same status throughout the year; instead, they can switch between the mentioned three statuses. However, a person who has spent at least one month in a "non-flexible" status (i.e., pensioner, student, etc.) is considered non-flexible. Women with children up to the age of one are also considered non-flexible.

Having defined flexible persons, we create the new groups of "employed" and "non-employed" from this basin. The latter group embraces flexible persons who have worked less than 260 hours during the year. The former group consists of flexible persons who have worked at least 1,560 hours in the year.[2] PTR is calculated for non-employed persons. Notice that, in the original sample, there may exist households with two or more non-employed persons. In these cases, the necessary number of replicas of such households are created so that the transition of each non-employed person is treated separately.[3]

3.3. Household microdata and EUROMOD

This analysis uses EUROMOD, a microsimulation model of taxes and social benefits for EU countries.[4] The Croatian module of EUROMOD is employed, based on the tax-benefit rules valid on 30 June 2019.[5] EUROMOD is used to assess the impact of direct taxes, social insurance contributions, and social benefits on disposable household income and work incentives and allows comparisons between EU countries. EUROMOD is a static non-behavioural model: "non-behavioural" means that potential "behavioural" reactions of individuals are not considered when calculating taxes and social benefits; "static" means that the sociodemographic characteristics of the observed individuals are unchanged in the observed period (otherwise, the model would be "dynamic"). EUROMOD also assumes that there is no tax evasion and that all persons entitled to benefits take it in full.

EUROMOD input data are based on the EU Statistics on Income and Living Conditions (EU-SILC).[6] The data for the income year 2019 is used, based on the EU-SILC 2020. Input data contain information on the gross incomes of each household member, separately for various income sources (income from employment, self-employment, contractual work, capital, and property). There is also information on various social benefits (e.g., social assistance benefits, unemployment benefits, disability benefits, etc.) and private transfers (e.g., alimony). Furthermore, EUROMOD input contains information on education, economic activity and employment status, and many other demographic and socioeconomic characteristics of persons and households.

EUROMOD simulates the main tax-benefit instruments for each country: social insurance contributions, personal income taxes, unemployment benefits, social assistance benefits, child benefits, etc. In some cases, simulation of a tax or a benefit is not possible, primarily due to the lack of information in the EU-SILC; in these cases, the amount reported by a respondent is used, if available.[7]

For the calculation of PTR, we need employment income and gross incomes obtained from other sources, social insurance contributions, personal income taxes and social benefits. All these components are obtained from EUROMOD. For each selected person and each tax-benefit scenario, the model is run twice: for the state of non-employment and employment.

Since many of the analysed persons did not work during the reference income period, there are, obviously, no inputs for their monthly earnings. Heckman's selection model is used to predict the gross monthly earnings of non-employed persons using the data on the wages of employed persons. The results of the model are available in Appendix.[8]

3.4. Description of in-work benefits

Three types of in-work benefits are implemented into the Croatian tax-benefit systems. All three reforms include introducing modified benefits borrowed from the UK, namely WTC.[9] The essential features of these policies are retained, but various adjustments and simplifications are introduced.

Eligible are persons between 18 and 65 years of age, who have worked at least 20 hours per week. In the first and third reforms, the simulated benefit is family-based (henceforth WTC-Fam-I and WTC-Fam-II), while in the second, an individual-based in-work benefit is introduced (henceforth WTC-Ind). In the case of WTC-Fam-I and WTC-Fam-II, the beneficiary unit is a family consisting of spouses and their children up to 18 years of age if they are in education (or children up to 16 years of age if they are no longer in education). The only difference between these two benefits is that WTC-Fam-II uses an extended withdrawal threshold in the case there is a couple in the household in which both persons are eligible for the in-work benefit.

The benefit amount depends on the income remaining after social insurance contributions are paid. The amount of benefit also varies depending on the type of household (single person, single parent, couple, etc.; applicable for WTC-Fam-I and WTC-Fam-II) and the number of hours per week spent in employment. The parameters needed to calculate the benefit amount are shown in Table 1 and were calibrated so that the total cost of introducing the benefit is equal to EUR 200 million.

Table 1. Parameters of in-work benefits, in EUR

	WTC-Fam-I	WTC-Ind	WTC-Fam-II
Components:			
(a) Basic amount	1,069	1,034	982
(b) Supplement for a single parent	1,090	0	1,007
(c) Supplement for a couple	1,090	0	1,007
(d) Supplement for 40 hours per week of work or more	439	427	406
Income threshold (IT_i^1)	3,480	3,386	3,216
Extended income threshold for secondary earners (IT_i^2)	-	-	6,431
Withdrawal rate (w)	0.41	0.41	0.41

Source: Authors' calculations

Note: The amounts are converted using an exchange rate of HRK 7.5345 = 1 EUR.

The total benefit amount obtained by a person i is obtained as follows:

$$IWB_i = \max\{0, M_i - \max[0, w(D_i - IT_i^r)]\}, \qquad (3)$$

where in the WTC-Fam-I and WTC-Ind, the index r accounts for 1 ($r = 1$), while in WTC-Fam-II scenario it takes two values, $r = \{1,2\}$. Accordingly, in the WTC-Fam-II scenario, $r = 1$ if only one person in the couple is eligible and $r = 2$ if both persons in the couple are eligible for the in-work benefit. In all three scenarios, M_i denotes the maximum amount of benefit, which equals the sum of components (a), (b), (c), and (d) (see Table 1), D_i is income net of social insurance contributions, IT_i^r is the threshold after which the maximum benefit is reduced, and w is the withdrawal rate.

To illustrate the potential amounts of benefits, Figure 1 shows the amounts of three simulated in-work benefits as a function of the gross employment income. The subject of this analysis are (a) a one-earner couple, i.e., a family in which the first spouse is considering full-time employment (40 hours per week), and the second is non-employed; and (b) two-earner couple, i.e., a family in which the second spouse is considering full-time employment, and the first is already employed on a full-time basis, earning a minimum gross wage (which is equal to 42% of the average gross wage (AGW)). In 2019, average monthly gross wage in Croatia was EUR 1,163.

The amounts of all three benefits shown in Figure 1a have the same "shape". We notice a "plateau" on the

Figure 1. Annual amounts of in-work benefits for one-earner and two-earner couples

(a) One earner couple
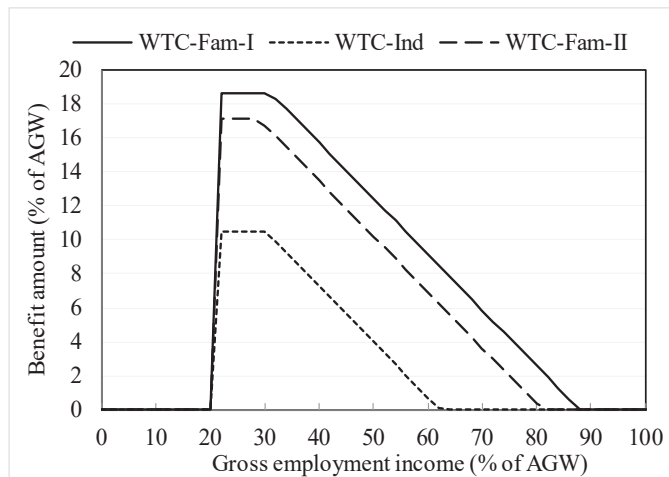
(b) Two earner couple
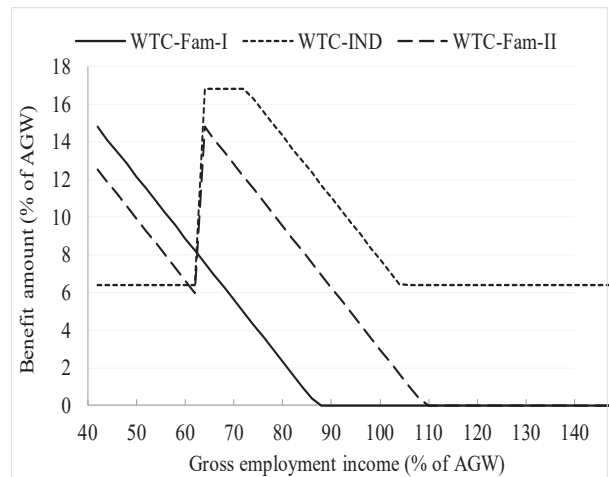
Source: Authors' calculations

left-hand side, which begins at employment incomes of 21% of the AGW[10] and ends at the value related to the income threshold parameter. To the right of income threshold, the benefit amount linearly decreases with each additional euro of employment income, at the rate of 41%. In this case, the first spouse is full-time employed and can earn 42% of the AGW and more. As shown in Figure 1a, both WTC-Fam-I and WTC-Fam-II provide almost the same benefit amounts for this type of family and can be received by persons employed at a gross wage up to 80% and 86% of AGW, respectively. On the other hand, WTC-Ind amounts are about half as much and can be received by persons who earn up to 60% of AGW.

Since it is assumed that the first spouse is already employed at 42% of the AGW, Figure 1b shows gross incomes from 42% AGW and above. When the second spouse becomes employed at a minimum gross wage (household gross employment income amounts 84% of AGW), the WTC-Fam-I amount is only 1% of the AGW. On the other hand, we can see the advantage of the WTC-Fam-II benefit, which is designed for two-earner families where both earners receive relatively

low amounts of gross wage. If the second spouse is also employed at 42% of the AGW, the WTC-Fam-II benefit amounts to 8% of the AGW, and the benefit drops to zero when the second spouse reaches a gross wage of 68% of the AGW (the point at which household gross income is 110% of the AGW). As for WTC-Ind benefit, for lower amounts of gross wages, WTC-Ind has a similar form as WTC-Fam-II. However, when one of the spouses works on low amounts of gross wages, the WTC-Ind benefit will never fall to zero even if the other spouse earns very high amounts of gross wages.

4. RESULTS

4.1. Main data characteristics

Table 2 and Table 3 present the structure of Croatian samples, whereby the sample and subsample sizes are expressed in weighted terms. Table 2 shows that the starting population comprises females aged 18 to 60 and males aged 18 to 65. There are 2.4 million such individuals in Croatia, with 67% of them being flexible.

Table 2. Flexible and inflexible persons in Croatia

	Number of persons (in thousands)	Share in the total number (%)
Persons aged 18 to 60(65)	2,445	100
All flexible persons	1,658	67
Not selected	113	5
Non-employed persons	295	12
Employed persons	1,250	50

Source: Authors' calculations

Table 3. Division of non-employed persons

	Number of persons (in thousands)	Share in the total number (%)
Non-employed persons	295	100
N1. In a couple with a non-employed spouse	28	10
N2. In a couple with an employed spouse	104	35
N3. In a couple with a non-flexible spouse	60	20
N4. Single in a multi-member household	74	25
N5. Single in a one-member household	23	8
N6. Single parent	6	2

Source: Authors' calculations

The share of non-employed persons in the total number is 12%, while the share of employed persons is 50%.

In the group of non-employed persons, the largest share (35%) is occupied by non-employed persons who live in a couple with an employed spouse. They are followed by singles in multi-member households (25%) (Table 3). The smallest subgroups of non-employed persons are non-employed single parents (2%).

4.2. Distribution of participation tax rate

Table 4 presents the distribution of PTR in the baseline, WTC-Fam-I, WTC-Ind and WTC-Fam-II scenario. The baseline scenario shows the situation according to the existing tax-benefit system in 2019. In contrast, the scenarios "WTC-Fam-I", "WTC-Ind" and "WTC-Fam-II" show how the situation changes if in-work benefits, described in section 3.4, are introduced into Croatian tax-benefit systems. For different subgroups of non-employed persons, the average PTR and the shares

Table 4. Distribution of PTR before and after the introduction of in-work benefits (in %)

	Average PTR	PTR 50-70%	PTR >70%
All non-employed			
Baseline	32.0	5.1	3.5
WTC-Fam-I	28.7	6.4	1.9
WTC-Ind	23.2	5.4	0.8
WTC-Fam-II	28.0	4.5	1.8
N1. In a couple with a non-employed spouse			
Baseline	34.2	7.9	8.5
WTC-Fam-I	14.7	8.1	0.3
WTC-Ind	24.8	9.1	3.5
WTC-Fam-II	17.7	8.3	1.6
N2. In a couple with an employed spouse			
Baseline	33.4	6.9	3.7
WTC-Fam-I	39.1	13.3	3.7
WTC-Ind	23.4	7.4	1.1
WTC-Fam-II	35.5	8.0	3.1
N3. In a couple with a non-flexible spouse			
Baseline	31.7	5.3	5.0
WTC-Fam-I	22.4	2.3	2.8
WTC-Ind	16.2	6.4	0.1
WTC-Fam-II	22.0	1.3	2.8
N4. Single in a multi-member household			
Baseline	28.3	1.3	0.2
WTC-Fam-I	25.2	0.5	0.0
WTC-Ind	25.5	0.5	0.0
WTC-Fam-II	26.1	0.7	0.0
N5. Single in a one-member household			
Baseline	34.5	2.0	2.0
WTC-Fam-I	29.2	1.8	0.0
WTC-Ind	29.9	1.8	0.0
WTC-Fam-II	30.3	2.8	0.0
N6. Single parent			
Baseline	35.8	16.3	7.4
WTC-Fam-I	14.0	8.8	0.0
WTC-Ind	26.7	17.4	2.9
WTC-Fam-II	17.8	13.6	0.0

Source: Authors' calculations

of persons with "high PTR" (in the range of 50 to 70%) and "very high PTR" (above 70%) are calculated. The results of the baseline scenario show that the average PTR for all non-employed persons in Croatia is 32.0%; 5.1% have a high PTR, while 3.5% have a very high PTR.

Because in-work benefits affect different groups of non-employed persons differently, it is more instructive to observe the distribution of PTR by these groups than to look at the whole population. Among those in couples, the highest PTR is seen for persons living with a non-employed spouse (N1), which is expected. The average PTR for this subgroup (N1) is 34.2%. Because neither of the spouses is employed, social benefits are more generous than in other cases, and they are steeply reduced when a person starts working. A higher average PTR is also recorded for single parents (N6), equalling 35.8%.

We now turn to reform scenarios and focus on the most problematic groups regarding the WTC-Fam-I: non-employed persons living in a couple with an employed spouse (N2). Expectations from the literature are fulfilled for this subgroup; WTC-Fam-I significantly increases the average PTR, from 33.4% to 39.1%. It also increases the share of persons with PTR higher than 50%, from 10.6% to 17.0%. On the other hand, WTC-Fam-II increases the average PTR more moderately, by 2.1 percentage points for the subgroup N2, and slightly increases the share of persons with PTR higher than 50% by 0,5 percentage point. Finally, the WTC-Ind reduces the average PTR by 10.0 percentage points and also reduces the share of persons with PTR greater than 50% by 2.1 percentage points.

For all other groups of the non-employed, all three types of simulated in-work benefits reduce the average PTR, but with different relative intensities. WTC-Fam-I and WTC-Fam-II are much more effective in reducing PTR for persons living with a non-employed spouse (N1) and single parents (N6), who also have the highest PTR in the baseline scenario. In subgroup N1, WTC-Fam-I and WTC-Fam-II reduce PTR by 19.5 and 16.5 percentage points respectively, while WTC-Ind reduces PTR by 9.4 percentage points. Furthermore, in the subgroup N6, WTC-Fam-I and WTC-Fam-II reduce PTR by 21.8 and 18.0 percentage points, in turn, while WTC-Ind reduces PTR by 9.1 percentage points.

For other types of persons, all three simulated

in-work benefits achieve similar results, except for persons living with a non-flexible spouse (N3), where WTC-Ind in Croatia is significantly more effective than the other two types.

The results of this research for Croatia are in line with previous research conducted for other countries. This paper confirmed the results from the previous research (e.g. Blundell 2000; Blundell and Hoynes 2004; Eissa and Hoynes 2004; Brewer et al. 2006) that 'classic' family-based in-work benefits like WTC-Fam-I increase work incentives of vulnerable groups such as persons living with a non-employed spouse (N1) and single parents (N6). However, WTC-Fam-I have a negative impact on work incentives of non-employed persons living in a couple with an employed spouse (N2). On the other side, WTC-Ind is by definition an individual-based benefit, therefore it increases the work incentives of all subgroups. Its main disadvantage is that it can be awarded to persons living in wealthier households, which is why it has a weaker effect on more vulnerable groups (e.g. subgroups N1 and N6) than the WTC-Fam-I. Family-based in-work benefit with a premium for secondary earners (WTC-Fam-II) retained all the positive characteristics of the WTC-Fam-I and almost eliminated the negative impact of the benefit on the second earner in the family. Therefore, the introduction of this type of in-work benefit could be an effective tool in achieving the goal of increasing work incentives in Croatia.

4.3. Redistributive effects of in-work benefits

This subsection analyzes the impact of introduced in-work benefits on poverty indicators, without taking into account any potential behavioural effects. Poverty lines are calculated based on the baseline scenario and the results are shown in Table 5.

The results show that both family-based in-work benefits (WTC-Fam-I and WTC-Fam-II) have similar effects on poverty reduction, while the individual-based in-work benefit (WTC-Ind) reduces the poverty to a lesser extent. At the poverty line of 60% of the median, the baseline poverty rate is 19.6%, and the introduction of the WTC-Fam-I and WTC-Fam-II benefits reduce the poverty rate by 5.9% and 5.8% and about 14 and 13 thousand households rose above the poverty line,

Table 5. Poverty indicators before and after the introduction of in-work benefits

	Baseline scenario	WTC-Fam-I	WTC-IND	WTC-Fam-II
Poverty line at 60% of median equivalised income				
At risk of poverty rate (in%)	19.6	18.5	19.0	18.5
Changes in the at risk of poverty rate compared to the base scenario (in %)		-5.9	-3.2	-5.8
Number of households below the poverty line (in thousands)	338	324	331	325
Poverty line at 40% of median equivalised income				
At risk of poverty rate (in %)	8.1	7.5	7.8	7.5
Changes in the at risk of poverty rate compared to the base scenario (in %)		-8.2	-3.7	-7.7
Number of households below the poverty line (in thousands)	145	138	141	138

Source: Authors' calculations

respectively. On the other hand, at the poverty line of 60%, the WTC-Ind benefit reduces the poverty rate by 3.2%, which moves around 7 thousand households above the poverty line. As for the results at the poverty line of the 40% median, it turns out that in relative terms the reduction in the poverty rate after the introduction of in-work benefits is even greater when the poverty line is set at 40% of the median than when it is set at 60%.

The conducted analysis shows that although in-work benefits are primarily intended to increase work incentives, they also have a positive impact on reducing the poverty rate. The results also illustrate that family-based in-work benefits better target the poor population, and are at the same time more effective in reducing the poverty rate than individual-based in-work benefit.

5. CONCLUSION

This paper analyses the impact of three hypothetical in-work benefits on work incentives and the poverty rate in Croatia. The first benefit (WTC-Fam-I) is family-based and uses the British WTC as an exemplar and the second benefit (WTC-Ind) is individual-based. Because the standard types of family-based in-work benefits are known to have a negative impact on the work incentives for the secondary earners, a third type of in-work benefit is introduced. This one is the family-based in-work benefit with a premium for secondary earners (WTC-Fam-II), which aims to mitigate

the mentioned negative effect. As an indicator of work incentives for the transition from non-employment to employment, the participation tax rate (PTR) is estimated. EUROMOD (the tax-benefit microsimulation model for EU countries) is used for the PTR and poverty rate estimation. Income data and tax-benefit rules refer to 2019.

Starting with the types of in-work benefits that have been commonly analysed in the literature (WTC-Fam-I and WTC-Ind), the results show that WTC-Fam-I and WTC-Ind have different effects on the size of the PTR for specific subgroups of non-employed persons. WTC-Fam-I is more effective in reducing the PTR of the most vulnerable subgroups of non-employed persons, namely those living with a non-employed spouse and single parents. However, WTC-Fam-I increases the PTR of non-employed persons living in a couple with an employed spouse. This finding confirms a well-known fact about the possible negative impact of family-based in-work benefits. On the other hand, the WTC-Ind benefit reduces the PTR for all subgroups of non-employed persons, but it is not concentrated on the most vulnerable subgroups.

WTC-Fam-II provides almost the same results as WTC-Fam-I for all but one subgroup of non-employed persons. The exception is in the case of non-employed persons living with an employed spouse, where WTC-Fam-I significantly increases the average PTR as well as the share of persons with a PTR greater than 50%, while WTC-Fam-II only slightly increases the average PTR and the share of persons with a PTR greater than 50%. The above showed that the WTC-Fam-II retained

all the positive characteristics of the WTC-Fam-I and almost eliminated the negative impact of the benefit on the second earner in the family.

Despite the fact that the primary aim of in-work benefits is not to reduce poverty in the population, the results illustrate that all three types of benefits reduce the poverty rate in the population. As expected, both family-based in-work benefits have a greater impact on poverty reduction than individual-based one, since they target poorer households by definition. WTC-Fam-I and WTC-Fam-II reduce the poverty rate by 1.1 percentage points (from 19.6% to 18.5%), while WTC-Ind reduces it by 0.6 percentage points.

In the Croatian Recovery and Resilience Plan (RPP) (European Commission 2021), it is pointed out that the employment rate in Croatia is still well below the EU average despite the progress achieved in recent years. Furthermore, under the component of the RPP called the improvement of the social welfare system, it is also stated that one of the main tasks is raising the adequacy and coverage of the Guaranteed Minimum Benefit which is the main poverty-reducing benefit at the national level.[11] In general, poverty reduction and increasing social benefits amounts are very important, especially in the current times of high inflation. However, when reforming the social benefit system, policymakers should definitely pay attention that the increase in the social benefits amounts does not negatively impact work incentives. One of the possibilities could be the introduction of in-work benefits.

One of the more important policy implications arising from this research is that the government should be careful when choosing the type of in-work benefits, especially when choosing between individual-based or family-based benefits. All means-tested social benefits in Croatia are awarded using a means test at the family level. Therefore, Croatian policymakers could be more inclined to the introduction of family-based in-work benefits. It has been shown that such benefits for certain types of households have a negative effect on work incentives. However, with careful design of family-based benefits (such as the

WTC-Fam-II), all the positive characteristics of family-based benefits can be exploited as well as their negative effects on work incentives can be overcome.

To sum up, the results showed that in-work benefits increase work incentives and at the same time reduce the poverty rate. Therefore, in-work benefits could be an ideal upgrade to the reforms included in the RPP, which are related to increasing the employment rate and reducing the poverty rate in the population. This research shows that one of the directions could be the introduction of in-work benefits such as WTC-Fam-II, which has been shown to combine the positive characteristics of the two most commonly used types of benefits such as WTC-Fam-I and WTC-Ind. Of course, choosing the best type of in-work benefits depends on the policy objectives and we hope that this paper will encourage policymakers and researchers to further research this topic. One of the potential topics for future research can be an empirical analysis of the impact of in-work benefits on the labor supply in Croatia.

The limitations of the research are reflected in the limitations of the survey data and the EUROMOD microsimulation model. Limitations in the data consequently reduce the accuracy of the estimates of the microsimulation models that use this data. Some of the limitations of the data are the lack of information on assets and the aggregation of income variables at the annual level, which makes it impossible to precisely define the income censuses used in the simulation of social assistance programs. To anonymize the data in the EU-SILC survey, several types of social benefits are aggregated into one variable, which also reduces the accuracy of the model's estimates. Furthermore, due to the lack of precise data on all types of social benefits and taxes, only the most significant policies from the tax-benefit system in an individual country are incorporated into EUROMOD. Tax evasion is also not modeled in EUROMOD due to a lack of data, and full take up of benefits is assumed. However, despite all the limitations mentioned, this research provides a representative picture of the situation in Croatia.

Endnotes

1   The information was downloaded from the Eurostat database (online data code: LFSI_EMP_A). It refers to the population aged 20 to 64.

2   The standard full-time hours per week in Croatia is 40, which gives 2,080 hours per year.

3   For example, let us take a household that consists of two non-employed spouses without children. We create two replicas of that household. In the first case, we observe the transition of the first spouse from non-employment to employment, with unchanged characteristics of the second spouse. In the second case, we observe the transition of the second spouse from non-employment to employment, with unchanged characteristics of the first spouse.

4   For the detailed description of the EUROMOD, please see the paper Sutherland and Figari (2013).

5   The detailed description of the tax and social benefits system in Croatia can be found in the Euromod Country Report for Croatia (Urban and Bezeredi 2022).

6   EU-SILC is a mandatory survey that allows a comparative analysis of income statistics, poverty indicators, and social exclusion for all EU countries. For more information, see https://ec.europa.eu/eurostat/web/microdata/european-union-statistics-on-income-and-living-conditions.

7   Property taxes, public pensions, and health and disability benefits are examples of tax-benefit instruments typically not simulated in EUROMOD.

8   For examples of similar applications, see Bargain and Orsini (2006), Bargain et al (2010), O'Donoghue (2011), Bezeredi and Urban (2016).

9   For more about the design of the "original" WTC, see Reis and Tasseva (2020).

10 The condition for receiving in-work benefits is that the person works at least 20 hours per week, whereby the person can earn at least half the minimum wage, i.e. 21% of AGW.

11 One of the goals is to reduce the poverty rate below 15%.

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APPENDIX

A.1. The results of Heckman's selection model

We predict the gross wages of non-employed persons in Croatia using Heckman's selection model. We use the logarithm of gross wage per hour as a dependent variable, and the independent variables used in the model are defined in Table A1.

Table A1. Description of variables used in Heckman's selection model

Independent variables	Description of variables
age	Number of respondents years.
$dob^2/100$	The squared amount of the variable "*age*" divided by 100.
education	Number of years spent in education.
work_exp	Number of years spent in employment.
$work\_exp^{\,2}/100$	The squared amount of the variable "*work_exp*" divided by 100.
urban	A binary variable that takes the value 1 if a person lives in an urban area.
health _prbl1	A binary variable that takes the value 1 if a person has a health limitation in activities that people usually perform.
health _prbl2	A binary variable that takes the value 1 if a person has a strongly health limitation in activities that people usually perform.
marital_st	A binary variable that takes a value of 1 if a person has a partner/spouse.
chld00_06	Number of children aged 0 to 6 years.
chld07_14	Number of children aged 7 to 14 years.
income1	Equivalent household income consisting of the income of other household members from: (a) employment and self-employment; (b) capital and property; (c) received private transfers. The total amount was divided by 10,000, and income was equalized using the OECD scale.
income2	Equivalent household income consisting of the income of other household members from: (a) pension; (b) unemployment benefit, sickness, maternity and parental leave benefits. The total amount was divided by 10,000, and income was equalized using the OECD scale.
income3	Equivalent household income consisting of the income of other household members from: (a) child benefits; (b) social benefits. The total amount was divided by 10,000, and income was equalized using the OECD scale.

Source: Authors' work

The results of Heckman's selection model for Croatia are shown in Table A2.

Table A2. Estimation of Heckman's selection model

	Females	Males
	Coeff. (Std. Error)	Coeff. (Std. Error)
Wage equation		
age	-0.016 (0.007)**	0.003 (0.008)
age²	0.001 (0.009)	-0.011 (0.009)
education	0.099 (0.003)***	0.089 (0.004)***
work_exp	0.042 (0.004)***	0.023 (0.005)***
work_exp²/100	-0.048 (0.009)***	-0.026 (0.009)***
urban	0.137 (0.018)***	0.133 (0.018)***
constant	2.211 (0.134)***	2.325 (0.132)***
Selection equation		
age	0,001 (0.022)	-0.013 (0.021)
age	-0.105 (0.027)***	-0.107 (0.025)***
education	0.126 (0.012)***	0.144 (0.016)***
work_exp	0.192 (0.010)***	0.152 (0.012)***
work_exp²/100	-0.253 (0.025)***	-0.096 (0.027)***
urban	0.198 (0.067)***	-0.050 (0.073)
health_prbl1	-0.262 (0.070)***	-0.514 (0.075)***
health_prbl2	-0.795 (0.130)***	-1.154 (0.140)***
marital_st	-0.094 (0.071)	0.125 (0.082)
chld00_06	-0.436 (0.055)***	0.179 (0.073)**
chld07_14	-0.181 (0.042)***	0.082 (0.057)
income1	-0.259 (0.070)***	0.160 (0.097)*
income2	-0.420 (0.201)**	-0.358 (0.278)
income3	-3.983 (1.866)**	-14.221 (2.166)***
constant	-0.513 (0.405)	-0.265 (0.411)
rho	0.662 (0.054)	-0.237 (0.064)***
sigma	0.404 (0.008)	0.427 (0.005)***
lambda	0.267 (0.026)	-0.101 (0.028)***
Number of obs	4,032	4,118
Censored obs	1,213	732
Uncensored obs	2,819	3,386
Log likelihood	-2,701	-3,122

*Significance: *p<0.1, **p<0.05, ***p<0.01*

Source: Authors' calculations

THE ROLE OF CONSUMER KNOWLEDGE IN THE PRIVACY PARADOX OF PERSONALISED ADVERTISING

Miralem Zahirović, Esmeralda Marić, Melika Husić-Mehmedović

Abstract

Current literature on the privacy paradox in personalised advertising lacks insight into how consumers' knowledge of the data types used shapes their responses to these ads. Building on privacy calculus theory, theory of reasoned action, and signalling theory, this research explores how consumers' knowledge of data types in personalised advertising influences their reactions. Multigroup path analysis examines differences in established relationships based on consumers' data knowledge. The moderating effect of this knowledge in the relationship between perceived invasiveness and purchase intentions is also tested. Findings from a sample of millennials indicate that privacy concerns increase perceived invasiveness. However, multigroup and moderation analyses reveal that perceived invasiveness' impact on purchase intentions varies with consumers' data knowledge. Specifically, in the search history group, perceived intrusiveness negatively affects purchase intentions. These results underscore the situation-specific nature of the privacy calculus and assist advertisers in understanding consumer behaviour in response to personalised ads.

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1. INTRODUCTION

Personalised advertising is a growing trend in online advertising (Brinson and Eastin 2016; Tucker 2014). In recent years, online advertising has become highly personalised, with content tailored to the needs of consumers. Personalisation has many benefits, but the preference for personalised experiences comes at a price. Consumers perceive personalised advertising as a valuable time-saving tool, and it is widely accepted

(Lee, Im, and Taylor 2008; Srinivasan, Anderson, and Ponnavolu 2002). The main problem in personalised advertising is that high invasiveness impairs purchase intentions (Phelps, D'Souza, and Novak 2001). Personal information collected without knowledge and consent leads to a negative attitude towards this practice (Xu, Dinev, Smith, and Hart 2011). The growing number of invasive advertisements leads to greater concerns among consumers, resulting in the need for a secure online environment (Tucker 2014).

Many recent research efforts have focused on understanding the effects of risks and benefits associated with personalised advertising on attitudes (Taylor, Lewin, and Strutton 2011) and behavioural intentions (Baek and Morimoto 2012; Lin and Kim 2016). These studies often provide contradictory results that make further research on this topic imperative. Considering that recent research on advertising signals suggests a dual nature of the information cues conveyed (Taj 2016), a more detailed investigation of the universality of relationships in a risk-related side of privacy calculus in personalised advertising as a function of consumers' knowledge of the data types used for personalised advertising is needed. Offering quite conflicting results on the effectiveness of personalised advertising, the literature lacks a comprehensive understanding of the role that situational factors, such as consumer knowledge of the data types used in personalised ads, play in shaping purchasing decisions. This research draws on the privacy calculus theory, the theory of reasoned action and the signalling theory. It aims to analyse the risk-related side of the privacy calculus theory and explore if established relationships in the risk-related side of the privacy calculus theory differ across consumers with different knowledge of the data types used. Specifically, as the analysis proceeds, we explore if consumer knowledge of the data types used in personalised advertising creates differences in their purchase intentions upon perceiving the invasiveness of personalised ads. For the purpose of achieving this aim, this research relies on a similar, multigroup analysis-based procedure to a study by Gironda and Korgaonkar (2018) and complements it with a moderation analysis. By exploring what is previously explained, this research contributes to the theory in two different ways. First, it explores the universality of the risk-related side of the privacy

calculus across consumers with different knowledge of the data types used for personalised advertising using a multigroup analysis approach. Second, it explains how this situational factor changes established relationships. Furthermore, the research has important implications for business management as it explains customer behaviour in an online environment and sheds light on the importance of educating and informing consumers about personalised advertising.

The following text included a thorough literature review on personalised advertising and the privacy calculus theory. We then develop our hypothesis and research question and proceed with the methodology explanations and result presentation. Finally, we provide a detailed discussion of our findings, state the limitations of our research and offer recommendations for future researchers.

2. LITERATURE REVIEW

2.1. Personalised Advertising

In terms of personalised advertising, personalisation means that elements about the target customers are integrated into the text of an ad (Dijkstra and Ballast 2012). The concept of personalisation is narrower than customised (tailored) communication, as the latter is an umbrella term for personalisation, feedback, contextual adaptation, source matching and consumer exposure (Dijkstra 2008). Data segmentation plays a crucial role in creating personalised ads.

Companies use data segmentation to improve the relevance of advertising, reduce the risk of irritation and increase the effectiveness of personalised advertising (Gironda and Korgaonkar 2018). However, various studies have found that consumers have negative attitudes towards personalised advertising and that these attitudes often do not depend on factors such as time, level of education regarding digital tracking practices and the use of advanced advertising technology (e.g. Aguirr et al. 2015; Boerman, Kruikemeier, and Bol 2021; Bol et al. 2018; Frick and Li 2016; Karwatzki, Dytynko, and Veit 2017; Matic et al. 2017; White et al. 2008;). Consumers who are informed about data collection, dissemination, and potential use of personal data make some technological and non-technological efforts to protect themselves from potential risks (Li

and Nill 2020). Nevertheless, consumption of personalised content includes the trade-off between benefits and risks, which is all a matter of concern in the privacy calculus.

2.2. The privacy calculus theory

The privacy calculus model can be explained as the relationship between the expected benefit and the perceived risk in terms of consumer privacy. Knijnenburg et al. (2017) discuss the descriptive and prescriptive aspects of the model. Under the descriptive aspect, the privacy calculus is based on the premise that consumers use a rational cognitive process to evaluate the risks and benefits of disclosing personal information. The concept of privacy is defined differently in the literature (Boerman and Smith 2023). Taking the Internet as an example (Dinev et al. 2013), privacy is presented as a broad and fragmented concept of information privacy. According to one of the generally accepted classifications of privacy (Burgoon 1982), information privacy is characterised as the ability to control the collection and dissemination of information. The fundamental characteristic of the Internet is that users leave permanent traces, which is considered the basic principle of online privacy. Since information and privacy are seen as consumer goods, consumers must decide whether to disclose personal information in exchange for a benefit by weighing the perceived risk and expected benefit. This again points to the premise of the model that the decision to disclose information is a rational process. On the other side, the prescriptive version of the privacy calculus model, on the other hand, favours a contextual approach. This adaptive (contextual) approach refers to the transfer of responsibility for decision-making from consumers to an algorithm that takes into account a number of elements — context, consumer characteristics and the history of consumer decisions of similar profiles.

The following discussion focuses on the descriptive aspect of the privacy calculus theory, explaining two opposite elements of the privacy calculus: the relevance of personalised advertising as the benefit-related side of the privacy calculus theory and privacy concerns as the risk-related side of the privacy calculus theory.

2.3. Relevance of Personalised Advertising and Privacy Concerns

The relevance of personalised advertising means that the content of the advertising corresponds to the interests and needs of the consumers. If the advertised product has a certain value to the consumer, some of this value will also be transferred to the advertisement, resulting in greater relevance (Xu and Zhou 2013). The value of advertising is subjective and depends on information, deception, irritation, and entertainment factors (Ducoffe 1995). Consumers consciously choose to interact with advertising and invest their time. As they expect highly relevant advertising, they agree that companies collect and use their personal information.

However, in addition to the relevance of personalised advertising, privacy concerns play an important role in shaping consumer responses to personalised ads. Loss of control increases privacy concerns (Piao et al. 2016; Tucker 2014), which can block desired business outcomes (Hoffman, Novak, and Peralta 1998; McKnight and Chervany 2002; Urban et al. 2009). Furthermore, empirically validated conclusions suggest that privacy concerns decrease when consumers have more control over their personal information (Lee and Cranage 2011). In the privacy calculus model, the increase in perceived control over privacy can be seen as a benefit as it ultimately reduces privacy concerns and perceived invasiveness. A lot of factors can influence the formation of privacy concerns, and even artificial intelligence seems to be one of them (Kronemann et al. 2023).

2.4. The invasiveness and privacy paradox

The concept of invasiveness is difficult to separate from privacy concerns because this concept would not exist if consumers did not think about the practice of online tracking. Privacy concerns, then, mean that consumers are concerned about the practice of tracking resulting from individual development, environmental influences, and social interactions (Lwin and Williams 2003). Considering that the environment and experiences shape an individual's attitude, the perceived invasiveness of advertising based on

personalisation can be described as a belief in a clear violation of online privacy from the consumer's perspective (Wieczorkowski and Polak 2017).

The privacy paradox is inherent in the privacy calculus model, which is based on the premise that the risk-benefit assessment of personal information disclosure is a rational cognitive process (Knijnenburg et al. 2017). According to the privacy calculus, consumers strive to maximise benefits and minimise risk. Information asymmetry is the most common cause of the privacy paradox (Wilson and Valacich 2012). As a result of information asymmetry, uninformed consumers rely on heuristic methods when making decisions (Dietrich 2010). The more consumers are informed about protection strategies, the higher the risk perception (Gironda and Korgaonkar 2018), but practice has shown that this is not a sufficient reason for implementing avoidance strategies. Most importantly, situational factors can impair established relationships in the privacy calculus, resulting in consumer reactions that are different from what could be expected.

3. HYPOTHESIS DEVELOPMENT

Concerns about the protection of privacy through personalised advertising are often linked to negative consequences for behaviour. According to privacy calculus theory, the risk associated with disclosing personal information has a negative effect on behaviour, and the final decision about behaviour is made through a rational risk-benefit calculation (Culnan and Armstrong 1999). However, most of the previous efforts have been aimed at understanding the effect of privacy concerns on ad reactance. These studies proved the positive effect of privacy concerns on ad avoidance (Beak and Morimoto 2012; Ham 2017) and their negative effect on the intention to share an ad (Lee, Kim, and Ham 2016). In addition, research has shown that higher levels of privacy concerns lead to lower levels of information disclosure (Li, Cho and Goh 2019) and increased privacy measures (Miltgen, Cases, and Russel 2018). The effect of privacy concerns on purchase intention has rarely been studied compared to efforts to measure the impact on advertising-related behavioural consequences. However, it has been reported that purchase intent decreases due to

greater privacy concerns with personalised advertising (Lin and Kim 2016). In addition, researchers have demonstrated that the higher perceived risks associated with disclosing personal information lead to a lower intention to share personal information, which in turn has a positive impact on purchase intentions related to location-based mobile advertising (Kurtz, Wirtz, and Langer 2021). Interestingly, in a study based on the theory of reasoned action (TRA) (Ajzen and Fishbein 1980), according to which beliefs regarding a certain action influence attitudes toward that action and, through attitudes, behavioural intentions and behaviour, the technology acceptance model (TAM) was applied to assess the effects of Facebook ad privacy concerns as behavioural beliefs on behavioural intentions (Lin and Kim 2016). The results showed a significant negative effect of such beliefs on purchase intention. Based on privacy calculus theory, the theory of reasoned action, and the available literature, we propose:

H1: Privacy concerns in the context of personalised advertising negatively affect purchase intentions.

Various studies have shown that privacy concerns related to personal advertising have both cognitive and behavioural effects. Among the most common cognitive consequences of privacy concerns, researchers include intrusiveness or invasiveness (Beak and Morimato 2012; Van Doorn and Hoekstra 2013; Morimoto 2021; Mpinganjira and Maduku 2019). When people feel that an ad is too personal, they react to it (White et al. 2008) and have a strong sense of abuse (Okazaki, Li, and Hirose 2009) because they cannot control their personal information. Some authors see intrusiveness as a facet of invasiveness and define it as the realisation that private information is being used for advertising without their knowledge (Morimoto 2017). Invasiveness in itself is the extent to which consumers feel that advertising invades their privacy and creates a sense of loss of control over the information they consider their own (Miltgen, Cases, and Russel 2019) and is directly related to privacy concerns that exist in the age of online networks and social media (Gironda and Korgaonkar 2018; Sheehan and Hoy 1999). Since there appears to be a strong connection between personalisation and invasiveness (Taylor, Lewin, and Strutton 2011) and evidence that consumers tend to experience a sense of invasion

when their data is used without them being aware of this use, we suggest that consumers exhibiting high privacy concerns should record higher levels of invasiveness when exposed to personalised ads. Therefore, we hypothesise:

H2: Privacy concerns positively affect the perceived invasiveness of personalised advertising.

Previous research suggests that the perception of the practice as something that violates privacy (Paschal et al. 2009) negatively influences behavioural intentions in various contexts (Gironda and Korgaonkar 2018; Thibodeaux and Kudisch 2003). Gironda and Korgaonkar (2018) conducted one of the first studies on the effects of intrusiveness on behavioural intentions in terms of engagement (intention to click) and purchase intention. Their results show a significant relationship in both paths, suggesting the accuracy of the risk-related side of privacy calculus theory in the context of personalised advertising. Following the logic of the privacy calculus theory and the available literature, we propose the following:

H3: Perceived invasiveness of personalised advertising negatively affects purchase intentions.

3.1. The privacy calculus theory, information asymmetry, and information signalling

Privacy calculus is conceptualised as a highly situation-specific trade-off (Kehr, Wentzel, and Mayer 2013; Kehr et al. 2015). The company-consumer relationship is characterised by high information asymmetry (Sun, Wang, and Shen 2021). When it comes to personalised advertising on social media, consumers cannot always assess which information related to their characteristics or online behaviour is used to create personalised ads, which harms information asymmetry (Wang et al. 2020). The asymmetry is reduced when educated consumers know something about the data used. However, we still don't know with certainty if the relationships between perceived risks and behavioural responses are under the influence of the consumers' knowledge. Different types of information and their quantity can be one of the situational factors that may, but not necessarily, lead to differences in previously hypothesised relationships (Gironda and Koragankar 2018). Following recent findings on the signalling theory in organisational communication (Taj 2016), it's important to acknowledge that the information on the data types implies more than fear or risk and could potentially be used to assess relevance and create changes in established relationships in the risk-related side of the privacy calculus. Therefore, we raise the following research question:

RQ1: Do the proposed relationships between privacy concerns, perceived invasiveness, and purchase intentions in personalised advertising differ depending on consumers' knowledge of the data types used for personalised advertising and how?

Figure 1. Conceptual model
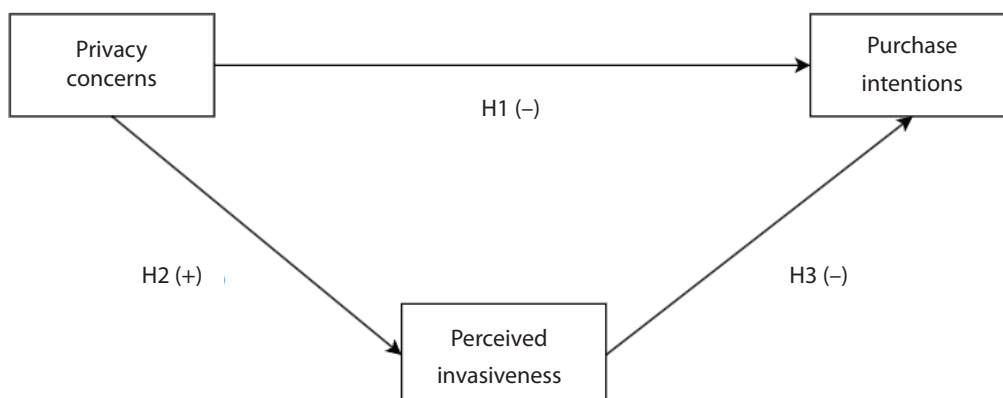
4. METHODOLOGY

The main goal of this research is to determine how situational factors in terms of consumer knowledge of data used for the creation of personalised ads affect their responses to these ads. Specifically, we wanted to test the universality of established relationships in the risk-related side of the privacy calculus across consumers with different knowledge of the data type used for personalised advertising and explore how consumer knowledge creates differences in these relationships.

4.1. Research design

We designed a quasi-experimental research to test our hypothesis and answer our research question. The research instrument is a questionnaire based on scenarios. Respondents were randomly assigned a questionnaire with a scenario guaranteeing data privacy and anonymity. Scenarios were used to examine the possible discrepancy in our hypothesised relationships caused by the respondents' knowledge about the data used for personal advertisements. A control group was part of the first sub-sample, and the scenario generally describes the practice of personalised advertising without mentioning the type of data used for advertising. Besides general information about ads using personalisation, the second scenario encompassed a situation in which personalised advertising was created as a result of search history. Finally, the third group received the scenario in which, in addition to the general description of personal advertising, the use of metadata for such an advertisement was mentioned. In this third scenario, a general classification of metadata was provided; we told research participants that a diverse group of data, such as search history, social media posts, email, etc., was used to create such an advertisement. Using these three scenarios was essential for testing the applicability and universality of our model. Since it was previously mentioned that the impact of the risk-related factors of the privacy calculus theory on purchase intentions could be different depending on situational circumstances, these three scenarios represent three different situations across which we wanted to test our hypothesised paths and check for their universality.

4.2. Sample and Instrument

This research relies on the convenience sampling method. Data was collected at the beginning of 2022, and the sample included 300 millennials. According to the gender structure, the ratio of respondents was approximately the same, with the male respondents representing 51.3% of our sample. The respondents belong predominantly to the millennial generation born between 1980 and 1996. Most of our research participants had a university degree, 192 of them, or 64%. They were followed by respondents with acquired high school diplomas (21.3%) and masters (13.7%). According to the structure of employment, respondents who are employed full-time form the largest group, which makes up 80.3% of our sample.

The questionnaire included four questions on demographics, followed by questions from the scales we used. Privacy concerns were measured using the Internet Privacy Concerns scale (Dinev and Hart 2006). The perception of invasiveness was measured using the Invasiveness Perceptions scale (Tepper and Braun 1995), while purchase intentions were measured through the Behavioral Intention scale (Venkatesh et al. 2003).

5. EMPIRICAL ANALYSIS

Following an established multigroup structural equation modelling procedure, we started our analysis by testing measurement invariance through multigroup confirmatory factor analysis (MGCFA) (Steenkamp and Baumgartner 1998). Three types of invariances are assessed: configural, metric, and factor covariance invariance. Since all indices indicated a very good model fit of our multigroup CFA according to widely applied thresholds (Bentler and Bonett 1980; Hu and Bentler 1999; Steiger 2007; Tabachnick and Fidell 2007), configural invariance was supported. By constraining factor loading to equality, we assessed metric invariance, after which we tested factor covariance invariance. Reflecting on good model fits of newly established models and insignificant change in the chi-square tests, our analysis supported metric invariance and factor covariance invariance. These results indicate that our constructs have the same meaning across the groups and that the relationships

among study constructs can be compared across our experimental groups. However, it is worth mentioning that we removed one item from the original Privacy Concerns scale due to bad model fit, which is a common practice (i.e., Zhao and Othman 2011). A possible explanation for the worse fit with the item included might be the sample size, and in that case, measurement item purification is acceptable (Hair et al. 2006). Our multigroup CFAs remaining within-group standardised loadings were all above 0.6, respectively (Awang 2014). The results of invariance testing and multigroup CFA are in Tables 2 and 3.

The results from multigroup CFA were used to test discriminant and convergent validity for each group. Since average variance extracted (AVE) values were above 0.5, the squared root of AVE for each construct proved to be higher than correlations between latent variables (Fornell and Larcker 1981), composite reliability was above 0.7, and item standardised

loadings were higher than 0.6, we can conclude that convergent and discriminatory validity are supported (Table 2). Each model had a satisfactory model fit: No data group (χ^2=24.148, RMSEA=0.008, SRMR=0.042, GFI=0.950, CFI=1), Search history group (χ^2=44.606, RMSEA=0.093, SRMR=0.056, GFI=0.915, CFI=0.970), and Metadata group (χ^2=45.729, RMSEA=0.088, SRMR=0.047, GFI=0.916, CFI=0.969). The presented results are above-accepted thresholds in the literature of 0.95 for CFI (Hu and Bentler 1999), 0.9 for GFI (Shevlin and Miles 1998), below 0.08 for SRMR (Hu and Bentler 1999), and 0.1 for RMSEA (Fabrigar et al. 1999). For the second and third experimental groups, it's worth mentioning that RMSEA above the cutoff of 0.08, when accompanied with values of other indices indicating good fit can be expected due to lower sample size, and evaluation of such model solely based on RMSEA could lead to rejection of such model, even though it is correctly specified (Kline 2015). In

Table 1. Invariance testing

Model	χ^2	df	$\Delta\chi^2$	Δdf	p-value ($\Delta\chi^2$, Δdf)	RMSEA	NFI	CFI	AIC
Unconstrained	114.883	74	-	-	-	0.043	0.942	0.978	236.483
Measurement weights	132.317	86	17.434	12	0.121	0.043	0.933	0.975	230.317
Structural covariances	144.46	98	29.577	24	0.185	0.040	0.926	0.975	218.460

Table 2. Factor loadings, composite reliability, and correlations

Constructs	Loadings	CR	1	2	3
No data information					
1. Privacy Concerns	(0.845-0.927)	0.951	**0.930**		
2. Perceived Invasiveness	(0.799-0.890)	0.932	0.630	**0.903**	
3. Purchase Intentions	(0.665-0.913)	0.901	-0.221	-0.159	**0.869**
Search history					
1. Privacy Concerns	(0.889-923)	0.962	**0.827**		
2. Perceived Invasiveness	(0.813-0.929)	0.855	0.781	**0.925**	
3. Purchase Intentions	(0.747-0.942)	0.824	-0.173	-0.256	**0.908**
Metadata					
1. Privacy Concerns	(0.903-0.928)	0.970	**0.923**		
2. Perceived Invasiveness	(0.749-0.883)	0.919	0.739	**0.889**	
3. Purchase Intentions	(0.789-0.928)	0.912	0.024	-0.056	**0.945**

Notes: CR=Composite Reliability, squared roots of AVE (Average Variance Extracted) are on the diagonal line, and correlations are below the line

the case of the first experimental group, our model fits almost perfectly, with the Chi-square value being insignificant.

After finalising the MGCFA analysis, we proceeded to path analysis for hypothesis testing. By observing our results, we can conclude that privacy concerns have a strong positive impact on perceived invasiveness in all of our experimental conditions ($\beta_{\text{No data}}$ = 0.648, $p < 0.000$; $\beta_{\text{Search history data}}$= 0.774, $p < 0.000$; β_{Metadata} = 0.749, $p < 0.001$), which confirms

our hypothesis H1. However, Privacy concerns don't significantly affect Purchase intention in any of our groups. Interestingly, unlike in the case of the other two groups, in the case of the Search history data group, perceived invasiveness significantly affects Purchase intention (β = -0.317, $p < 0.05$). None of our control variables (birth year (age) and gender) have a significant impact on endogenous variables in our model (perceived invasiveness and Purchase Intention), considering two-tailed p values.

Table 3. Path analysis

Paths	No data information	Search history	Metadata
H1: Privacy concerns → Perceived Invasiveness	0.648***	0.774***	0.749***
H2: Perceived Invasiveness → Purchase Intention	-0.037	-0.317*	-0.158
H3: Privacy concerns → Purchase Intention	-0.202	0.090	0.111
Controls:			
Birth year (Age) → Perceived Invasiveness	0.109	-0.047	0.012
Birth year (Age) → Purchase Intention	-0.009	-0.131	0.076
Gender → Perceived Invasiveness	0.141	0.107	-0.093
Gender → Purchase Intention	0.04	-0.038	-0.197
R^2	0.422	0.622	0.558

Global model fit: χ^2=135.138, df=108, χ^2/df=1.251, RMSEA=0.029, NFI=0.933, CFI=0.985

Note: *** p one-tailed significant at 0.1% level, * p one-tailed significant at 5% level

Figure 2. Moderation effect of consumers' knowledge of the data used for personal advertising
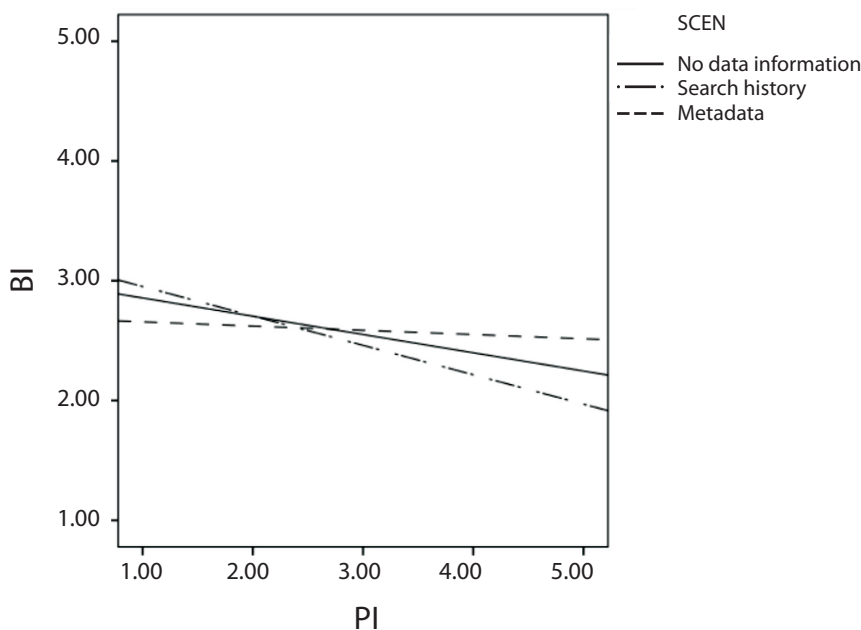
Note: BI (purchase intention), PI (perceived invasiveness)

Since our analysis indicated differences in the relationship between perceived invasiveness and purchase intention between our three experimental groups, we proceeded with moderation analysis in Process, Model 1 (Hayes 2017). In the model specification, experimental groups that represented information on the data used were used as a multicategorical moderator. Our results show that our experimental groups (information on data used for personal advertising) serve as a significant moderator of the relationship between perceived invasiveness and purchase intention, with the effect for Perceived invasiveness*Search history data being -0.246 ($p <$ 0.05, LLCI = -0.457, ULCI = -0.0339), which can be clearly observed from Figure 2.

6. DISCUSSION AND CONLUSIONS

The aim of this research was to examine the generalizability of the relationship between privacy concerns regarding personalised advertising, perceived invasiveness and purchase intentions across consumers with different knowledge of data types used in personalised advertising and explore the moderating effects of the consumer knowledge of data types used in personalised advertising in the relationship between perceived intrusiveness and purchase intentions.

As expected, privacy concerns increase perceived invasiveness. However, the direct effect of privacy concerns on purchase intentions is lacking, which draws some attention to the benefit-related side of the privacy calculus. Previous studies confirm that consumers perform a risk-benefit calculation of all factors when evaluating privacy concerns (Culnan and Armstrong 1999). They are even willing to disclose more personal information if the perceived benefit of personalised advertising is higher (Bol et al. 2018). They are aware that their behaviour is being monitored and that their private information is being used (Montgomery et al. 2019). Although this awareness may increase privacy concerns, this may not be reflected in reduced purchase intentions as consumers are used to personalised advertising and have had positive experiences with it because they are advertised with products and services that meet

their personal needs (Meyer and Schwager 2007). This brings us to the utilitarian side of the privacy calculus theory, which leads us to believe that the benefits of personalised advertising outweigh the disadvantages in decision-making (Taddicken 2014).

Our research shows that the effect of invasiveness on purchase intent depends on whether consumers know what data types are used for personalised advertising. Although the conclusion on the effects of privacy concerns on purchase intentions and perceived invasiveness is the same across groups of consumers with different knowledge of the type of data used in personalised advertising, differences between groups occur in the relationship between perceived invasiveness and purchase intentions, leading us to a conclusion that situational factors in terms of the type of data used for personalised ads indeed plays an important role in shaping consumer responses. An insignificant effect is observed in the relationship between perceived invasiveness and purchase intentions in the group without data information and the group with metadata. However, the significant negative effect of perceived invasiveness on behavioural intentions is present in the case of the group with search history, which contradicts some previous findings suggesting significant relationships when more data is used (e.g., metadata) (Gironda and Korgaonkar 2018). To conduct a more thorough analysis, we tested the moderating effect of knowledge about the type of data used for personalised ads in the relationship between perceived invasiveness and purchase intention using Process Macro. The analysis proved the significance of the abovementioned moderating effect. The explanation for these results could again be based on the utility side of the privacy calculus model and ad relevance (Zhu and Chang 2016). Even when they perceive an ad as invasive, consumers' purchase intentions don't decrease when they rate the benefits of personalised advertising higher than the risks associated with the use of their personal information (Desimpelaere, Hudders, and Van de Sompel 2021). Personalised ads are more relevant; consumers are targeted based on their preferences, which saves them time (Srinivasan, Anderson, and Ponnavolu 2002). Moreover, it is not only the time-saving benefit that consumers experience. Receiving benefits such as customised service (Xu 2006), personalised entertainment (Lee, Im, and

Taylor 2008) and benefits related to their social image and self-perception as well as financial rewards (Lee, Ahn, and Bang 2011) can result in desired behavioural responses and prevent the negative effects of privacy-related risks on purchase intentions. When multiple types of information are used to create ads and consumers recognise this, they may consider the ads more relevant, so the perception of invasiveness does not lead to a significant decrease in purchase intention, which explains the non-significant effect in the case of the metadata group. The situation is similar for the metadata group: If they do not learn anything about the data, they may assume that a diverse information base was used, so the effect is also not significant. However, limiting and focusing cognitive focus solely on search history data can lead to consumers perceiving ads as irrelevant and not tailored to their needs. If consumers feel that not enough information is being used to create ads, their sense of invasion of privacy is sufficient to reduce purchase intention due to perceived lower relevance. This is consistent with previous research highlighting the prevailing effect of utility on behavioural intentions (Taddicken 2014) as well as the lower degree of creepiness and higher degree of relevance of unique personalised advertising among modern consumers (Eisend and Tarrahi 2022). All of this means that our findings represent an important addition to current knowledge about the situation-specific nature of the privacy calculus in the context of personalised advertising and provide a new perspective on information signalling and the privacy calculus through multigroup path analysis and moderation tests.

7. IMPLICATIONS, LIMITATIONS AND RECOMMENDATIONS

Our study has multiple theoretical and practical contributions. First of all, the study contributes theory on the risk-related side of the privacy calculus theory when applied to personalised advertising. The way this study contributed to the risk-related side of the privacy calculus in personalised advertising is by testing the generalizability of established relationships in this side of the privacy calculus across consumers with different knowledge of data types used for

personalised advertising and proving the moderating role of this knowledge in the relationship between perceived invasiveness and purchase intentions. This means that although increased privacy concerns increase perceived invasiveness, increased perceived invasiveness doesn't necessarily mean decreased purchase intentions. This finding is novel and unique in the literature because prior research tackling the role of consumer knowledge offers limited insights into how it changes established relationships. By doing so, our research draws some attention to the role of consumer knowledge of data used in personalised advertising and information signalling that should be even more explored.

From a practical perspective, this research helps online advertisers understand the purchasing behaviour of consumers exposed to personalised ads. Although privacy concerns play crucial roles in the legalisation part of personalised advertising, our research suggests that, from the perspective of the effectiveness of these ads, managers should pay a lot of attention to what consumers know about the data types used. These concrete findings, therefore, have significant implications for how online advertisers communicate and engage in the talk about data used for the creation of personalised ads. Educating consumers on data used for the creation of personalised ads is very important because our research proves that this knowledge is a crucial factor in moderating common relationships in the risk-related side of privacy calculus. Consumers learn about personalised advertising from various sources and having in mind that this knowledge changes relationships leading to their purchase intentions, advertisers should engage more in this process of education. For example, suppose they think consumers could assume that they used search history data to create personalised ads. In that case, they should make sure that they inform consumers about the usage of metadata for ad creations and its relevancy. In general, what consumers know about data types used for personalised advertising changes how they respond to invasive ads, and advertisers should be aware of it.

One of the limitations of our study is the reliance on a sample consisting of millennial consumers. Future research could include a more diverse demographic structure. However, the main limitation of

our study is the fact that we did not test the impact of the perceived usefulness of personalised advertising. The logic behind the privacy-calculus theory, from which we derive most of our explanations, has led us to assume that insignificant effects are observed due to benefits associated with the personalisation of advertising, i.e. relevance. However, it would also be beneficial to test the effects of perceived benefits on purchase intentions. As our study revealed some differences in the scenario comparisons compared to the study by Gironda and Korgankar (2018), we encourage future researchers to analyse the universality of the scenarios in different contexts. Since we draw explanations of our findings of the role of consumer knowledge of the type of data used from the prior research and theories about the information, future research should empirically test the relevance of the data information from our scenarios and examine the impact of this relevance on behavioural intentions. This would be a useful addition to our research as it would explain the mechanisms behind the impact of consumers' knowledge of the data used in the creation of personalised advertising on behavioural intentions. We have not hypothesised this, but it has emerged as a possible explanation for our findings when placed in the context of previous empirical research and relevant theories.

Future research should consider including online privacy protection and regulation issues, either as central themes or as moderating factors, to better understand the dynamics between privacy concerns, perceived invasiveness, and purchase intentions. This approach can provide a more comprehensive analysis of how regulatory environments influence consumer behaviour in digital contexts. In addition, further research on the specific situational factors is needed, as the effects of risks and benefits on behavioural intentions obviously depend on these situational factors. Future researchers could also focus on specific media of personalised advertising because recent research proves that consumer reactions to personalised ads might differ due to the ad source (De Keyzer, van Nort, and Kruikemeier 2022). Based on the above, we conclude that further research is needed to understand the mechanisms in the decision-making process that follows personalised advertising.

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THE NEXUS BETWEEN ECONOMIC POLICY UNCERTAINTY AND STOCK MARKET VOLATILITY IN THE CEE-3 COUNTRIES

Arifenur Güngör, Mahmut Sami Güngör

Abstract

A stock market plays a pivotal role in a financial system and is monitored as a yardstick of a healthy economy. It is a stylized fact that there is a positive and significant relationship between financial development and economic growth. However, emerging markets often exhibit more volatile returns than developed markets, and extreme volatility might prevent financial stability. The literature underlines the role of uncertainty in predicting volatility and suggests a strong positive association between economic policy uncertainty and stock market volatility. Against this backdrop, this study examines the dynamic nature of relationships between economic policy uncertainty (in Germany and the US) and long-run stock market volatility of CEE-3 (Central and Eastern European: the Czech Republic, Hungary, and Poland) countries. This study follows two steps in empirical analysis. First, it obtains long-run stock market volatility and then estimates dynamic regression models. The evidence shows a positive and significant one-period lagged impact of economic policy uncertainty on long-run stock market volatility.

Keywords: *Emerging stock markets, long-run volatility, uncertainty*

JEL Classification: *C22, C58, G10, G15*

1. Introduction

The stock market is an essential component of the financial system and plays a crucial role in directing funds from savers to investors (Harrison and Moore 2012). It is also one of the prominent barometers of the macroeconomy (Bai et al. 2021). Its volatility is often used to gauge financial and economic vulnerability and be a guide for policymakers (Botoc 2017). For this reason, modeling stock market volatility is a widely attractive issue in the literature. It has been of interest to scholars, financial analysts, global investors, and policymakers during the last decades because of its implications for financial risk management, hedging strategy, portfolio diversification, and market regulation.

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The literature emphasizes a positive and significant relationship between stock market development and economic growth (Lazarov, Miteva-Kacarski, and Nikoloski 2016, Setiawan et al. 2021) in the long run (Nyasha and Odhiambo 2017). Lee (2023) also suggests that financial development positively impacts firm-level growth in CEE-3 countries. Figure 1 provides time series graphs of portfolio equity net inflows and GDP per capita growth in CEE-3 countries from 2000 to 2022. A sharp decline in portfolio equity net inflows worsens economic growth in CEE-3 countries. It is a stylized fact because emerging economies are highly contingent on foreign capital inflows (Angelovska 2020).

The market capitalization is also positively related to economic growth (Setiawan et al. 2021). The stock indices for CEE-3 countries are the foremost indicators of the real economy (Lyocsa, Baumöhl, and Vyrost 2011). Lyocsa (2014) provides empirical evidence on the unidirectional Granger causality from stock returns to the real economy in CEE-3 countries. Furthermore, stock market returns are positively linked to international portfolio inflows (Angelovska 2020). Figure 2 gives both time series graphs and box plots of total values of stock traded (% of GDP), and the lower panel is for CEE-3 countries. Although the degree of integration of CEE stock markets with European financial markets has continuously increased (Harkmann 2014, Chirila and Chirila 2022), Figure 2 shows that the market capitalization as a percentage of GDP in CEE-3 countries has regularly decreased since the global financial crisis. Besides, those ratios are highly lower than those of other markets, as shown in Figure 2. These findings mean that CEE-3 stock markets are undervalued compared to historical averages and other stock markets. Middleton, Fifield, and Power (2008) also emphasize the substantial benefits of investing in CEE stock markets.

Figure 1. Portfolio equity and GDP per capita growth
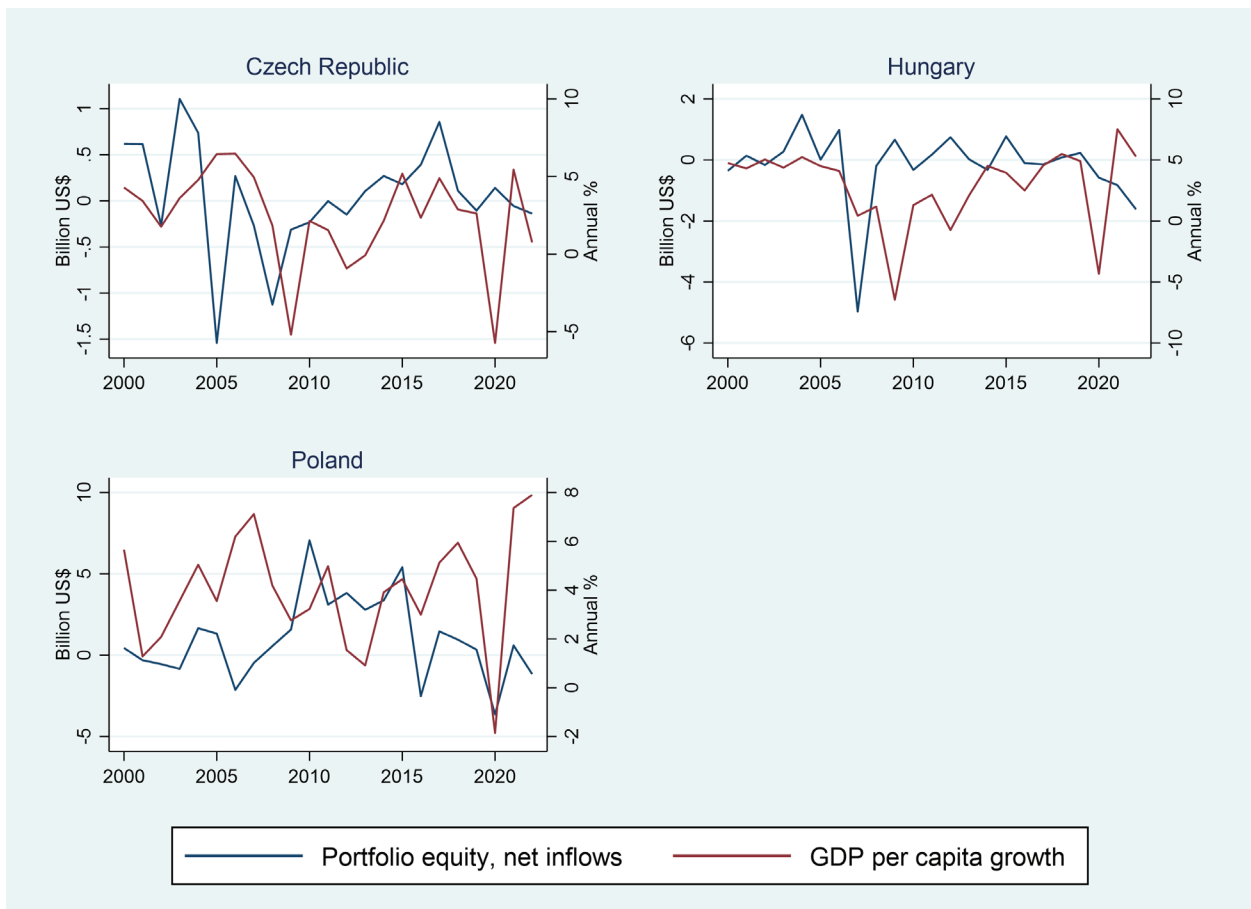
Data source: World Bank

Figure 2. Total values of stocks traded
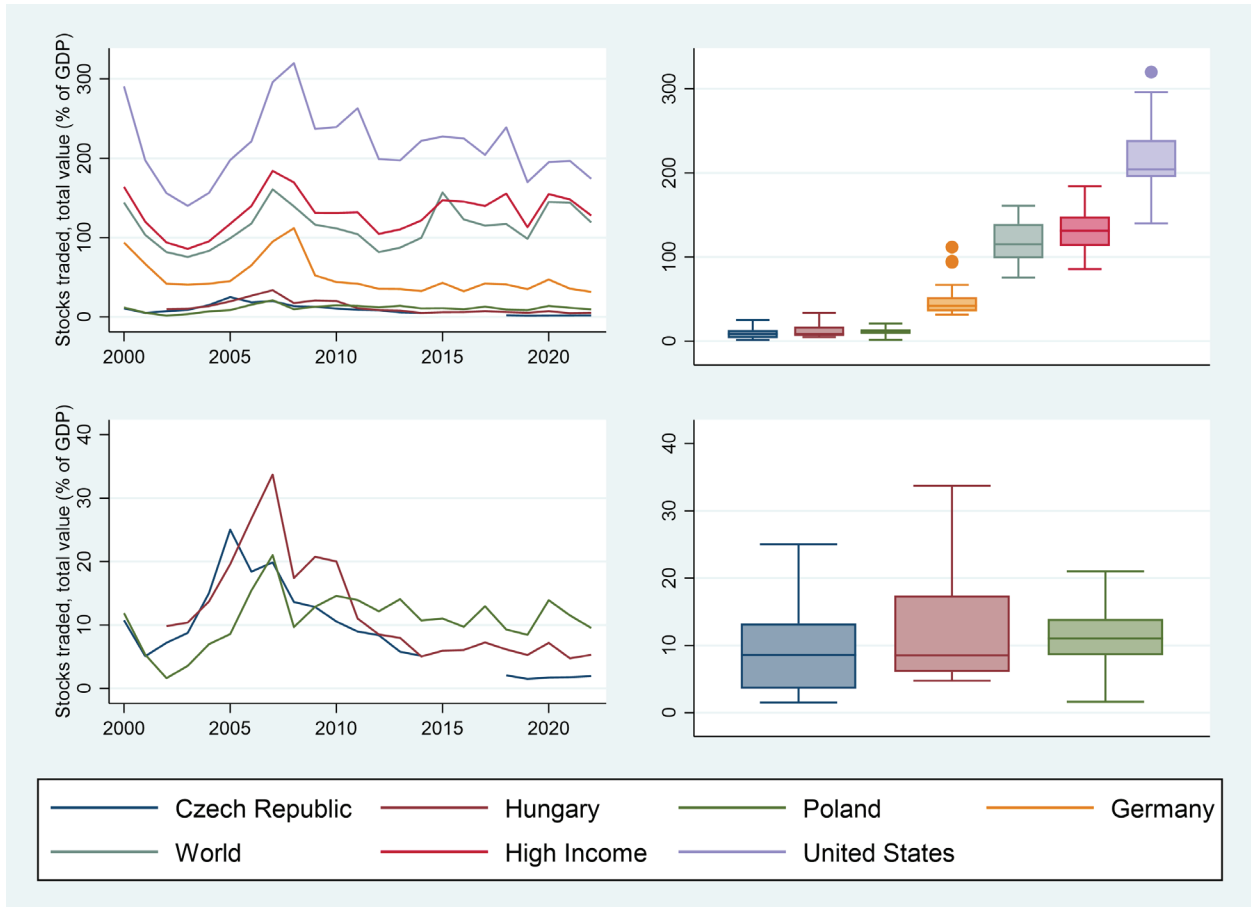
Data source: World Bank

The real economy encounters significant fluctuations, and it affects the returns of assets. The typical theoretical explanations of the fluctuations are based on real shocks; however, the recent literature emphasizes the role of uncertainty in predicting stock market volatility (Liu and Zhang 2015, Bekiros, Gupta, and Kyei 2016, Balcilar et al. 2019, Yu and Huang 2021, Fameliti and Skintzi 2024). Numerous direct and indirect economic and financial factors also effectively drive stock market volatilities (Bai et al. 2021). Stock returns are highly associated with economic fundamentals (Chen and Chiang 2016), and worsening economic conditions lead to higher stock market volatility (Chen et al. 2016). Chiu et al. (2018) suggest a strong link between the long-run component of volatility and macroeconomic fundamentals, while the short-run component is more closely related to investors' sentiment than the real economy.

The literature underlines various forms of uncertainty as a source of stock market fluctuations (Fameliti and Skintzi 2024). The widely used uncertainty measures apart from economic policy uncertainty are financial uncertainty (Su, Fang, and Yin 2019, Jiang, Liu, and Lu 2024), news-based uncertainty (Su, Fang, and Yin 2019, Xu et al. 2021), uncertainty in government policy (Pastor and Veronesi 2012), implied volatility (Shu and Chang 2019, Fameliti and Skintzi 2024), news implied volatility (Fang et al. 2018), infectious disease equity market volatility (Bai et al. 2021, Coronado, Martinez, and Romero-Meza 2022, Fameliti and Skintzi 2024), Twitter-based uncertainty (Kropinski 2024). Many empirical studies show that economic policy uncertainty, proposed by Baker, Bloom, and Davis (2016), is a crucial factor for financial market volatilities (Bai et al. 2021). Baker, Bloom, and Davis (2016) developed new indices of economic policy uncertainty for twelve

major economies, including the United States, and showed a strong positive association between the economic policy uncertainty index and implied stock market volatility. They also argued that the policy uncertainty is related to reduced investment and employment. A rise in economic policy uncertainty leads to deteriorated investment opportunities (Lee, Jeon, and Nam 2021) and decreased stock market returns (Sum 2013, Arouri et al. 2016, Christou et al. 2017, Peng, Huiming, and Wanhai 2018, Xu et al. 2021).

Economic policy uncertainty can potentially affect decisions taken by economic agents such as consumption, saving, and investment decisions, and then it might escalate risk in financial markets (Arouri et al. 2016, Liu et al. 2017, Ziwei, Youwei, and Feng 2020). It is more likely to decrease stock prices in response to a rise in economic policy uncertainty (Ko and Lee 2015, Luo and Zhang 2020). Stock prices probably respond to policy-generated uncertainty because the uncertainty affects macroeconomic fundamentals like consumption, investment, and production. Thus, it is expected that the higher the uncertainty, the more stock market volatility (Chang et al. 2015). There are various channels for propagating the effects of policy uncertainty throughout the economic and financial system. Chiang (2019) characterizes two distinct channels in disseminating the impact of economic policy uncertainty: the first one is through business operations, and the second one is related to market expectations. Pastor and Veronesi (2012) also emphasize the role of a rise in firms' expected profitability (pushes stock price up) and an increase in discount rates (pushes stock price down). They use a general equilibrium model to highlight the link between risk premia and volatility of stock returns when examining the impact of uncertainty in government policy on stock returns.

Emerging markets often display more volatile stock returns than developed markets (Boubaker and Raza 2016). Some studies suggest a negative relationship exists between a stock's return and its volatility (Albu, Lupu, and Calin 2015, Arouri et al. 2016, Yang and Jiang 2016). A certain amount of stock market volatility is reasonable due to the competition among investors, which causes a natural repeating characteristic of stock market prices. Extreme price volatility generally emerges in emerging stock markets due to

their small size and illiquidity (Angelovska 2020). However, excessive stock market volatility is undesirable for investors and policymakers. It is likely to disrupt the functioning of stock markets, preclude establishing financial stability, and prevent firms from increasing risk capital. As investors switch their preferences away from riskier assets in response to very high volatility, this risk aversion will probably force them to dissuade their investment decisions and inevitably affect macroeconomic indicators (Harrison and Moore 2012).

Many empirical studies focus on the effects of economic policy uncertainty on stock market volatility in developed stock markets (Mei et al. 2018, Chiang 2019, Su, Fang, and Yin 2019, Chang 2022, Shin, Naka, and Wang 2024) and in emerging stock markets (Yu, Fang, and Sun 2018, Su, Fang, and Yin 2019, Li et al. 2020, Yu, Huang, and Xiao 2021, Ghani and Ghani 2024, Wang, Yin, and Li 2024, Zeng et al. 2024), and highlight the prediction power of the uncertainty indices (Liu and Zhang 2015, Yu and Huang 2021, Fameliti and Skintzi 2024). Most empirical findings suggest positive relationships between economic policy uncertainty and stock market volatility. The empirical evidence indicates that economic policy uncertainty contributes helpful information for forecasting stock market volatility. Balcilar et al. (2019) also point out the role of policy uncertainties in predicting emerging stock market volatility, providing mixed empirical evidence.

The literature pays relatively little attention to the stock markets of CEE-3 countries, although a considerable amount of literature has been published on the role of economic policy uncertainty on stock market volatility for developed and emerging countries. Recently, Kropinski (2024) examined the impact of Twitter-based uncertainty measures on the stock returns of CEE countries. The empirical studies put forward that there are long-run relationships between macroeconomic fundamentals and stock markets of CEE countries (Barbic and Condic-Jurkic 2011, Ligocka 2023). The CEE stock markets exhibit long memory in returns and conditional variances (Kasman, Kasman, and Torun 2009, Necula and Radu 2012). Botoc (2017) points out that bad news results in more volatility than good news in CEE stock markets. There is a considerable degree of integration of CEE stock markets with the stock markets of Germany and the US (Botoc and Anton 2020).

Macroeconomic variables are crucial determinants of long-run stock market volatility (Conrad and Loch 2015), and those variables are expected to impact long-run volatility rather than short-run volatility (Girardin and Joyeux 2013). Likewise, Wang, Yin, and Li (2024) find a positive and significant relationship between economic policy uncertainty and long-run stock market volatility. Harrison and Moore (2012) suggest that, on average, GARCH-type models are better than other popular models for forecasting the stock market volatility of CEE countries. Engle, Ghysels, and Sohn (2013) propose a model to distinguish long-run and short-run volatility, and it is called a GARCH-MIDAS approach. Furthermore, the GARCH-MIDAS approach provides a superior variance forecast than traditional GARCH models (Asgharian, Hou, and Javed 2013). Accordingly, it has recently become one of the most popular methodologies to investigate the role of uncertainty indices on long-run stock market volatility (Fang et al. 2018, Belcaid and El Ghini 2019, Su, Fang, and Yin 2019, Li et al. 2020, Yu and Huang 2021, Yu, Huang, and Xiao 2021, Ghani and Ghani 2024). Some studies also benefit the MIDAS framework (Wang, Yin, and Li 2024, Zeng et al. 2024).

Against this backdrop, this study examines the dynamic nature of the relationships between economic policy uncertainty and long-run stock market volatility of CEE-3 countries, namely the Czech Republic, Hungary, and Poland. Dajcman (2013) finds high correlations between CEE stock markets and stock markets of the US and Eurozone. Grabowski (2019) also shows that CEE-3 stock markets are the recipients of volatility and have received much volatility from Germany and the US. For this reason, this study uses economic policy uncertainty indices for Germany and the US, developed by Baker, Bloom, and Davis (2016). This study follows two steps in empirical analysis. First, it estimates the GARCH-MIDAS model for each CEE-3 stock market. This model lets us decompose daily stock market volatility into short- and long-run components. Second, this study conducts dynamic regression analysis to investigate the link between economic policy uncertainty (in Germany and the US) and long-run stock market volatility in CEE-3 countries. This study also includes two uncertainty indices as control variables in dynamic regression models. The first is the implied volatility of Eurozone stock

markets, and the second is infectious disease equity market volatility, proposed by Baker et al. (2020). To our knowledge, the literature has not studied dynamic associations between economic policy uncertainty in developed economies and long-run stock market volatility in CEE-3 countries. This study fills this gap in the literature. It provides new empirical evidence on uncertainty and stock market volatility.

The second section introduces the data set and methodology, the third provides empirical results, and the last concludes.

2. Data and methodology

This study conducts the empirical analysis in two stages. First, it decomposes the conditional volatilities of stock market returns into short- and long-run components using the GARCH-MIDAS approach. Then, this study benefits from the ARDL method to investigate dynamic relationships between economic policy uncertainty and long-run stock market volatility. This section introduces the data set used in the first stage of the empirical analysis. It also presents the building blocks of the GARCH-MIDAS and ARDL methods.

2.1. Data Set

This study focuses on the stock markets of (Central and Eastern European) CEE-3 countries: the Czech Republic, Hungary, and Poland. It uses the following daily stock market indices: the PX index for the Czech Republic, the BET index for Hungary, and the WIG index for Poland. The empirical analysis is carried out from April 3rd, 2006 to October 16th, 2020. The daily stock market indices are obtained from the Datastream database.

Equation (1) provides a logarithmic difference formula to compute stock market returns:

$$r_{i,t} = 100 \times \left[ln(p_{i,t}) - ln(p_{i,t-1}) \right] \qquad (1)$$

where r_{it} is a log-return, and p_{it} is a value of the daily index of stock market i at time t.

Figure 3 provides time series plots of stock market returns in CEE-3 countries. As consistent with the

stylized fact about time series of financial assets, it reveals the volatility clustering in those returns across the global financial crisis and the COVID-19 pandemic. The return of the WIX index fluctuates in a narrower band than those of the BET and PX indices during the global financial crisis, while it fluctuates in a broader band than other returns during the pandemic.

Table 1 gives the stock market returns' descriptive statistics and diagnostic tests. There are 2571 observations for each stock market to estimate long-run volatilities. The log-returns have negatively skewed and leptokurtic distributions. The CEE-3 stock markets are attractive for risk-seeking investors due to the leptokurtic distributions of the returns. This study conducts various diagnostic tests for the returns. First, the Jarque-Bera tests reject the null hypothesis of normally distributed returns. Then, the ARCH-LM tests reject the null hypothesis of no existing ARCH effect in all cases. Besides, the Ljung-Box Q squared tests reject the null hypothesis of no serial correlation for the squared log-returns at a 5% significance level, while the Ljung-Box Q tests cannot reject the null

hypothesis of no serial correlation for the log-returns.

Before estimating the volatility model, this study examines time series specifications of the returns. To do this, it conducts the augmented Dickey-Fuller (ADF) unit root tests with an intercept and with a trend and an intercept, respectively (Dickey and Fuller 1981). Besides, the Phillips-Perron (PP) unit root tests have been conducted with an intercept and with a trend and an intercept, respectively (Phillips and Perron 1988). The latter unit root test considers problems regarding serial correlations. Eight lags are used for the Newey-West standard errors (Newey and West 1987) while carrying out the PP unit root tests. The number of lags is computed in line with the Newey-West recommendation: $m = 4(T/100)^{\frac{2}{9}}$ where T is the sample size (Wooldridge 2013). Table A.1 presents the results of unit root tests for the returns. Those tests reject the null hypothesis of a unit root in all cases. Overall, these findings indicate that the stock market returns of CEE-3 countries are stationary for the period analyzed.

Figure 3. Stock market returns
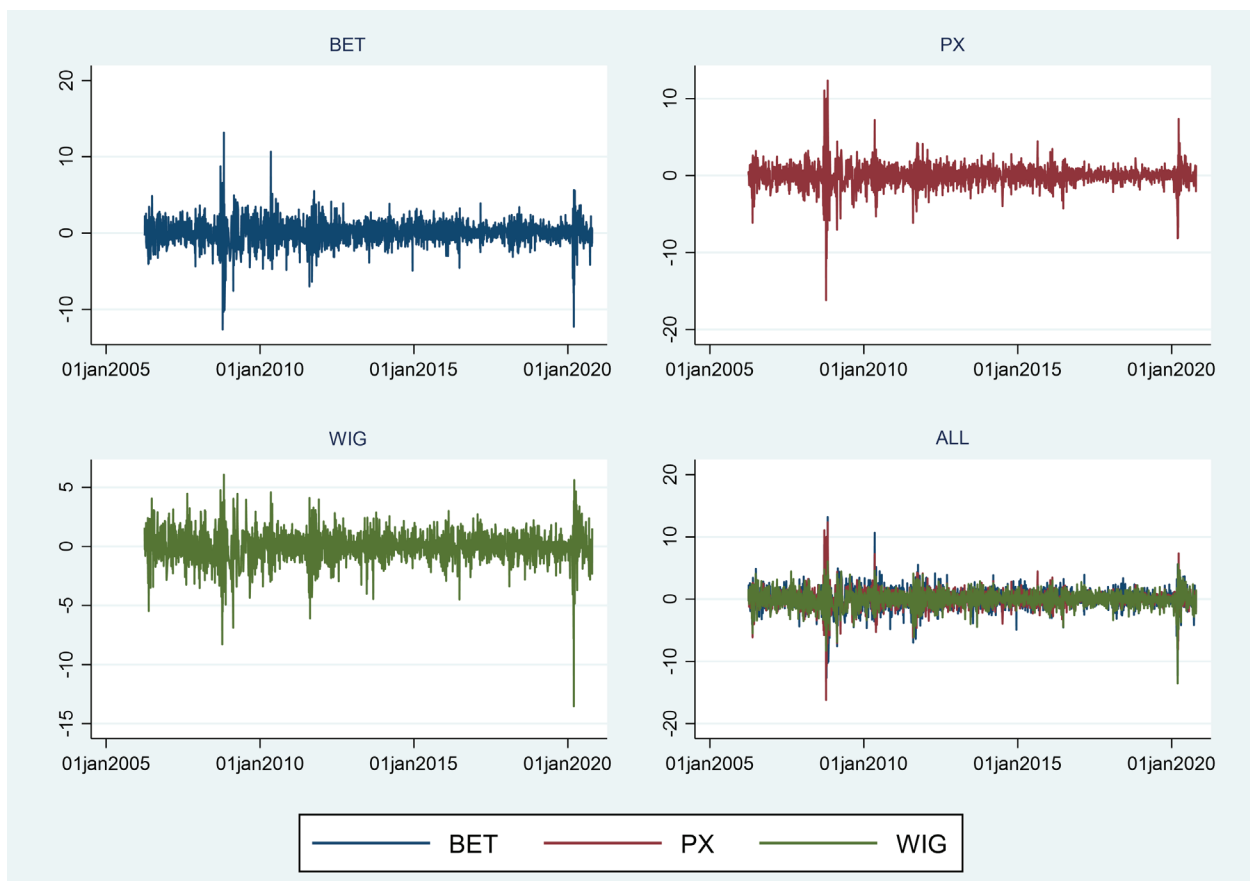
Table 1. Descriptive statistics and diagnostic tests

	BET	PX	WIG
Mean	0.0283	-0.0103	0.0044
Median	0.0643	0.0257	0.0274
Maximum	13.177	12.364	6.0837
Minimum	-12.648	-16.185	-13.526
Std. Dev.	1.5006	1.3392	1.2204
Skewness	-0.5192	-0.5838	-0.9906
Kurtosis	13.738	24.072	12.753
Jarque-Bera	12468.71 [0.000]	47715.88 [0.000]	10612.35 [0.000]
ARCH 1-2	169.50 [0.000]	362.83 [0.000]	74.341 [0.000]
ARCH 1-5	163.82 [0.000]	202.14 [0.000]	103.43 [0.000]
ARCH 1-10	88.497 [0.000]	173.81 [0.000]	54.751 [0.000]
Q(20)	16.976 [0.524]	17.113 [0.515]	11.231 [0.884]
$Q^2(20)$	30.601 [0.031]	43.633 [0.000]	58.426 [0.000]
Observations	2571	2571	2571

Note: The significance levels of tests are given in square brackets. ARCH 1-2, ARCH 1-5, and ARCH 1-10 test the null hypothesis of no existing ARCH effect up to order two, five, and ten in the residuals, respectively. Q(20) and $Q^2(20)$ are the Ljung-Box serial correlation test statistics for returns with 20 lags and squared returns with 20 lags, respectively.

2.2. The GARCH-MIDAS Approach

In the first part of the empirical analysis, this study uses a generalized autoregressive conditional heteroscedasticity (GARCH)-mixed data sampling (MIDAS) model proposed by Engle, Ghysels, and Sohn (2013) to estimate the long-run volatility of CEE-3 stock markets. This approach provides a better variance forecast than standard GARCH models (Asgharian, Hou, and Javed 2013). As mentioned earlier, the literature has extensively used the MIDAS framework due to its superiority in predicting stock market volatility. The GARCH-MIDAS model enables us to decompose stock market volatility into two components: the first is related to short-run (daily) fluctuations, and the second is long-run (monthly) fluctuations, called a secular component.

Equation (2) shows the process of a univariate GARCH-MIDAS model:

$$r_{i,t} - E_{i-1,t}(r_{i,t}) = \sqrt{\tau_t \cdot g_{i,t}}\, \xi_{i,t} \quad \forall i = 1, \dots, N_t \tag{2}$$

where $\xi_{i,t} | \Phi_{i-1,t} \sim N(0,1)$, and $\Phi_{i-1,t}$ is information set up to the day $(i-1)$ of period t. $r_{i,t}$ is a log-return for ith day of any arbitrary period t (month, quarter, biannual). This study uses t as a month. In this case, $r_{i,t}$ denotes a log return for ith day of month t, and N_t

represents the number of trading days in a given month. Thus, the model estimates at least two components of stock market volatility. First, $g_{i,t}$ is a short-term component and accounts for daily fluctuations in stock market returns. Second, τ_t indicates a slowly moving secular component and explains monthly fluctuations in returns. $E_{i-1,t}(\bullet)$ is a conditional expectation given information set up to $(i-1)$th day of period t. It is supposed $E_{i-1,t}(r_{i,t}) = \mu$. Then, one can rewrite Equation (2) as in Equation (3):

$$r_{i,t} = \mu + \sqrt{\tau_t \cdot g_{i,t}}\, \xi_{i,t} \tag{3}$$

Equation (4) provides a short-run component of stock market volatility ($g_{i,t}$), and the short-run component is assumed to follow a GARCH (1,1) process:

$$g_{i,t} = (1 - \alpha - \beta) + \alpha \frac{(r_{i-1,t} - \mu)^2}{\tau_t} + \beta g_{i-1,t} \tag{4}$$

with the restrictions that $\alpha > 0, \beta \geq 0$, and $\alpha + \beta < 1$.

A long-run component of stock market volatility (τ_t) is also modeled by using a MIDAS regression. It rules out a restriction that the secular component (τ_t) is fixed over period t, and then allows τ_t to vary by daily frequency throughout the period t.

Equation (5) gives the secular component of the volatility:

$$\tau_i^{(rw)} = m^{(rw)} + \theta^{(rw)} \sum_{k=1}^{K} \phi_k(\omega_1, \omega_2) RV_{i-k}^{(rw)} \quad (5)$$

where $m^{(rw)}$ and $\theta^{(rw)}$ denotes an intercept and a slope for the rolling window MIDAS filter, respectively. Those parameters have to satisfy the following stationarity conditions: $0 < m^{(rw)}$, and $0 < \theta^{(rw)} < 1$ (Yang, Cai, and Hamori 2018). $RV_i^{(rw)}$ is the rolling-window realized volatility, and it equals to $\sum_{c=1}^{N'} r_{i-c}^2$. $\phi_k(\omega_1, \omega_2)$ represents the MIDAS weighing scheme.

Equation (6) and Equation (7) provide the beta lag polynomial and exponential weighting, respectively. Those equations describe the MIDAS weighting scheme:

$$\phi_k(\omega) = \frac{(k/K)^{\omega_1-1}(1-k/K)^{\omega_2-1}}{\sum_{j=1}^{K}(j/K)^{\omega_1-1}(1-j/K)^{\omega_2-1}} \quad (6)$$

$$\phi_k(\omega) = \frac{\omega^k}{\sum_{j=1}^{K} \omega^j} \quad (7)$$

The beta lag polynomial is quite flexible in including various lag structures. It can represent either a monotonically increasing/decreasing or a hump-shaped (unimodal) weighting scheme. Ghysels, Sinko, and Valkanov (2007) provide further details regarding various patterns obtained with the beta lags. Equations from (2) to (7) construct a GARCH-MIDAS model for time-varying conditional variance with the rolling-window realized volatility. The parameter space of the model is as follows: $\Theta = \{\mu, \alpha, \beta, m^{(rw)}, \theta^{(rw)}, \omega_1, \omega_2\}$. It is fixed both for different time spans t (month, quarter, or semester) and for different numbers of lags (K) in the MIDAS weighing scheme (Engle, Ghysels, and Sohn 2013). The GARCH-MIDAS approach uses the quasi-maximum likelihood method to estimate those parameters, and this estimation method provides consistent and asymptotically normal estimations (Wang and Ghysels 2015).

2.3. The ARDL Model

Most of the time, the effects of economic policies do not take place instantaneously; however, those effects are generally distributed over time. Thus, it is crucial to model the dynamic nature of economic relationships with an appropriate approach. One can model dynamic relationships in three different ways: (i) distributed lag model, (ii) autoregressive distributed lag model, and (iii) modeling serially correlated errors (Hill, Griffiths, and Lim 2011). Financial time series will likely correlate with their past values over time. It is also very likely that periods of high (low) volatility of stock market returns will tend to follow periods of high (low) volatility. Accordingly, Yang and Jiang (2016) show that the fluctuations of stock returns are much affected by their previous values. In addition, there is strong evidence of the presence of long memory in conditional variance in CEE stock markets (Kasman, Kasman, and Torun 2009). Thus, this study utilizes an autoregressive distributed lag (ARDL) approach to explore dynamic relations among uncertainty measures and long-run stock market volatility. The distinctive feature of the ARDL method is that it employs lagged values of the regressand as explanatory variables in a regression model. Like distributed lag models, an ARDL model also contains lagged values of regressors. It captures the dynamic effects of lagged variables and can eliminate autocorrelation problems in errors (Hill, Griffiths, and Lim 2011).

Equation (8) provides a general specification of an $ARDL$ (p, q) model used in the empirical analysis:

$$log\eta_t = \alpha + \Sigma_{i=1}^{p} \varphi_i log\eta_{t-i}$$
$$+ \Sigma_{k=1}^{m} \Sigma_{j=0}^{q} \delta_{kj} X_{kt-j} + \gamma t + \epsilon_t \quad (8)$$

where $log\eta_t$ is the natural logarithm of long-run volatilities, α is a constant term, p is the maximum number of lags of the regressand, m is the number of regressors included in the model, q is the maximum number of lags of regressors, and ϵ_t is the error term. φ_i, δ_{kj}, and γ are the coefficients associated with autoregressive terms, lags of the m regressors, and a linear trend, respectively. This study includes a trend term into a regression model to consider time-specific effects on long-run stock market volatility.

3. Empirical results

Many economic and financial factors effectively drive stock market volatilities through direct and indirect channels (Bai et al. 2021). The literature emphasizes the role of macroeconomic variables on stock market volatility, especially on long-run components (Barbic and Condic-Jurkic 2011, Asgharian, Hou, and Javed 2013, Engle, Ghysels, and Sohn 2013, Girardin and Joyeux 2013, Conrad and Loch 2015, Chiu et al. 2018, Tastan and Gungor 2019). Likewise, Ligocka (2023) finds that macroeconomic variables influence CEE stock markets in the long run rather than the short run. The short-run stock market volatility is more closely related to investors' sentiment than the real economy (Chiu et al. 2018). The literature also highlights uncertainty measures in driving stock market volatilities. (Liu et al. 2017, Li et al. 2020, Zeng et al. 2024, Kropinski 2024).

The uncertainty measures, financial, economic, or policy-generated, can inevitably affect the behaviors of investors, macro-financial fundamentals, and stock markets. Ghani and Ghani (2024) suggest that economic policy uncertainty in the US is a powerful predictor of emerging stock market volatility. Accordingly, it is essential to examine the effectiveness of the uncertainty mechanism (Skrinjaric and Orlovic 2020). The empirical evidence points out a significant link between uncertainty and stock market volatility; thus, this relation should not be overlooked. However, the literature pays relatively little attention to the role of uncertainty on volatility in CEE-3 stock markets, although a considerable amount of literature has been published for developed and emerging countries.

This study carries out empirical analysis in two stages. First, it estimates the GARCH-MIDAS model for each stock market to decompose the conditional volatilities of CEE-3 stock market returns into short- and long-run components. Then, it benefits from an ARDL approach to examine the dynamic relationships between economic policy uncertainty and long-run stock market volatility.

This section provides the estimation results of the long-run volatility of CEE-3 stock market returns and introduces the data set used in the second stage of the empirical analysis. Finally, it gives the parameter estimates of ARDL models for each stock market.

3.1. The long-run stock market volatility

This study estimates the GARCH-MIDAS models for log-returns of CEE-3 stock markets from April 3rd, 2006 to October 16th, 2020 to obtain the long-run stock market volatility. It prefers to estimate those models with rolling-window realized volatility, as in Girardin and Joyeux (2013) and Tastan and Gungor (2019), rather than with fixed-window realized volatility, as in Engle, Ghysels, and Sohn (2013), because the rolling window approach efficiently overcomes the problem of structural changes (Feng, Zhang, and Wang 2024).

The number of lags of the MIDAS weights is determined by the model based on the Bayesian information criterion. Thirty-two MIDAS lags are used to estimate the GARCH-MIDAS models. Those models consider twenty-two daily observations ($N = 22$) for the number of trading days for each month. As a result, the models utilize 704 initial observations, (22 x 32 = 704), and thus exploit roughly three years of daily observations to estimate the MIDAS weighting scheme. That is why the monthly data set begins from 2009 instead of 2006.

Table 2 provides the parameter estimates of the GARCH-MIDAS models for each stock market. Almost all parameters are statistically significant at a 1% level, while the others are also statistically significant at

Table 2. GARCH-MIDAS parameter estimates

	BET	PX	WIG
μ	0.000547*** (0.0002)	0.000254* (0.0001)	0.000301* (0.0001)
α	0.10452*** (0.0093)	0.13646*** (0.0110)	0.07788*** (0.0074)
β	0.83737*** (0.0166)	0.78881*** (0.0195)	0.85982*** (0.0217)
m	0.00767*** (0.0007)	0.00592*** (0.0005)	0.00744*** (0.0005)
θ	0.15870*** (0.0109)	0.15976*** (0.0112)	0.14347*** (0.0121)
ω	4.2082*** (1.1175)	8.6790*** (2.2712)	12.280** (5.2118)
LLF	8749.08	9383.16	9318.15
BIC	-17449.2	-18717.1	-18587.1

Note: The numbers in the parentheses are standard errors. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively. LLF indicates the optimal log-likelihood function value. BIC is the Bayesian information criterion.

conventional levels. Optimal weights monotonically decrease over the lags (Girardin and Joyeux 2013). Table 2 presents only the estimation of ω_2 because the optimal ω_1 is equal to one. Thus, ω in Table 2 corresponds to ω_2 in Equation (5). The estimated GARCH-MIDAS models satisfy the stationarity conditions, $\alpha + \beta < 1$, $0 < \theta < 1$, and $m > 0$. Besides, the weighting function is rapidly declining because the weighting parameter ω is higher than one for each model.

Figure 4 gives time series plots of the conditional volatilities of CEE-3 stock markets and their secular components derived from the GARCH-MIDAS models. The dashed (blue) line denotes the total volatility, and the thick (red) line represents slowly moving secular

components. The short-run volatility of CEE-3 stock markets mostly exhibit similar patterns to each other, while the short-run volatility of the WIG index fluctuates within the narrower band during the tranquil period. Those volatilities spiked to their highest levels in response to the COVID-19 pandemic. The lower right panel of Figure 4 provides jointly the long-run volatility of CEE-3 stock markets. Those volatilities plummeted after the European sovereign debt crisis and increased dramatically at the onset of the pandemic. The long-run volatility of the BET index is higher than those of other indices except at the time of the pandemic, while the volatility of the WIG index is above those of others during the pandemic.

Figure 4. Volatility decomposition
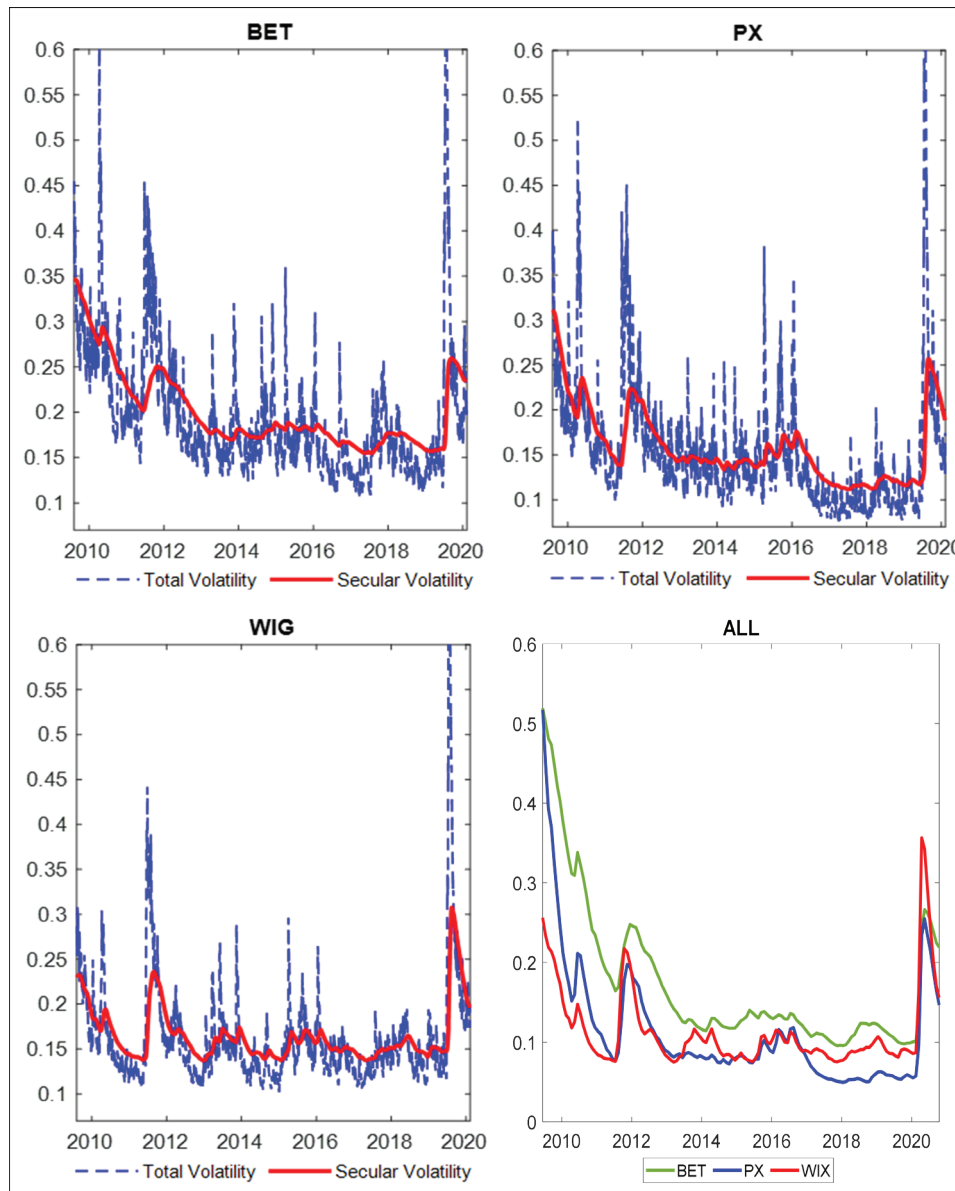
3.2. The stock market volatility and economic policy uncertainty

This study focuses on dynamic relationships between economic policy uncertainty and long-run stock market volatility in CEE-3 countries. It is essential to determine which countries' economic policies can potentially affect the stock markets of CEE-3 countries. For this purpose, this study benefits from the trade shares of the countries in the total trade of CEE-3 countries because those shares can be used to specify how important a particular country is for the CEE-3 economies in terms of international linkages.

Figure 5 provides time series plots of the trade shares of selected regions and countries in the total trade of CEE-3 countries. The trade share denotes the percentage of the total trade (exports plus imports) of one country or region with another country or region in the total trade of the latter country or region with the world. Those shares are calculated using a monthly data set for exports and imports obtained from the International Monetary Fund Direction of Trade Statistics (DOTS) from January 2014 to December 2022 (the data for May and June 2020 is missing).

The upper right panel of Figure 5 puts forward that the trade shares of the Euro area countries are, on average, about 60 percent of the total trade of CEE-3 countries. Among those countries, Germany has the lion's share of the total trade of CEE-3 countries, and its share is, on average, nearly 30 percent of the total trade of CEE-3 countries. It is shown that the CEE-3 countries are economically embedded in European countries, especially in Germany. Besides, Arendas, Chovancova, and Pavelka (2020) suggest that the German stock market is Granger-causing the development of CEE-3 stock markets. The volatility spillover from the developed European stock markets like Germany to CEE stock markets is significant. (Chirila and Chirila 2022).

On the other hand, the US is the major contributor and the critical transmitter of risk spillover (Bai et

Figure 5. Trade shares

Data source: The International Monetary Fund Direction of Trade Statistics

al. 2019) due to its dominant position in the global financial system (Shi and Wang 2023). Furthermore, there exists substantial evidence of co-movement between the US and CEE stock markets (Boubaker and Raza 2016), although the trade share of the United States (US) is, on average, below three percent of the total trade of CEE-3 countries, as shown in the lower right panel of Figure 5. The influence of Germany on the CEE stock market is more potent than that of the US due to its strong trade linkages (Botoc and Anton 2020) and its leading role in European countries. As a result, this study opts to use economic policy uncertainty in Germany and the US to examine dynamic relations between economic policy uncertainty and long-run stock market volatility in CEE-3 countries.

The literature highlights various forms of uncertainty as a source of stock market fluctuations (Fameliti and Skintzi 2024). Many empirical studies show that economic policy uncertainty, proposed by Baker, Bloom, and Davis (2016), is a crucial factor for financial market volatilities (Bai et al. 2021). For this reason, this study

uses economic policy uncertainty indices developed by Baker, Bloom, and Davis (2016) to measure economic policy uncertainty in Germany and the US.

Bai et al. (2021) examine the impact of infectious disease equity market volatility on long-run stock market volatilities due to the unprecedented equity market response to the COVID-19 pandemic (Baker et al. 2020). Likewise, the infectious disease volatility index Granger-causes the stock market volatility of Latin American countries (Coronado, Martinez, and Romero-Meza 2022). The literature also uses implied volatility as an uncertainty measure (Shu and Chang 2019, Fameliti and Skintzi 2024). The VSTOXX volatility index significantly affects the returns of international stock markets (Shu and Chang 2019). It is based on the Euro Stoxx 50 index, which includes 50 blue-chip companies operating in 11 countries over the Eurozone.

As a result, this study uses two control variables in dynamic regression analysis along with economic policy uncertainty in Germany and the US. The first one is infectious disease equity market volatility

Figure 6. Time series plots of the indices
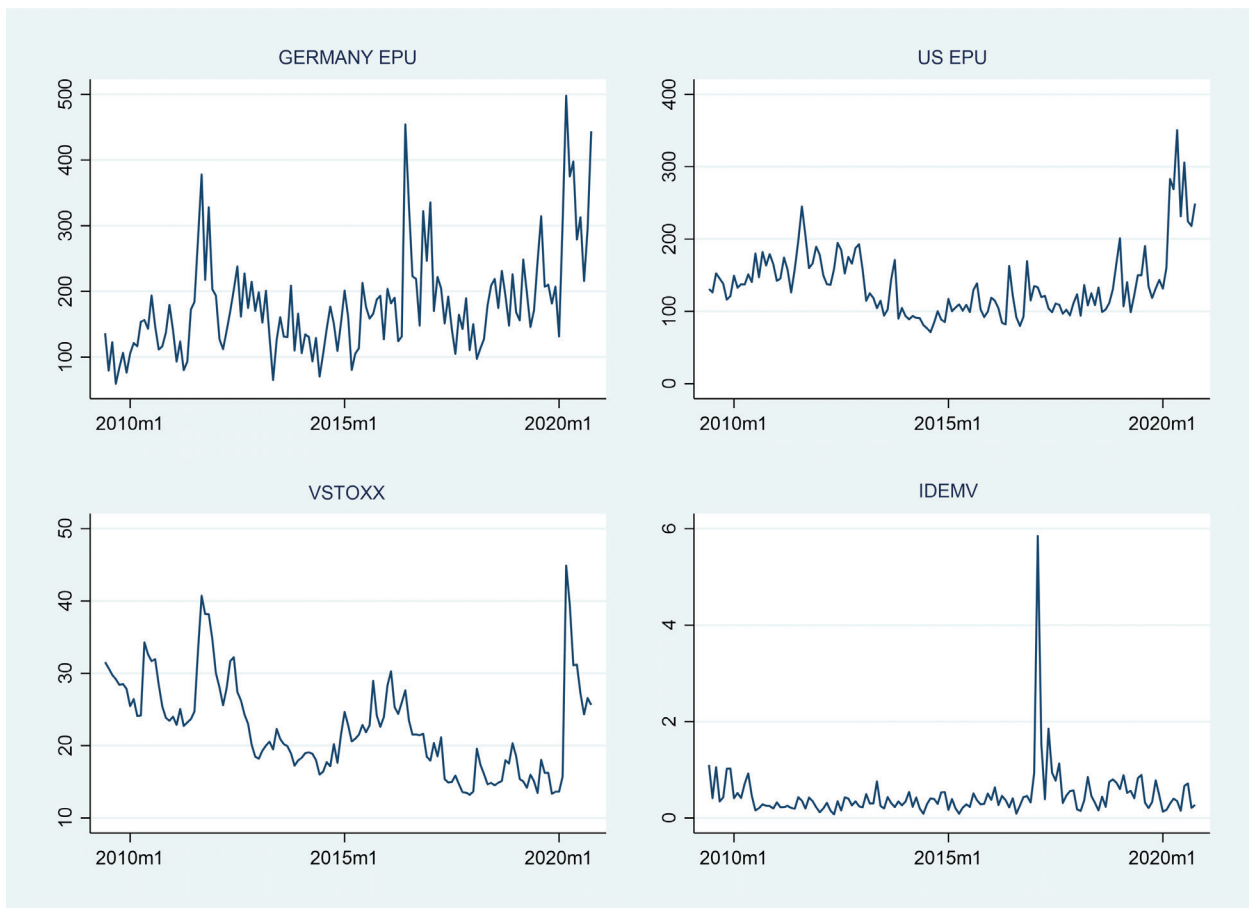
(IDEMV) based on the study of Baker et al. (2020), and it quantifies uncertainty in equity markets caused by infectious diseases like COVID-19. The second one is the VSTOXX volatility index as a proxy for uncertainty in the Eurozone. Figure 6 gives time series plots of the monthly economic policy uncertainty indices for Germany and the US, the VSTOXX volatility index, and the infectious disease equity market volatility.

This study estimates ARDL models for each stock market in the second stage to investigate dynamic relationships between economic policy uncertainty and long-run stock market volatility. Table 3 provides the descriptive statistics for the variables used to estimate ARDL models. As stated earlier, in the first stage, the long-run stock market volatility (LRV) is estimated by the GARCH-MIDAS model for each stock market. This study receives the data on economic policy uncertainty indices and the IDEMV index from the following website: https://www.policyuncertainty.com. Besides, the implied volatility of Eurozone stock markets (VSTOXX) is obtained from the Datastream database. The dataset covers 137 monthly observations from June 2009 to October 2020. Those monthly variables have positively skewed and leptokurtic distributions. Harrison and Moore (2011) suggest that the nonlinearity in CEE stock markets should be considered to avoid misleading inferences. Accordingly, the natural logarithm of all variables except IDEMV is used in regression models.

Before embarking on a dynamic regression analysis, this study investigates time series specifications of the variables. For this purpose, it conducts the ADF and the PP unit root tests with an intercept and with a trend and an intercept. The PP unit root tests are conducted by using four lags for the Newey-West standard errors. The number of lags is computed in accordance with the Newey-West suggestion. Table A.2 gives the results of unit root tests for the variables. According to the results of the unit root tests with an intercept, the null hypothesis of a unit root is rejected in all cases. Besides, the unit root tests with a trend and an intercept reject the null hypothesis of a unit root for all variables except the LRVs. Thus, those unit root tests are also carried out on the first differences of long-run stock market volatility. The latter tests reject the null hypothesis of non-stationarity for the first differences of the LRVs. It is possible to get a stationary variable by extracting the effects of the deterministic components from a trend stationary variable (Hill, Griffiths, and Lim 2011).

Equation (8) specifies the ARDL model used in the second stage of the empirical analysis. One can directly include a constant term and a trend term in a regression model rather than utilizing the de-trended data for estimation (Hill, Griffiths, and Lim 2011); therefore, this study includes those terms in dynamic regression equations. The dependent variables are the log values of long-run volatility in CEE-3 stock markets. The optimal lag orders p (for the regressand) and q (for the regressors) are determined by using the Bayesian information criterion (BIC) because the BIC tends to choose parsimonious models (Kripfganz and Schneider 2023). The maximum admissible lag lengths for the dependent and independent variables are also restricted to four to ensure sufficient degrees of freedom for estimating the models.

This study estimates four distinct ARDL models for each stock market. It uses the Newey-West estimator to obtain heteroskedasticity and autocorrelation consistent (HAC) standard errors. The least squares

Table 3. Descriptive statistics for the variables

	GER EPU	US EPU	VSTOXX	IDEMV	LRVBET	LRVPX	LRVWIG
Mean	179.78	137.89	22.504	0.465	0.1745	0.1132	0.1138
Median	165.86	130.22	21.545	0.349	0.1315	0.0851	0.0950
Maximum	498.05	350.45	44.890	5.8495	0.5194	0.5168	0.3564
Minimum	59.587	71.26	13.211	0.0747	0.0955	0.0496	0.0749
Std. Dev.	79.06	46.87	6.478	0.543	0.0929	0.0781	0.0509
Skewness	1.528	1.612	0.808	7.427	1.855	2.557	2.482
Kurtosis	5.904	6.661	3.489	72.361	6.113	10.934	9.732
Observations	137	137	137	137	137	137	137

will be biased if there is a serial correlation problem in the errors (Hill, Griffiths, and Lim 2011). For this reason, this study conducts the Breusch-Godfrey test for higher-order serial correlation in residuals for all estimated models. This autocorrelation test is a Lagrange multiplier (LM) test of the null hypothesis of

no autocorrelation up to a predefined order. The null hypothesis of no serial correlation up to orders one and twenty cannot be rejected at a 5% significance level in any estimated ARDL model.

Table 4, Table 5, and Table 6 provide the parameter estimates of the ARDL models for the stock market

Table 4. Parameter estimates for the Hungary stock market

$L\eta_t$	Model 1	Model 2	Model 3	Model 4
$L\eta_{t-1}$	1.66712***	1.40985***	1.39299***	1.54139***
	(0.1671)	(0.0984)	(0.0987)	(0.0893)
$L\eta_{t-2}$	-1.04120***	-0.44484***	-0.43415***	-0.85780***
	(0.2990)	(0.0934)	(0.0938)	(0.1393)
$L\eta_{t-3}$	0.50520**			0.40200***
	(0.2419)			(0.1191)
$L\eta_{t-4}$	-0.17515*			-0.13877**
	(0.0917)			(0.0565)
$LGEREPU_t$	0.02780*	0.00078	-0.00477	0.00426
	(0.0157)	(0.0094)	(0.0101)	(0.0109)
$LGEREPU_{t-1}$	0.04451*		0.02053*	
	(0.0260)		(0.0115)	
$LGEREPU_{t-2}$	-0.04293*			
	(0.0228)			
$LUSEPU_t$				-0.03269*
				(0.0177)
$LUSEPU_{t-1}$				0.05459***
				(0.0191)
$LVSTOXX_t$		0.15529***	0.15904***	0.17772***
		(0.0403)	(0.0371)	(0.0415)
$LVSTOXX_{t-1}$		0.13463**	0.13438**	0.09259*
		(0.0638)	(0.0635)	(0.0488)
$LVSTOXX_{t-2}$		-0.24595***	-0.25121***	-0.25383***
		(0.0803)	(0.0780)	(0.0892)
$LVSTOXX_{t-3}$				0.08450*
				(0.0477)
$LVSTOXX_{t-4}$				-0.05986**
				(0.0265)
$IDEMV_t$			-0.00811**	-0.00804**
			(0.0037)	(0.0033)
$IDEMV_{t-1}$			0.00339	0.00487**
			(0.0026)	(0.0023)
$IDEMV_{t-3}$			0.01776**	0.01700**
			(0.0068)	(0.0066)
Constant	-0.22091*	-0.21403***	-0.29400***	-0.35666***
	(0.1200)	(0.0768)	(0.0819)	(0.1158)
Trend	-0.00021	-0.00017	0.000004	-0.00005
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Adjusted R^2	0.98207	0.99206	0.99161	0.99208
LM test prob[a]	0.5608	0.2175	0.0792	0.6868
LM test prob[b]	0.7940	0.2021	0.1560	0.3148
BIC	-2.84139	-3.57746	-3.45791	-3.37521
LLF	210.959	261.099	264.184	270.910

Note: The numbers in the parentheses are Newey-West HAC standard errors. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively. [a] and [b] indicate p-values for the Breusch-Godfrey serial correlation LM test for one lag and twelve lags, respectively. BIC is the Bayesian information criterion. LLF indicates the optimal log-likelihood function value.

of Hungary (the BET index), the stock market of the Czech Republic (the PX index), and the stock market of Poland (the WIG index), respectively. The empirical results are pretty similar for the stock markets of CEE-3 countries; therefore, it is preferred to holistically interpret the findings rather than individual stock markets to avoid monotonic interpretation. According to all estimated models, positive and statistically significant relationships exist between the long-run stock market volatility of CEE-3 countries and their first lags.

Table 5. Parameter estimates for the Czech Republic stock market

$L\eta_t$	Model 1	Model 2	Model 3	Model 4
$L\eta_{t-1}$	1.64933***	1.47246***	1.45911***	1.48032***
	(0.1528)	(0.0978)	(0.1002)	(0.0936)
$L\eta_{t-2}$	-1.12365***	-0.93578***	-0.92207***	-0.97550***
	(0.2740)	(0.1590)	(0.1648)	(0.1512)
$L\eta_{t-3}$	0.57356***	0.50878***	0.49823***	0.56371***
	(0.1945)	(0.1192)	(0.1208)	(0.1178)
$L\eta_{t-4}$	-0.18587***	-0.13550***	-0.12193**	-0.15599***
	(0.0632)	(0.0462)	(0.0471)	(0.0467)
$LGEREPU_t$	0.05162**	0.00074	-0.00554	0.01598
	(0.0258)	(0.0143)	(0.0151)	(0.0176)
$LGEREPU_{t-1}$	0.09112**	0.04329**	0.05620***	0.02969*
	(0.0381)	(0.0181)	(0.0168)	(0.0156)
$LGEREPU_{t-2}$	-0.06084*			
	(0.0347)			
$LUSEPU_t$				-0.08399***
				(0.0309)
$LUSEPU_{t-1}$				0.09402***
				(0.0274)
$LVSTOXX_t$		0.28429***	0.29523***	0.32345***
		(0.0498)	(0.0424)	(0.0488)
$LVSTOXX_{t-1}$		0.17900**	0.17842**	0.15422**
		(0.0720)	(0.0790)	(0.0706)
$LVSTOXX_{t-2}$		-0.36978***	-0.37740***	-0.38727***
		(0.1265)	(0.1221)	(0.1126)
$LVSTOXX_{t-3}$		0.16097*	0.16143**	0.17097**
		(0.0833)	(0.0796)	(0.0734)
$LVSTOXX_{t-4}$		-0.15403***	-0.15706***	-0.16830***
		(0.0463)	(0.0450)	(0.0440)
$IDEMV_t$			-0.01809***	-0.01496***
			(0.0057)	(0.0055)
$IDEMV_{t-2}$			-0.01935***	-0.01888***
			(0.0056)	(0.0063)
$IDEMV_{t-3}$			0.02136***	0.02157***
			(0.0073)	(0.0069)
Constant	-0.57948***	-0.73830***	-0.76422***	-0.76548***
	(0.2067)	(0.1548)	(0.1556)	(0.1693)
Trend	-0.00070**	-0.00017	-0.00014	-0.00015
	(0.0002)	(0.0001)	(0.0001)	(0.0001)
Adjusted R^2	0.96365	0.98473	0.98560	0.98670
LM test prob[a]	0.3299	0.2216	0.2719	0.4530
LM test prob[b]	0.6363	0.1279	0.1846	0.1234
BIC	-1.79409	-2.54710	-2.46497	-2.48813
LLF	141.314	201.170	207.933	214.364

Note: The numbers in the parentheses are Newey-West HAC standard errors. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively. a and b indicate p-values for the Breusch-Godfrey serial correlation LM test for one lag and twelve lags, respectively. BIC is the Bayesian information criterion. LLF indicates the optimal log-likelihood function value.

This finding is consistent with the study of Yang and Jiang (2016) and indicates the appropriateness of using the autoregressive model. In contrast, the parameter estimates are negative and statistically significant for the second lags of the long-run stock market volatility. This finding confirms the evidence from Zeng et al. (2024), which indicates the time-varying effects of policy uncertainty on stock market volatility.

The evidence on the immediate effects of economic policy uncertainties on long-run stock market volatilities is mixed. The parameter estimates of the first lag of the US economic policy uncertainty are positive and statistically significant. It means that a rise in economic policy uncertainty in the US leads to an increase in the long-run stock market volatility of CEE-3 countries after one period. Similarly, the

Table 6. Parameter estimates for the Poland stock market

$L\eta_t$	Model 1	Model 2	Model 3	Model 4
$L\eta_{t-1}$	1.32979***	1.17970***	1.14106***	1.15198***
	(0.1728)	(0.0781)	(0.0769)	(0.0727)
$L\eta_{t-2}$	-0.63914***	-0.30144***	-0.28547***	-0.32219***
	(0.2203)	(0.0643)	(0.0674)	(0.0586)
$L\eta_{t-3}$	0.16898*			
	(0.0944)			
$LGEREPU_t$	0.01012**	0.00264	0.00272	0.00501
	(0.0051)	(0.0029)	(0.0030)	(0.0033)
$LGEREPU_{t-1}$	0.01691	0.00561**	0.00739**	
	(0.0106)	(0.0028)	(0.0031)	
$LGEREPU_{t-2}$	-0.00733**		-0.00648**	
	(0.0032)		(0.0029)	
$LUSEPU_t$				-0.00897
				(0.0057)
$LUSEPU_{t-1}$				0.01768***
				(0.0063)
$LVSTOXX_t$		0.04047***	0.04189***	0.04309***
		(0.0068)	(0.0064)	(0.0064)
$LVSTOXX_{t-1}$		0.05871**	0.06116**	0.06142**
		(0.0297)	(0.0286)	(0.0287)
$LVSTOXX_{t-2}$		-0.09473***	-0.09300***	-0.09564***
		(0.0317)	(0.0302)	(0.0296)
$IDEMV_t$			-0.00055	-0.00017
			(0.0009)	(0.0009)
$IDEMV_{t-1}$			-0.00117	-0.00150
			(0.0012)	(0.0011)
$IDEMV_{t-3}$			0.00704***	0.00701***
			(0.0024)	(0.0024)
Constant	-0.03766	-0.04069*	-0.05306**	-0.07912***
	(0.0343)	(0.0212)	(0.02127)	(0.0268)
Trend	-0.00002	-0.00002	0.00001	0.00002
	(0.00005)	(0.00004)	(0.00004)	(0.00004)
Adjusted R^2	0.86842	0.94449	0.94642	0.94863
LM test prob[a]	0.8427	0.6357	0.7145	0.7302
LM test prob[b]	0.4342	0.1839	0.2331	0.1122
BIC	-5.00489	-5.83993	-5.73055	-5.80088
LLF	357.368	416.269	420.204	422.436

Note: The numbers in the parentheses are Newey-West HAC standard errors. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively. a and b indicate p-values for the Breusch-Godfrey serial correlation LM test for one lag and twelve lags, respectively. BIC is the Bayesian information criterion. LLF indicates the optimal log-likelihood function value.

empirical results show a positive one-period lagged effect of economic policy uncertainty in Germany on the long-run stock market volatility of CEE-3 countries. Overall, these results suggest that changes in economic policy uncertainty either in Germany or the US have a distributed lag effect on the long-run stock market volatility of CEE-3 countries. This result is consistent with the study of Chiang (2019), which found a positive effect of lagged uncertainty on stock market volatility, and with the findings of Yu and Song (2018), which showed a significant effect of uncertainty on one-ahead-step volatility.

The one-period lagged impact of economic policy uncertainty in the US on the long-run stock market volatility of CEE-3 countries is larger than the effect of economic policy uncertainty in Germany. This result suggests that the long-run stock market volatility of CEE-3 countries is more vulnerable to economic developments in the US, although those countries are economically embedded in the economic processes of European countries. This evidence confirms the findings of Bai et al. (2019), Shi and Wang (2023).

Turning to the empirical evidence on the control variables, the estimates indicate that the effects of the VSTOXX volatility are dynamically more complex. Its immediate and one-period lagged effects are positive and statistically significant. It can be said that an increase in the European stock market volatility positively affects the long-run stock volatility of CEE-3 countries, both in the current and one period later. Finally, the relationships between the infectious disease equity market volatility and the long-run stock market volatility of CEE-3 countries differ by stock markets and time lags. The estimates of the impact multipliers are negative for all stock markets; however, those estimates are statistically significant except for the Poland stock market. This evidence suggests that a rise in the infectious disease equity market volatility leads to a decline in the long-run volatility of CEE-3 stock markets at the current period.

4. Conclusion

This study examines dynamic associations between economic policy uncertainty in developed countries (Germany and the US) and long-run stock market volatility in CEE-3 countries. For this purpose, this study carries out empirical analysis in two stages. First, it obtains long-run stock market volatilities. Then, it estimates dynamic regression models. Empirical evidence suggests a distributed lag effect of economic policy uncertainty on long-run stock market volatility. The findings show that economic policy uncertainty has a positive and significant one-period lagged impact on long-run stock market volatility. On the other hand, this study provides mixed empirical evidence of economic policy uncertainties' immediate effects on long-run stock market volatilities.

This study includes two uncertainty measures as control variables in dynamic regression models. The implied volatility of Eurozone stock markets has positive and significant effects on long-run stock market volatility in CEE-3 countries. Further, the immediate impact of infectious disease equity market volatility is negative. The empirical results are limited to CEE-3 stock markets; however, covering other emerging stock markets in Europe would be interesting. Further research might use firm- or sectoral-level data instead of aggregate stock market indices. The findings will benefit global investors, hedgers, portfolio managers, regulators, and policymakers seeking to comprehend how the uncertainty measures affect the CEE-3 stock market volatility over time.

APPENDICES

Table A 1. Unit root tests for stock market returns

	Intercept in test equation				
	ADF Test			*PP Test*	
Stock market index	Z(t)	p-value	*Z(rho)*	Z(t)	p-value
BET	-50.441	0.000	-2587.601	-50.448	0.000
PX	-47.974	0.000	-2314.113	-47.902	0.000
WIG	-48.052	0.000	2523.863	-48.168	0.000
	Trend and intercept in test equation				
	ADF Test			*PP Test*	
Stock market index	*Z(t)*	p-value	*Z(rho)*	*Z(t)*	p-value
BET	-50.441	0.000	-2586.483	-50.447	0.000
PX	-47.971	0.000	-2313.328	-47.899	0.000
WIG	-48.051	0.000	-2523.379	-48.165	0.000

Table A 2. Unit root tests for the variables

	Intercept in test equation				
	ADF Test			PP Test	
Variables	Z(t)	p-value	*Z(rho)*	*Z(t)*	p-value
GER EPU	-5.521	0.000	-51.907	-5.460	0.000
IDEMV	-8.605	0.000	-103.272	-8.753	0.000
US EPU	-3.932	0.001	-24.127	-3.519	0.007
VSTOXX	-3.174	0.021	-17.294	-3.099	0.026
LRVBET	-2.942	0.040	-7.342	-2.731	0.068
LRVPX	-3.278	0.015	-12.110	-3.254	0.017
LRVWIG	-2.880	0.047	-19.096	-3.387	0.011
	Trend and intercept in test equation				
	ADF Test			*PP Test*	
Variables	*Z(t)*	p-value	*Z(rho)*	*Z(t)*	p-value
GER EPU	-6.624	0.000	-72.192	-6.728	0.000
IDEMV	-8.683	0.000	-103.776	-8.809	0.000
US EPU	-3.901	0.012	-23.888	-3.475	0.042
VSTOXX	-3.389	0.052	-23.147	-3.399	0.051
LRVBET	-0.860	0.960	-5.218	-1.472	0.838
ΔLRVBET	-6.241	0.000	-57.892	-6.094	0.000
LRVPX	-2.132	0.528	-11.998	-2.616	0.272
ΔLRVPX	-6.198	0.000	-55.036	-5.953	0.000
LRVWIG	-2.643	0.260	-18.021	-3.190	0.086
ΔLRVWIG	-6.341	0.000	-56.149	-6.078	0.000

Note: This table provides the results of unit root tests for the natural logarithm of the variables except IDEMV. Δ denotes the first difference of a time series.

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THE CAPITAL STRUCTURE DYNAMICS OF SMES IN KOSOVO: EVIDENCE USING PANEL DATA

Argjentë Qerimi, Driton Balaj, Besnik A. Krasniqi

Abstract

This paper evaluates the applicability of capital structure theories in assessing the financial choices made by SMEs in Kosovo. Additionally, it examines whether previously studied determinants of capital structure, such as firm age and size, liquidity, profitability, firm growth, asset structure, effective tax rate, and non-debt tax shield, can explain the capital structure choices of SMEs in Kosovo. Utilizing annual firm-level data, a panel data methodology is employed to test empirical hypotheses on a sample of 90 SMEs in Kosovo from 2013 to 2018. Dynamic panel model findings reveal that the financial behavior of Kosovo's SMEs is influenced not only by internally generated funds but also by various specific firm characteristics, including liquidity, effective tax rate, non-debt tax shield, size, asset structure and growth. Finding aligns with the pecking order theory, which suggests that more profitable SMEs tend to rely less on debt financing. The study offers implications and recommendations for both firms' managers and policymakers.

Keywords: *Capital structure, trade-off theory, pecking order theory, SMEs*

JEL classification: *G32, E22, M21*

1. Introduction

An increasing body of literature shows that SMEs play a unique role in the modern economy and are essential for jobs, innovation, and economic growth (Urbano et al. 2020; Audretsch et al. 2023). Despite SMEs' vital role in job creation and production, much of the literature highlights that these firms need help accessing external financing compared to larger corporations. This difficulty in securing funding hampers their ability to grow and develop (Ardic, Mylenko, and Saltane 2011; Krasniqi et al. 2023).

Numerous empirical research studies focus on the drivers of debt in large and publicly listed enterprises,

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while the small firm sector receives far less attention, particularly in transition countries (Czerwonka and Jaworski 2021; Qerimi et al. 2023). Since SME growth may be constrained by several factors relating to these countries' unique economic and institutional conditions (Mateev, Poutziouris, and Ivanov 2013; Hashi and Krasniqi 2011), the available funds and access to these funds remain an important issue for discussion.

Much of the existing research on the capital structure of SMEs relies on static regression models. Yet, static models may not encompass the dynamic nature of capital structure decisions or the intertemporal dependencies present in longitudinal data. Despite the importance of considering dynamics and time series in analyzing capital structure decisions, research on SMEs, particularly in economies with shorter market traditions, has been less inclined towards using dynamic panel models. Additionally, evaluating capital structure theories with dynamic panel models is a relatively recent approach in the SME sector.

The article contributes in several ways to the firms' capital structure determinants. The first objective is to broaden the scope of the debate to the limited empirical research regarding capital structure determinants of SMEs in emerging/transition economies.

The study examines empirically two of the most pertinent theories explaining financial policy in SMEs: pecking order and trade-off theories, using a database comprising nonlisted Kosovar SMEs from 2013-2018. Using a dynamic panel data analysis the study determines which capital structure theory better describes the financial decisions of SMEs in Kosova. Additionally, we put effort into identifying whether the choice of capital structure of SMEs in Kosovo can be interpreted through factors that have been studied by previous studies, which are represented by the determinants of the choice of capital structure.

The remainder of the article is organized in the following manner. In Section 2, the theoretical discussions and empirical evidences are presented. Section 3 explains the methodology and the data utilized. Section 4 summarizes the primary outcomes, while Section 5 offers concluding remarks followed by limitations, constraints and future research directions

2. Literature Review

The capital structure significantly impacts business finances' overall success and development (Tripathy, Wu, and Zheng 2021). Earlier study by Evans (1987) shows that small enterprises outperform larger firms in terms of growth rates. Carpenter and Petersen (2002) found that internal finance limits the expansion of small enterprises, which is pertinent to capital structure research. Many theories seek to explain financial constraints, explicitly focusing on capital structure.

Since Modigliani and Miller's (1958, 1963) seminal work on firm capital structure, various ideas have emerged to challenge the assumptions of a perfect market and the lack of insolvency, agency, and transaction costs. Criticism of these paradigms sparked various new ideas. Martinez, Scherger, and Guercio (2019) and Kumar, Sureka, and Colombage (2020) have shown that two are significant to the SME sector. Two primary theoretical frameworks explain the firm-level determinants of capital structure that fit SMEs: the trade-off and pecking order theory that will be used as framwork for analysis in this study.

2.1. Trade-off Theory (TOT): Taxation, Bankruptcy, and Agency Costs

The trade-off theory is the first concept to appear in SME related literature. According to its static version, when shaping their capital structure, companies compare the costs of financial distress and bankruptcy with the expected tax benefits associated with debt financing. This means there is an optimal capital structure when these benefits and costs are equal (Baxter 1967; Kraus and Litzenberger 1973). The dynamic version of the trade-off hypothesis predicts that firms will optimize their capital structure by becoming indebted or repaying debts at a set rate. This level of debt is related to the specified minimum of adjustment costs functioned by a change in the cost of financial distress, on the one hand, and benefits from tax shield, on the other (Huang and Ritter 2005; Kayhan and Titman 2007; Lemmon, Roberts, and Zender 2008).

2.2. Pecking Order Theory (POT) and Asymmetry of Information

The second notion mentioned in the literature is the pecking order theory, based on the theoretical considerations of adverse selection. Myers (1984) and Myers and Majluf (1984) developed the theory that the company's financial demands increase is met according to a specified hierarchy. The model does not suggest a target or ideal capital structure.

Table 1. The direction of influence of individual factors on corporate debt according to TOT and POT.

Factors	Trade-off theory (TOT)	Pecking order theory (POT)
Age	+	−
Size	+	+
Growth	−	+
Profitability	**+**	−
Liquidity	+	−
Asset structure	**+**	**+**
Effective tax rate	**+**	−
Non-debt tax shield	−	−

Source: Frank and Goyal (2009); Rajan and Zingales (1995)

The structure results from aggregated rules about profitability development, dividend distributions, and investment opportunities (Klein, O'Brien, and Peters 2002; Bharath, Pasquariello, and Wu 2009). The lessons of these two theories were applied by finance research to examine the debt behavior of SMEs in the lack of a financial theory tailored to their needs.

2.3. Empirical Studies in the SME Sector

Empirical research on SME capital structure decisions is relatively new, with the initial studies focusing on the differences between small and large enterprises (Daskalakis and Thanou 2010). Frank and Goal (2009) have investigated the issues related to SMEs compared to big firms. Van Der Wijst and Thurik (1993) and Sogorb-Mira (2005), among others, researched the small firm capital structure. They confirm that most of the variables used in capital structure theory to determine firm leverage also apply to small enterprises. The significant conclusion, however, is that the determinants differ between short and long-term debt ratios.

Delcoure (2007) studied capital structure determinants in Central and Eastern European countries to discover whether Western economic theories and determinants interpret the capital structure in these countries. The study stated that companies in Central and Eastern Europe depended heavily on short-term debt rather than long-term in their capital structure against those in developed countries. Summarizing the literature, Table 2 represents the most recent theories that best explain the financial decisions of SMEs based on the dynamic panel data approach.

Table 2. Empirical studies on determinants of SME capital structure

Authors	Research Sample and Period	Positive Determinants of Debt	Negative Determinants of Debt	Indicated Theory
Lopez-Gracia and Sogorb-Mira (2008)	3,569 Spanish SMEs over the Period 1995-2004	Size, CFGO	NDTSH, Growth Opportunities, Cash Flow, Age	Trade-Off
Mateev, Poutziouris, and Ivanov (2013)	3,175 SMEs in Central And Eastern Europe (CEE) over the Period 2001-2005	Asset Structure (Negative in Short-Term Debt), Size, Future Growth Opportunities, Liquidity (Long-Term Debt)	Profitability, Cash Flow for the Medium Firm, Liquidity (Short-Term Debt)	Pecking Order Theory
Jindrichovska, Ugurlu, and Kubickova (2013)	260 Czech SMEs During The Period 2004-2011	Size	ROA, Cash Flow, Age	Mix Evidence (Weaken Results for Pecking Order Theory)

(continued)

Table 2. *Continued*

Authors	Research Sample and Period	Positive Determinants of Debt	Negative Determinants of Debt	Indicated Theory
Forte, Barros, and Nakamura (2013)	19,000 Brazilian SMEs during 1994-2006	Asset Growth, Size	Profitability, Risk, Age	Pecking Order Theory
Adair and Adaskou (2018)	2,370 French SMEs for the Period 2003-2007 and 2008-2010	Size, Profitability, Growth Opportunity, Trade Credit (After Crisis), Guarantees	Age, Growth Opportunities, Asset Structure, ROA, Cash Flow, Trade Credit (Before Crisis), Low and Medium Risk, High Risk	Mixed Evidence
Kenourgios, Savvakis, and Papageorgiou (2019).	1,120 European SMEs over the Period 2005-2015	Asset Structure, Size, Growth	Profitability, Tax	Mixed Evidence
Pham and Hrdy (2023)	Visegrad Group (Czech Republic, Slovakia, Hungary, Poland) SMEs from 2011-2018		Profitability, Liquidity, Size, Asset Structure, Non-Debt Tax	Pecking Order Theory, Trade Off Theory Only For Non-Debt Tax
Jaworski and Czerwonka (2023)	2820 SMEs in Poland Operating in The 2011-2018 Period	Size, Growth Rate	Tangibility, Liquidity	Pecking Order Theory

Source: Authors' elaboration

3. Data and methodology

The data for this study were collected from the financial statements of private companies reporting to Kosovo Council for Financial Reporting (KCFR) within the Ministry of Finance, covering the period from 2013 to 2018. This period was chosen to ensure data consistency and reliability. Extending the dataset beyond 2018 was not feasible due to significant changes in reporting standards that took effect in January 2019.

To ensure the reliability of the results, companies with missing reporting years within the 2013-2018 period were excluded. This approach was essential for maintaining data integrity and coherence, given the use of both static and dynamic analyses.

The final dataset comprised 90 SMEs that consistently reported across the selected years, providing a stable and accurate basis for examining the impact of financial variables on the capital structure of SMEs.

3.1. Variables and Hypothesis

According to (Michaelas, Chittenden, and Poutziouris 1999; Cassar and Holmes 2003; Sogorb-Mira 2005; Bonfim and Antão 2012; Prenaj, Miftari, and Kransiqi 2023; Jaworski and Czerwonka 2023), the total leverage ratio can serve as a measure of capital structure. However, other authors (Van Der Wijst and Thurik 1993; Barclay and Smith 1999; Mateev, Poutziouris, and Ivanov 2013; Pham and Hrdy 2023) have found that total liabilities alone may not adequately capture the fundamental distinctions between long-term and short-term debt. Consequently, to better understand the capital structure, we considered analyzing the leverage ratio in three ways: long-term, short-term, and total term debt. Independent or explanatory variables identified include cash flow, age, size, asset structure, liquidity, profitability, growth, effective tax rate, and non-debt tax shield.

3.1.1. Age

The age of the business is fundamental in the study of the capital structure of the companies (Baird and Lucey 2010). The literature on age and financing structure posits that younger firms face additional difficulties when accessing external financing, which eases as the firm ages (Berger and Udell 1998). Thus, the following hypothesis is proposed to test the age factor:

H1: A positive relationship exists between the age of firms and their debt ratio in Kosovar SMEs

Variable age is measured by the number of years the SME was in the business by looking at the establishment date until the recent year of observation (Esperança, Gama, and Azzim 2003; Abor and Biekpe 2009).

3.1.2. Size

According to (Warner 1977; Pettit and Singer 1985), from a financial distress standpoint, larger firms are typically more diversified and have a lower likelihood of failure, making size an inverse indicator of bankruptcy probability. Therefore, from the perspective of the trade-off theory, large firms can be pushed towards higher debt (Ang 1991). As SMEs are often family businesses with owners who prefer to maintain control over the company, they are less likely to lose control when issuing debt than when issuing equity. Combined with their small size, these factors impose high information costs under asymmetric information regimes and raise the cost of external financing, making SMEs prime candidates for a pecking-order finance pattern. Hence, we aspect the following hypothesis:

H2: A positive relationship exists between the size of firms and their debt ratio in Kosovar SMEs.

3.1.3. Liquidity

According to the trade-off theory, higher liquidity of assets leads to increased leverage. Conversely, in the pecking order theory, firms with higher liquidity may have more internal funds available, decreasing their need for external financing. Also, liquidity is a question of short-term assets and short-term liabilities. Firms with higher liquidity may have lower financial risk and be more capable of repaying debt obligations. Thus, firms with higher liquidity are expected to have lower debt levels.

H3: A negative relationship exists between firms' liquidity and debt ratio in Kosovar SMEs.

3.1.4. Profitability

In an environment where institutions are insufficiently developed to alleviate information asymmetry between lenders and firms, raising debt can be expensive for firms (Belkhir, Maghyereh, and Awartani 2016). According to the trade-off theory, a profitable firm is expected to have a higher level of debt to offset corporate tax (Fama and French 2002). On the contrary, from the pecking order perspective, profitable firms generate higher internal funds from operations, reducing their need for external financing. Based on the above discussion, we assume that Kosovar SMEs tend to act following the pecking order theory, preferring internal resources over debt and avoiding equity issuance. Hence, we expect the following relationship:

H4: A negative relationship exists between firms' profitability and debt ratio in Kosovar SMEs.

3.1.5. Asset structure

The asset structure of an SME holds significant importance in bridging the financing gap. Mateev, Poutziouris, and Ivanov (2013) suggest that small firms encounter challenges in securing commercial bank financing, particularly long-term loans, due to various factors, including a lack of collateral. Wan Der Wijst and Thurik (1993) state that permanent nature of fixed assets and the preference for tangible assets over intangible ones as collateral makes them more secure than current ones.

The trade-off theory suggests that a higher proportion of tangible assets may lead to reducing costs of financial distress and an easier way to secure debt financing. As a result, the following hypothesis may arise:

H5: A negative relationship exists between firms' asset structure and debt ratio in Kosovar SMEs.

3.1.6. Growth

Firms experiencing significant growth usually need more aggressive funding strategies. According to the

pecking order theory, when these firms exhaust their internal finances, they resort to borrowed financing. As a result, among two firms with comparable profitability levels, it is reasonable to expect that the firm with a higher growth rate will have greater leverage. The trade-off theory, as proposed by Myers (1984), suggests that firms with greater growth prospects tend to carry less leverage. Consequently, there should exist a negative association between growth opportunities and leverage.

H6: A positive relationship exists between the firm's growth and debt ratio in Kosovar SMEs.

3.1.7. Effective Tax Rate

Using debt as a source of financing holds a clear advantage, namely, reducing income tax. While additional debt does not give rise to significant inherent costs of financial distress, companies will decide to increase their leverage ratio (Fama and French 2002). The Pecking Order Theory emphasizes tax considerations less than the Trade-off Theory. Firms in high-tax jurisdictions may be more inclined to use debt financing to benefit from tax shields, leading to higher debt levels. Following above discussion:

H7: A positive relationship exists between Kosovar SMEs' effective tax rate and debt ratio.

3.1.8. Non-Debt Tax Shield

Interest payments are not the only way to reduce income tax. Firms try to reduce their tax burden by using NDTS instead of debt, thus avoiding distress costs or other adjustment costs (Dammon and Senbet 1988). The following hypothesis can be formulated:

H8: A negative relationship exists between the firm's non-debt tax shield and the debt ratio in Kosovar SMEs.

Variables used in the study, defined and chosen as the most frequently by other authors, are presented in the Table 3. Capital structure is measured as a dependent variable, with total-term debt ratio as total debt to total assets; long-term debt ratio as long-term debt to total assets; and the short-term debt ratio, as short-term debt to total assets. The selected explanatory variables are widely used in the empirical literature, such as size, age, cash flow ratio, liquidity, profitability, asset structure, growth, effective tax rate, and non-debt tax shield, characterizing classic firm-specific factors as independent variables.

Table 3. Definition, description, and expected sign of variables for TOT and POT theory

Variable	Definition	Explanation	TOT	POT
			Expected sign	
Dependent variables				
TOTD	Total-term debt	Total debt to total assets		
LOTD	Long-term debt	Long debt to total assets		
SHTD	Short-term debt	Short debt to total assets		
Independent variables				
CFLW	Cash flow ratio	The ratio of net earnings plus depreciation to total assets	/	−
AGE	Age of the firm	Observed year minus year of incorporation	+	−
SIZE	Size of the firm	Natural logarithm of total assets	+	+
LIQU	Liquidity	Current assets divided by current liability	+	−
PROF	Profitability	Earnings before interest and taxes (EBIT) divided by total assets	+	−
ASST	Asset structure	Fix assets divided by total assets	+	+
GROW	Growth	Sales divided by total assets	−	+
EFTR	Effective tax rate	Tax divided by earning before tax (EBT)	+	−
NDTS	Non-debt tax shield	Depreciation to total assets	−	−
YEAR	Year dummies	Dummy that takes the value 1 in year t and 0 otherwise, where t= 2013,…, 2018		

Source: Authors

Two types of analysis are applied for the study: static and dynamic panel models. Using static panel models, we can better control firm heterogeneity and reduce collinearity among the explanatory variables, enhancing econometric estimates' efficiency (Arellano and Bover 1995).

Following Mateev, Poutziouris, and Ivanov (2013), we will test some of the predictions of pecking order theory by using cash flow as an explanatory variable. Based on the above, we formulated the following equation:

$$DTR_{i,t} = \alpha_i + \beta_1 CFLW_{i,t} + \beta_2 AGE_{i,t} + \beta_3 SIZE_{i,t}$$
$$+ \beta_4 LIQU_{i,t} + \beta_5 ASST_{i,t} + \beta_6 GROW_{i,t} + u_i + \omega_{i,t} \qquad (1)$$

Where $DTR_{i,t}$ presents one of the three debt ratios: total-term debt to total assets, long-term debt to total assets, and short-term debt to total assets. CFLW is considered the primary variable of interest. Age, size, liquidity, profitability, asset structure, and growth are other control variables as defined in Table 3. The unobserved individual effect is given with u_i, while $\omega_{i,t}$ is denoted for the error term.

In cases where the selected variable is dependent upon its previous realizations, dynamic panel data models are more helpful. To take into account any dynamic effects, we design our model using the Generalized Method of Moments (GMM) developed by Arellano and Bond (1991) and extended by Blundell and Bond (1998). This dynamic estimate technique is based on instrumentation. An instrumental variable is employed to account for endogeneity in the explanatory variable, providing a consistent estimate of its effect on the dependent variable.

According to the trade-off theory, among other variables, we added the effective tax rate and non-debt tax shield as an instrumental variable to test for the target debt ratio.

A model can represent the gradual process of reaching the target (López-Gracia and Sogorb-Mira 2008):

$$DTR_{it} - DTR_{it-1} = \lambda \cdot (DTR_{it}* - DTR_{it-1}) \qquad (2)$$

where:
$DTR_{it}*$ – Debt target ratio,
λ – speed of adjustment.

Equation (2) indicates that changes in the debt ratio from period to period are induced by a desire to reach the target ($DTR_{it}*$) with an adjustment speed equal to λ (López-Gracia and Sogorb-Mira 2008; Shyam- Sunder and Myers 1999).

The target value of debt is unobservable, so it is necessary to introduce a variable based on the determinants of capital structure:

$$DEBTRatio_{i,t} = \alpha_0 + f (DEBTRatio_{it-1} + SIZE_{it}$$
$$+ LIQU_{it} + PROF_{it} + ASST_{it} + GROW_{it} + EFTR_{it}$$
$$+ NDTS_{it}) + n_i + n_t + \varepsilon_{i,t} \qquad (3)$$

DEBTRatio represents, TOTD, LOTD, and SHTD that are total, long, and short-term debt of firm i in year t, n_i is the unobserved firm-specific effects, n_t is time-specific effects, and ε_{it} is the error term. Unobservable company characteristics that significantly impact the firm's leverage are reflected in n_i. The macroeconomic effects are captured inside n_t factors such as inflation and interest rates, which vary over time but remain constant for all firms in a given year. Since the dependent variable is correlated with α_0, the OLS estimate is biased and inconsistent. In this case, Arellano and Bond proposed an approach that utilizes all available tools. The generalized method of moments used the moment conditions provided by the dependent variable's lagged levels (Hansen 1982). GMM produces reliable and unbiased estimates when the error terms are serially uncorrelated (Honore and Hu 2004).

To provide a comprehensive understanding of the impact of explanatory variables on debt levels, we also conducted a long-run analysis using GMM. This analysis helps to assess the sustained effects of the variables over time, complementing the short-run findings. The long-run effects were calculated using the following formula:

$$\beta_{LR} = \beta_{SR}/1-\lambda \qquad (4)$$

where:
– β_{LR} - denotes the long-run coefficient,
– β_{SR} - is the short-run coefficient of the explanatory variable,
– λ is the coefficient of the lagged dependent variable, reflecting the persistence of the effect.

4. Empirical Results

4.1. Descriptive Statistics

Table 4 summarizes the descriptive statistics of variables based on the financial data of 90 companies that were observed for six years in this research.

The relationship and strength between the measured and explanatory variables are presented in the correlation matrix in the Appendix table. Statistically positive or negative relationships between variables are indicated at 1 percent significance.

4.2. Pecking Order Model

- Estimation results for the parameters testing the model relevant to pecking order theory are presented in Table 5. Multiple regression of pooled OLS, fixed effects (FE), and random effects (RE) are estimated for total, long, and short-term debt.
- Wald test statistics are highly significant, suggesting that the explanatory variables are collectively significant in explaining the variation in each type of debt. The Breusch-Pagan LM, has suggested that heteroskedasticity is present in the models for all types of debt (Table 6). Robust standard errors are performed to correct heteroskedasticity. Using the robust option in fixed and random effects models helps ensure that the coefficient estimates remain unbiased and consistent even in heteroskedasticity.

The Hausman Test has been used to choose between the most appropriate models: fixed or random effects model (Table 6).

- Cash flow ratio was our main variable for testing pecking order assumtions. As shown in Table 5 cash flow has shown a statistically negative and significant relationship with all three levels of debt explaining capital structure. These results follow the pecking order theory, in which firms with more internal funds at their disposal typically resort less to external financing compared to similar companies.
- Variable liquidity is significant and negative in determining total and short-term debt. Consistent with prior studies, our research underscores the impact of debt type on the association between leverage and a firm's asset structure. Specifically, we find a positive correlation between long-term debt and asset structure. However, this relationship reverses when firms opt for short-term debt, exhibiting a negative correlation.
- These results are consistent with (Sogorb-Mira 2005; Mateev, Poutziouris, and Ivanov 2013). Additionally, firm size seems important only in explaining long-term debt, as larger firms show much higher leverage with long-term debt than smaller firms. Our findings align with Qerimi et al. (2023), indicating that larger companies tend to employ a greater proportion of long-term leverage.
- Findings regarding the relationship between variables and capital structure, under the pecking order theory (POT) assumptions, are presented in Table 7.

Table 4. Summary statistics of dependent and explanatory variables

	N	Mean	Median	Std. Dev.	Min	Max	Kurtosis	Skewness
TOTD	540	0.51	0.50	0.27	0.01	1.80	4.29	0.65
LOTD	540	0.12	0.07	0.15	0.00	0.81	5.45	1.51
SHTD	540	0.38	0.35	0.24	0.01	1.80	7.00	1.39
CFLW	540	0.09	0.08	0.10	-0.57	0.57	12.77	-0.11
AGE	540	11.48	12.00	3.29	0.00	18.00	3.28	-0.36
SIZE	540	15.49	15.55	0.60	13.52	16.76	2.85	-0.35
LIQU	540	2.93	1.76	3.87	0.30	36.50	31.11	4.69
PROF	540	0.08	0.07	0.10	-0.56	0.63	12.35	0.05
ASST	540	0.36	0.36	0.21	0.00	0.87	2.06	0.14
GROW	540	1.66	1.39	1.23	0.14	11.15	11.19	2.11
EFTR	540	0.09	0.10	0.09	0.00	1.65	198.78	11.54
NDTS	540	0.03	0.02	0.03	0.00	0.31	25.30	3.17

Authors' calculation.

Note: Descriptions of variables are defined in Table 3. The mean and median provide information for the central tendency of the distribution—the standard deviation measures for dispersion (how data is spread out).

Table 5. Estimation results for testing the pecking order theory of capital structure for total, long, and short-term debt

	Total Term Debt			Long Term Debt			Short Term Debt		
	Pooled OLS	Random Effects	Robust Fixed Effects	Pooled OLS	Robust Random Effects	Fixed Effects	Pooled OLS	Random Effects	Robust Fixed Effects
CFLW	-1.056***	-.808***	-.76***	-.217***	-.215*	-.203***	-.835***	-.614***	-.554***
	(.094)	(.071)	(.106)	(.066)	(.11)	(.063)	(.083)	(.074)	(.09)
AGE	-.016***	-.009***	-.008	-.002	-.004	-.005*	-.014***	-.005**	-.003
	(.003)	(.003)	(.005)	(.002)	(.003)	(.002)	(.002)	(.003)	(.005)
SIZE	.033**	.047**	.041	.035***	.037**	.037*	-.002	.012	.004
	(.017)	(.019)	(.041)	(.012)	(.018)	(.019)	(.015)	(.019)	(.032)
LIQU	-.031***	-.017***	-.015***	-.002	.002	.004**	-.029***	-.021***	-.018**
	(.002)	(.002)	(.005)	(.002)	(.003)	(.002)	(.002)	(.002)	(.008)
ASST	.07	-.056	-.088	.233***	.192***	.178***	-.158***	-.231***	-.265***
	(.044)	(.046)	(.059)	(.031)	(.064)	(.044)	(.039)	(.047)	(.089)
GROW	.045***	.015*	.005	.008	-.004	-.01	.038***	.023***	.015
	(.008)	(.009)	(.019)	(.006)	(.007)	(.008)	(.007)	(.009)	(.019)
_cons	.267	.002	.098	-.46**	-.451*	-.426	.717***	.426	.523
	(.259)	(.291)	(.635)	(.183)	(.273)	(.285)	(.229)	(.293)	(.505)
Observations	540	540	540	540	540	540	540	540	540
R-squared	.472	.308	.312	.168	.142	.098	.461	.238	.242

Source: Results are based on own calculations.

Note: CFLW- Cash flow ratio; AGE -Age of a company; SIZE – Size of a company; LIQU- Liquidity; ASST- Assets structure; GROW- growth . The Hausman specification test is employed to test the fixed and random effects model. Robust standard errors are utilized to address heteroskedasticity. Robust standard errors are in parentheses. ***p<.01, **p<.05, *p<.1

Table 6. Diagnostics and selected models for TOTD, LOTD, and SHTD

Diagnostics	Total Term Debt	Long Term Debt	Short Term Debt
Wald Test	36349.31***	4.2e+06***	1.2e+05***
Breusch-Pagan LM Test	708.12***	608***	540.92***
Hausman Test	55.54***	6.65	30.50***
Best fitted model	Fixed Effects	Random Effects	Fixed Effects

Source: Results are based on own calculations.

Note: *** Shows significance at the 0.01 level. Wald Test: tests the joint significance of the explanatory variables in the model; Breusch-Pagan LM Test: tests for heteroskedasticity in the regression model. Hausman Test: compares fixed effects and random effects models to determine if there is significant correlation between the regressors and the individual effects.

Table 7. Summary of the relationship of expected v/s empirical evidence for the Pecking Order Model.

Tested variables for POT	Expected sign	Test results	Indicated theory
V1-CFLW	Negative	TOTD- Supported, Sign. Negative	POT
		LOTD- Supported, Sign. Negative	POT
		SHTD- Supported, Sign. Negative	POT
V2-Age	Negative	TOTD- Rejected, N/S. Negative	POT
		LOTD- Rejected, N/S. Negative	POT
		SHTD- Rejected, N/S. Negative	POT
V3-Size	Positive	TOTD- Rejected, N/S. Negative	POT
		LOTD-Supported, Sign. Positive	POT
		SHTD- Rejected, N/S. Negative	POT
V4-Liquidity	Negative	TOTD- Supported, Sign. Negative	POT
		LOTD- Rejected, N/S. Positive	TOT
		SHTD- Supported, Sign. Negative	POT
V5-Asset structure	Positive	TOTD- Rejected, N/S. Negative	POT/TOT
		LOTD- Supported, Sign. Positive	POT/TOT
		SHTD- Rejected, Sign. Negative	POT/TOT
V6-Growth	Positive	TOTD- Rejected, N/S. Positive	POT
		LOTD- Rejected, N/S. Negative	TOT
		SHTD- Rejected, N/S. Negative	TOT

Source: Authors'calculation.

4.3. Trade-Off Model

The pecking order theory emphasizes tax considerations less than the trade-off theory. Following the literature, we added two new variables to the model: effective tax rate (ETR) and non debt tax shield (NDTS). For the robustness check, instead of the cash flow ratio, we decided to test for profitability (earnings before interest and taxes (EBIT) divided by total assets).

We estimated dynamic panel data methodology with the GMM method proposed by Arellano and Bond (1991). The dynamic model is initially estimated using a fixed effect approach using pooled OLS and LSDV approaches. For the decision of the best-fitted model, the pooled OLS estimate for ϕ is considered an upper-bound estimate. The corresponding fixed effects estimate is considered a lower-bound estimate. The best model relies on these two parameters.

The results of our estimation with a dynamic panel are very similar to the results obtained from the static panel.

Table 8. Estimation results for testing trade-off theory with dynamic panel data for total, long, and short-term debt

	Total Term Debt				Long Term Debt				Short Term Debt			
	OLS	FE	Onestep System GMM	Long Run Effects	OLS	FE	Twostep System GMM	Long Run Effects	OLS	FE	Onestep Difference GMM	Long Run Effects
L.TOTD	859***	424***	586***									
(Lagged 1)	(.019)	(.038)	(.096)									
L.LOTD					.79***	.26***	578***					
(Lagged 1)					(.027)	(.066)	(.118)					
L.SHTD									.744***	.317***	.66***	
(Lagged 1)									(.024)	(.043)	(.129)	
SIZE	-.001	.040	.008	.020	.005	.008	.018	.044	-.004	.037	.093	.275
	(.008)	(.036)	(.017)	(.042)	(.008)	(.027)	(.013)	(.028)	(.009)	(.034)	(.057)	(.201)
LIQU	-.006***	-.008**	-.013***	-.031***	.000	.004	.000	-.000	-.008***	-.014**	-.020**	-.059**
	(.001)	(.004)	(.004)	(.007)	(.001)	(.003)	(.001)	(.003)	(.001)	(.007)	(.009)	(.027)
PROF	-.278***	-.603***	-.649***	-1.57***	-.070	-.179**	-.153***	-.363**	-.312***	-.469***	-.337***	-.991**
	(.051)	(.088)	(.152)	(.406)	(.045)	(.075)	(.056)	(.141)	(.058)	(.101)	(.115)	(.449)
ASST	-.031	-.114*	-.008	-.020	.039*	.125**	.067*	.158**	-.07**	-.225**	-.335***	-.985**
	(.024)	(.061)	(.047)	(.113)	(.023)	(.062)	(.035)	(.076)	(.027)	(.093)	(.110)	(.413)
GROW	.009**	.012	.028***	.067***	.001	-.026**	.002	.005	.016***	.039*	.023	.069
	(.004)	(.019)	(.009)	(.022)	(.004)	(.010)	(.005)	(.012)	(.005)	(.020)	(.022)	(.065)
EFTR	-.140***	-.107**	-.105*	-0.253	-.029	-.003	-.038*	-.091*	-.104*	-.089	-.091	-.264
	(.047)	(.046)	(.058)	(.158)	(.044)	(.020)	(.020)	(.054)	(.053)	(.058)	(.098)	(.320)
NDTS	-.667***	-.701	-0.309	-0.745	-.408**	-.313	-.345**	-.817*	-.126	-.319	-.869*	-2.56
	(.197)	(.256)	(.332)	(.861)	(.183)	(.235)	(.165)	(.474)	(.221)	(.293)	(.439)	(1.74)
_cons	.158	-.216	.147		-.047	-.034	-.242		.218	-.201		
	(.131)	(.585)	(.279)		(.124)	(.429)	(.202)		(.148)	(.562)		

(continued)

Table 8. *Continued*

	Total Term Debt			Long Term Debt			Short Term Debt		
	OLS	FE	One Step System GMM	OLS	FE	Two Step System GMM	OLS	FE	One Step Difference GMM
Diagnostics:									
R-squared	0.90	0.47	-	0.709	0.20	-	0.827	0.34	-
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	450	450	450	450	450	450	450	450	360
Instruments/ Groups			22/90			17/90			21/90
Arellano-Bond test for AR (1)-Prob > z			0.000			0.000			0.000
Arellano-Bond test for AR (2)-Prob > z			0.435			0.377			0.464
Sargan Test-Prob >c^2			0.160			0.058			0.110
Hansen Test-Prob >c^2			0.181			0.167			0.170

Source: Results are based on own calculations.

Note: ***, **, and * denote significance at 1%, 5%, and 10%, respectively. P-values are in brackets. The Arellano-Bond test assesses autocorrelation, with the null hypothesis (Ho) being no autocorrelation. Rejection of this null hypothesis at the first order (p-value < 0.05) does not necessarily mean the model is misspecified. However, rejection at higher orders may suggest that the moment conditions are not met. The Sargan test evaluates the validity of overidentifying restrictions, with the null hypothesis (Ho) stating that these restrictions are valid. A p-value greater than 0.05 supports the validity of the restrictions, while rejection of this null hypothesis indicates a need to review the model or instruments. The robust option was used to account for heteroskedasticity. The small option was used to apply the Windmeijer correction. Year dummies were included to account for time-specific effects. Results were generally insignificant, suggesting no significant common time trends. Graphical representations are provided for clarity.

Table 8. represents the results of dynamic panel estimation for testing a trade-off assumption. In our dynamic panel data analysis, the coefficients of the lagged dependent variable indicate the degree to which past debt levels influence current debt ratios. Specifically, for total term debt, the coefficient is 0.586, suggesting that approximately 58.6% of the total term debt ratio from the previous period persists into the current period, resulting in a speed of adjustment of about 41.4%. For long-term debt, the coefficient is 0.578, meaning that 57.8% of the long-term debt ratio is retained from the previous period, with an adjustment speed of 42.2%. In contrast, the coefficient for short-term debt is 0.66, indicating that 66% of the short-term debt ratio is carried over, which translates to a quicker adjustment speed of 34%. These results reveal that SMEs exhibit a gradual adjustment process towards their target debt ratios for total and long-term debts, likely due to financial or operational constraints.

Conversely, the faster adjustment observed for short-term debt, possibly due to the more frequent opportunities to manage short-term obligations.

From the presented results in Table 8 we conclude that the firm's debt ratio is negatively related to profitability. A negative relationship between profitability and capital structure is found in empirical findings (Sogorb-Mira 2005; Daskalakis and Psillaki 2008; Kenourgios, Savvakis, and Papageorgiou 2019). This evidence contradicts the trade-off assumption, where more profitable firms use more debt, and is in line with our previous estimated model presented in Table 5. The applicability of POT to SMEs is also confirmed by (Atiyet 2012; Qerimi, Aliu, and Krasniqi 2021). Liquidity has negatively impacted short and total-term debt. These results contradict TOT assumptions and align with Jaworski and Czerwonka (2023) findings. Growth is significant and positive in determining total term debt. Prenaj, Miftari., and Kransiqi (2023) also find a

positive relationship between growth and total term debt. Asset structure has shown the same significance and relationship with debt as stated in static model. Non-debt tax shields showed a statistically negative relationship with long-term, and short-term debt. On the other hand, the coefficient for the effective tax rate is negative and important in determining total and long-term debt.

In the long run, SMEs demonstrate a significant responsiveness to financial indicators in their debt management. Specifically, increased liquidity and profitability are consistently associated with lower debt levels, indicating that financially healthier firms prefer less debt. This trend is evident across total term debt, long-term debt, and short-term debt. Additionally, factors like asset structure and effective tax rate also play a role, though their impact varies.

In our analysis, we included year dummies to control for any potential common time effects that could influence the dependent variables across different years. This approach helps account for time-specific factors that might impact the capital structure of SMEs uniformly across the sample period (Baltagi, 2008).

The year dummies were generally insignificant, indicating no substantial common time trends affecting the variables. Figure 1 illustrates the minimal impact of year effects on Total, Long-Term, and Short-Term Debt for 2013-2018.

Findings regarding the relationship between variables and capital structure, under the trade-off theory (TOT) assumptions, are presented in Table 9.

Figure 1. Yearly Effects on Total, Long-Term, and Short-Term Debt (2013-2018)
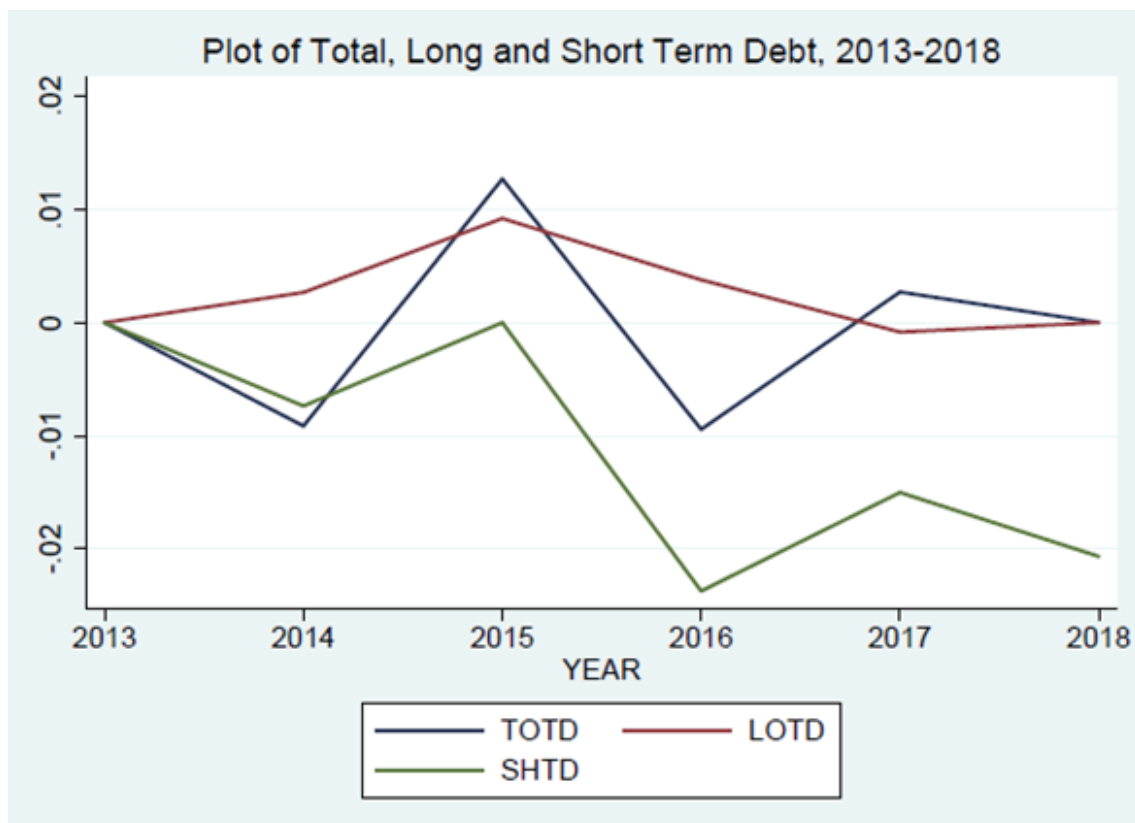
Source: Results are based on own calculations.

Note: Year dummies were included to control for time-specific effects. Results showed minimal impact on the variables, hence detailed results are omitted.

Table 9. Summary of the relationship of expected v/s empirical evidence for the Trade-off Model

Tested variables for TOT	Expected sign	Test results	Indicated theory
DTR −1	Positive	TOTD- Supported, Sign. Positive	/
		LOTD- Supported, Sign. Positive	/
		SHTD- Supported, Sign. Positive	/
V1-Size	Positive	TOTD- Rejected, N/S, Positive	TOT/POT
		LOTD- Rejected, N/S, Positive	TOT/POT
		SHTD- Rejected, N/S, Positive	TOT/POT
V2-Liquidity	Positive	TOTD- Rejected, Sign. Negative	POT
		LOTD- Rejected, N/S, Positive	TOT
		SHTD- Rejected, Sign. Negative	POT
V3-Profitability	Positive	TOTD- Rejected, Sign. Negative	POT
		LOTD- Rejected, Sign. Negative	POT
		SHTD- Rejected, Sign. Negative	POT
V4-Asset Structure	Positive	TOTD- Rejected, N/S. Negative	POT/TOT
		LOTD- Supported, Sign. Positive	POT/TOT
		SHTD- Rejected, Sign. Negative	POT/TOT
V5-Growth	Negative	TOTD-Rejected, Sign. Positive	POT
		LOTD- Rejected, N/S, Positive	POT
		SHTD- Rejected, N/S, Positive	POT
V6-Effective tax rate	Positive	TOTD- Rejected, Sign. Negative	POT
		LOTD- Rejected, Sign. Negative	POT
		SHTD- Rejected, N/S, Negative	POT
V7-Non-debt tax shield	Negative	TOTD- Supported, Sign. Negative	POT/TOT
		LOTD- Supported, Sign. Negative	POT/TOT
		SHTD- Supported, Sign. Negative	POT/TOT

Source: Authors'calculation.

4.4. Additional Robustness checks

To enhance the robustness of our analysis, we performed several additional checks beyond the primary estimations. Specifically, we conducted a sector-based subsample analysis. This approach allows us to examine whether the observed relationships between the financial variables and capital structure are stable across various sectors of the economy. The results of the subsample analysis, as detailed in Table 10 reveal sector-specific variations in debt determinants. The effects of profitability and liquidity are notably different between manufacturing and trade/services sectors, reflecting sectoral differences in financial dynamics. In manufacturing, factors such as profitability, asset structure and size have significant effects on debt levels, while in trade and services, liquidity, profitability, growth, asset structure and effective tax rate show more impacts.

These differences highlight the need for sector-specific analysis in understanding debt determinants, as sectoral characteristics can substantially influence the relationships between variables.

Table 10. GMM results for total, long and short term debt: sector sample

	Total Term Debt		Long Term Debt		Short Term Debt	
	By sector		By sector		By sector	
	Manufacturing	Trade and Services	Manufacturing	Trade and Services	Manufacturing	Trade and Services
	One Step System GMM	One Step System GMM	One Step System GMM	Two Step System GMM	Two Step System GMM	One Step Difference GMM
L.TOTD	.817***	.544***				
(Lagged 1)	(.179)	(.122)				
L.LOTD			515***	.630***		
(Lagged 1)			(.134)	(.168)		
L.SHTD					319***	.696 ***
(Lagged 1)					(.163)	(.156)
SIZE	.014	(.009)	.042*	.00	-.022	.106
	(.012)	(.028)	(.023)	(.017)	(.023)	(.076)
LIQU	-.007	-.014**	.001	-.001	-.019	-.024**
	(.006)	(.006)	(.002)	(.002)	(.013)	(.011)
PROF	-.364***	.691***	-.249**	-.112*	-.332**	-.418***
	(.128)	(.140)	(.10)	(.066)	(.152)	(.139)
ASST	-.001	.0160	.103*	.055	-.179***	-.375**
	(.410)	(.065)	(.054)	(.048)	(.057)	(.144)
GROW	.005	.029**	.014	-.003	.013	.038
	(.100)	(014)	(.010)	(.007)	(.018)	(.028)
EFTR	.150	-.137***	.327	-.053*	.236	-.099
	(.227)	(.051)	(.228)	(.027)	(.351)	(0.1)
NDTS	-.419	-.174	.468	-.167	.377	-.549
	(.247)	(.745)	(.322)	(.297)	(.436)	(.689)
_cons	-.100	.164	-.616	.049	.735	
	(.180)	(.447)	(.348)	(.269)	(.397)	

(continued)

Table 10. *Continued*

	Total Term Debt		Long Term Debt		Short Term Debt	
	By sector		By sector		By sector	
	Manufacturing	Trade and Services	Manufacturing	Trade and Services	Manufacturing	Trade and Services
	One Step System GMM	One Step System GMM	One Step System GMM	Two Step System GMM	Two Step System GMM	One Step Difference GMM
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes
Observations	135	315	135	315	135	252
Instruments/ Groups	17/27	22/63	17/27	17/63	17/27	21/63
Arellano-Bond test for AR (1)-Prob > z	0	0.004	0.013	0.001	0.006	0.001
Arellano-Bond test for AR (2)-Prob > z	147	0.587	0.535	0.138	0.79	0.286
Sargan Test-Prob >c^2	210	0.126	0.172	0.099	0.455	0.227
Hansen Test-Prob >c^2	366	0.291	0.187	0.124	0.494	0.684

Source: Results are based on own calculations.

Note: ***, **, and * denote significance at 1%, 5%, and 10%, respectively. P-values are in brackets. The Arellano-Bond test assesses autocorrelation, with the null hypothesis (Ho) being no autocorrelation. Rejection of this null hypothesis at the first order (p-value < 0.05) does not necessarily mean the model is misspecified. However, rejection at higher orders may suggest that the moment conditions are not met. The Sargan test evaluates the validity of overidentifying restrictions, with the null hypothesis (Ho) stating that these restrictions are valid. A p-value greater than 0.05 supports the validity of the restrictions, while rejection of this null hypothesis indicates a need to review the model or instruments. The robust option was used to account for heteroskedasticity. The small option was used to apply the Windmeijer correction. Year dummies were included to account for time-specific effects.

5. Conclusions

The paper contributed to investigating firm-specific characteristics associated with capital structure and evaluated prominent theories (POT, TOT) explaining the financial policy in SMEs in Kosovo.

Profitability showed consistent negative impact on debt term, indicating that more profitable firms are less dependent on external debt. Finding aligns with the pecking order theory, which suggests that more profitable SMEs tend to rely less on debt financing. Also higher cash flow and liquidity lead to reduced reliance on debt.

Larger firms and those with significant tangible assets tend to utilize more long-term debt. This suggests that size and asset structure play crucial roles in determining the capital structure.

The dynamic panel data analysis highlights the persistence of debt levels, indicating that past debt usage strongly influences current debt levels. This underscores the importance of understanding historical debt patterns in predicting future financing needs. The negative impact of non-debt tax shields and effective tax rates on debt suggests that firms with higher tax shields or more favorable tax conditions prefer less debt.

The analysis reveals sector-specific variations in debt determinants. This suggests that sector-specific characteristics should be considered when analyzing capital structure.

Our results have significant implications for policymakers and firm managers of Kosovar SMEs. They underscore that SMEs in Kosovo predominantly rely on internally generated funds to support their investment activities and growth, facing challenges in obtaining external financing.

The findings aslso suggest a need for targeted financial policies that address the specific challenges faced by SMEs in different sectors. Providing

sector-specific financial support and resources can help improve the capital structure and overall financial health of SMEs in Kosovo.

The study is limited by the availability of data and the specific sample of SMEs in Kosovo. Future research could benefit from larger and more diverse samples to enhance the generalizability of the findings.

Additional research could explore other factors influencing capital structure, such as market conditions, regulatory changes, and macroeconomic variables. Longitudinal studies and comparative analyses with SMEs in other countries could provide deeper insights into the dynamics of capital structure.

Appendix 1. Correlation matrix of dependent and explanatory variables

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
TOTD	1.000											
LOTD	0.484*	1.000										
SHTD	0.828*	-0.089	1.000									
CFLW	-0.388*	-0.162*	-0.335*	1.000								
AGE	-0.275*	-0.065	-0.271*	0.077	1.000							
SIZE	0.072	0.201*	-0.047	-0.163*	0.217*	1.000						
LIQU	-0.532*	-0.150*	-0.510*	0.077	0.111*	-0.119*	1.000					
PROF	-0.370*	-0.103	-0.354*	0.940*	0.112*	-0.135*	0.106	1.000				
ASST	0.106	0.352*	-0.102	-0.035	-0.067	0.230*	-0.168*	-0.129*	1.000			
GROW	0.137*	-0.113*	0.231*	0.211*	-0.069	-0.407*	-0.098	0.283*	-0.320*	1.000		
EFTR	-0.108	-0.063	-0.083	0.119*	0.026	-0.022	0.035	0.145*	-0.140*	-0.011	1.000	
NDTS	0.109	0.079	0.075	0.278*	-0.155*	-0.098	-0.179*	-0.006	0.375*	-0.067	-0.090	1.000

* Shows significance at the 0.01 level.

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THE RELATIONSHIP BETWEEN WORKPLACE ROBOTS, EMPLOYEE EXHAUSTION, AND TURNOVER INTENTIONS IN THE AGE OF INDUSTRY 5.0: RESEARCH FROM FOUR SOUTHEASTERN EUROPEAN COUNTRIES

Jelena Lukić Nikolić, Pero Labus

Abstract

This paper examines and analyzes the relationship between workplace robots, employee emotional exhaustion, and turnover intentions within the context of Industry 5.0. Empirical research was conducted from January to May 2024. During this period, a total of 582 respondents from four Southeastern European countries (Serbia, Croatia, Montenegro, Bosnia and Herzegovina) participated in the research. The proposed relationships between variables were tested by using the partial least squares method for structural equation modeling (PLS-SEM, SmartPLS software). The research results confirmed that the emotional exhaustion of employees had a positive relationship with turnover intentions, while workplace robots' effects were negatively related to employee emotional exhaustion and turnover intentions. Leaders, managers, and human resource professionals may benefit from the findings presented in this paper, especially during the decision-making process on how to reduce the emotional exhaustion of employees by using workplace robots, which, in the end, will result in employee retention.

Keywords: *Industry 5.0, Workplace Robots, Emotional Exhaustion, Turnover Intentions, Employee Retention*

JEL classification: *O33, M54*

1. Introduction

Industry 5.0 indicates the transition to a more sustainable, human, and resilient industry (Xu et al. 2021), which is a much safer, more responsible, and more ethical than previous industrial revolutions (Özdemir and Hekim 2018). The primary goal of Industry 5.0 is to produce personalized products and/or services by involving intensive collaboration between humans and machines, especially robots (Demir, Döven, and Sezen 2019). In this industrial revolution, technology represents a means to support and facilitate human labor by providing a safe and pleasant workplace, well-being, and physical and mental health (Xu et al. 2021). As a result, Industry 5.0 has a wide range of implications for human resource management and organizational

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behavior. First of all, there will be fully automated jobs, as the primary focus of workplace robots is on executing mundane, monotonous, and repetitive tasks. In this way, employees will be able to focus on more creative and challenging tasks and activities. In some workplaces, employees and robots may collaborate to partially automate tasks; in these scenarios, robots will assist and support employees rather than replace them (Lukić Nikolić 2024). Likewise, there will be new job positions in organizations, such as Robotics Technicians and Engineers, Robot Operators and Programmers, Robotics Ethics and Policy Specialists, Robot Training Specialists, etc. Certain jobs will experience changes in their responsibilities and duties, and some employees will become stressed due to their fear of losing their jobs or having their pay cut as contemporary automated systems and robots take over some of their duties (Lukić Nikolić 2022). Nevertheless, employees are one of the most crucial components of an organization's ability to run smoothly and accomplish its goals. Moreover, in the contemporary business environment and fierce competition, the ability of an organization to retain employees is a key indicator of its strength (Kundu and Lata 2017). Consequently, numerous organizations are implementing special strategies oriented toward long-term employee retention (Hom and Griffeth 1995). These retention strategies may focus on competitive compensation and benefits, career development opportunities, training and development, a positive organizational atmosphere and culture, work-life balance, health and wellness programs, as well as strong onboarding processes, feedback mechanisms, employee recognition programs, and the preparation of an adequate employee value proposition (Lukić Nikolić and Lazarević 2022; Lukić Nikolić and Garabinović 2023). Some companies even have a particular person that works as an "Employee Retention Specialist" and is primarily responsible for retaining current employees (Singh 2019). Employee retention represents a state in which employees desire to remain with their current organization due to favorable working conditions and an organizational climate that fully satisfies and engages them (Kibui, Gachunga, and Namusonge 2014).

Leaders, managers, and human resource professionals face a significant challenge in developing and implementing effective employee retention strategies.

The contemporary business environment, characterized by intense competition and relentless pressure to reduce costs, improve productivity, and satisfy customer demands, often leads to employee emotional exhaustion (Pacheco et al. 2023). As a result, numerous detrimental effects affect both the individual and the organization. The effectiveness of an organization is in doubt, and outcomes could be far worse in organizations with a high percentage of emotionally exhausted employees. Simultaneously, continuous technological progress in the age of Industry 5.0 has expedited the acceptance and application of various types of robots in the workplace (Turja and Oksanen 2019; Kim 2022; Lukić Nikolić 2024). Employers are experimenting with the use of workplace robots to enhance employees' overall experience, lessen emotional exhaustion, and decrease turnover intentions. According to estimates, by 2030, service robots could account for as much as 25% of the workforce (Bowen and Morosan 2018). As always with new technology, users have many doubts about its implementation and beneficial use (Čuić Tanković, Perišić Prodan, and Benazić 2023). Respecting each other's knowledge, skills, and capacities in the workplace is becoming increasingly important for humans and machines to coexist (Nahavandi 2019; Doyle Kent and Kopacek 2020). Leaders, managers, and employees need to be prepared for a working environment shaped by new technologies, such as robotic process automation, modern robotic systems, artificial intelligence, advanced data analytics, big data, and blockchain.

The aim of this paper is to examine and analyze the relationship between workplace robots, employee emotional exhaustion and turnover intentions in the age of Industry 5.0. The rapid evolution of Industry 5.0, characterized by the increasing integration of robots in workplaces, presents a critical challenge - understanding the multifaceted impact of automation on employees (Yam et al. 2023). The theories that underpin this research are sociotechnical systems theory and job demands-resources theory. By exploring how the introduction of workplace robots (a technical change) affects employee exhaustion and turnover intentions (social aspects), the paper provides empirical evidence for sociotechnical systems theory. Job demands-resources theory explains that job demands can lead to exhaustion, while job resources can reduce

employee exhaustion. In the context of workplace robots, this theory can be used to investigate how the introduction of robots affects the balance of job demands and resources, and subsequently, employee emotional exhaustion and turnover intentions. This research topic is of paramount importance as it seeks to address this challenge by examining both the positive and negative effects of robot adoption on employee emotional exhaustion and turnover intentions. The findings will offer valuable insights for organizations striving to optimize workplace robot implementation. Organizations can develop targeted strategies to mitigate negative consequences and foster a positive work environment. This includes implementing measures to reduce emotional exhaustion, decrease turnover rates, and promote a culture of continuous learning and adaptation, ultimately ensuring a successful and sustainable transition into the age of Industry 5.0.

The paper is organized as follows. The first part presents a literature review on employee turnover intentions, emotional exhaustion, and workplace robots in the age of Industry 5.0. The second part focuses on research methodology and provides a summary of the empirical research undertaken, beginning with the questionnaire structure, data collection procedure, and statistical software and techniques used. The third part contains the research results, while the fourth part discusses the research findings. Finally, the conclusion presents the key findings, their implications, the limitations of the paper, and propositions for future research on this topic.

2. Literature Review and Hypotheses Development

2.1. Employee Turnover Intentions and Emotional Exhaustion

Employee turnover is caused by a sequence of cognitive processes that happen before an employee departs from the organization (Hom et al. 2017). It is defined as the number of employees who leave an organization and are replaced by new employees (Codling et al. 2023). Voluntary turnover occurs when an employee decides to quit a job or organization, while involuntary turnover occurs when an employer decides to terminate an employee (Holtom et al.

2008). Employee turnover has a significant detrimental impact on organizational outcomes (Han 2022). It results in higher expenses due to the need to acquire and train new employees, a loss of tacit knowledge, decreased efficiency, and lower service quality (Duarte and Silva 2023). In those industries and businesses where employee-client connections are essential, high turnover rates have a detrimental impact on customer satisfaction and overall experience. Turnover intention is an employee's deliberate and intentional decision to leave their job and the organization (Tett and Meyer 1993). Employees who express higher levels of turnover intention are more likely to actively search for new employment opportunities and eventually resign from their current positions. Understanding and addressing the factors that contribute to turnover intention is crucial for organizations seeking to retain their valuable talent. There are numerous factors that influence employee turnover intentions, including organizational and managerial support, role clarity, autonomy, salary, reward system, job stress, and well-being (Kim 2014). Working in a highly competitive industry can be extremely stressful due to poor working conditions, a heavy workload, and constant pressure to impress clients (Chalkiti and Sigala 2010). In practice, employee turnover is mostly influenced by poor relationships with management and coworkers, job insecurity, and a low level of interactions among employees as well as between employees and superiors (Codling et al. 2023). One of the strongest predictors of employee turnover intentions is their emotional exhaustion (Ducharme, Knudsen, and Roman 2008; Knudsen, Ducharme, and Roman 2009; Green, Miller, and Aarons 2013; Ding and Wu 2023).

Maslach and Jackson (1981) defined emotional exhaustion as employees' feelings of being emotionally exhausted by their job. This definition emphasizes the draining nature of work-related stress on an individual's emotional well-being. Schaufeli and Buunk (2003) described emotional exhaustion as a chronic state of physical and emotional depletion that results from excessive job demands and exposure to stress. This definition emphasizes the chronic and persistent nature of emotional exhaustion, as well as its potential causes. Emotional exhaustion is defined as the depletion or overuse of an employee's psychological and emotional resources (Ding and Wu 2023). It happens

when job expectations are excessive and personal resources are insufficient. It is frequently caused by excessive and complex work responsibilities, the requirement to be continually available to superiors, colleagues, or clients, deadline pressure, or a lack of knowledge and abilities for assigned tasks and activities (Maslach, Schaufeli, and Leiter 2001; Lukić Nikolić and Mirković 2024). Employee emotional exhaustion causes a variety of negative consequences, including constant feelings of mental, emotional, and cognitive exhaustion, anxiety, feelings of powerlessness, apathy, decreased motivation and satisfaction, and decreased productivity and work results (Schaufeli and Enzmann 1998; Costin, Roman, and Balica 2023). Individuals can experience emotional exhaustion in a variety of situations, places, and work environments (Yang 2023). Multiple studies have demonstrated that one of the major causes of employee exhaustion is work overload and activities that are extensive, urgent, and complex (Leiter and Maslach 2005; Casserley and Megginson 2009; Edú-Valsania, Laguía, and Moriano 2022). Furthermore, the pressure to produce the best possible results, without errors, and within the specified dates can contribute to emotional exhaustion. Emotional exhaustion diminishes employees' satisfaction with their jobs and weakens their commitment to the organization. This is because exhaustion depletes their energy and enthusiasm, making it difficult to find meaning and fulfillment in their work (Demerouti et al. 2001; Park and Kim 2021). As a result, employees may start looking for alternative employment options. Consequently, the proposed hypothesis in this research is:

Hypothesis 1: Employee emotional exhaustion is positively related to their turnover intentions.

2.2. Workplace Robots

Many organizations are attempting to prevent employee exhaustion and turnover intentions using various solutions and methods. One of the solutions is to implement workplace robots. Robots are intelligent physical systems equipped with sensors, actuators, and a certain amount of artificial intelligence, and are programmed by computer algorithms to do various jobs in place of or alongside humans (Carrozza 2019; Smids, Nyholm, and Berkers 2020). Robots can sense their environment (they have perception) and act

upon it (execute an action) in an intelligent manner (Bekey 2005). Workplace robots are designed to be reprogrammable, allowing them to adapt to different tasks and environments. This flexibility is crucial in industries where production processes may change frequently (Siciliano and Khatib 2016). Unlike specialized machines that can only perform a single task, workplace robots are often designed to be multifunctional. This means they can be equipped with different tools and accessories to perform a variety of functions, which reduces the need for multiple machines, saving space and costs (Nof 2019). A collaborative robot, often known as a cobot, is specifically designed to work and interact with humans (Castillo et al. 2021). This type of robot possesses human-like qualities, allowing it to collaborate with both people and other robots. Unlike traditional industrial robots that were usually isolated in a separate workplace from employees, collaborative robots share the same workspace with employees and work together with them on mutual tasks (Pauliková, Gyurák Babeľová, and Ubárová 2021; Lukić Nikolić and Labus 2024).

Robots offer several benefits to organizations. They cost less than human employees, make fewer mistakes at work, and never complain about working conditions (Nakitare et al. 2020). Robots and automation systems can enhance the quality and variety of products and services (Ing, Grossman, and Christian 2022). Robots' primary benefits include supporting employees with everyday activities, delivering continuous services, and ensuring consistent service quality (Kwanya 2023). Furthermore, mobile robots and exoskeletons make some occupations easier and less physically demanding, allowing women to work in traditionally male-dominated jobs (Breque, De Nul, and Petridis 2021). In hazardous or high-stress work environments, robots can replace humans, protecting them from physical and psychological harm. This reduces the risk of burnout caused by prolonged exposure to dangerous or stressful situations (Parasuraman and Riley 1997). Robots can automate repetitive, mundane, and physically demanding tasks, thereby reducing the workload on employees. This can prevent exhaustion stemming from excessive work demands and free up employees to focus on more stimulating and intellectually engaging activities (Nof 2019). Furthermore, when robots take over tedious tasks, employees can focus on more

meaningful and skill-enhancing activities. This can lead to increased job satisfaction, a sense of accomplishment, and reduced emotional exhaustion (Frey and Osborne 2017). By automating routine tasks, robots can enable flexible work arrangements, allowing employees to adjust their schedules and work remotely when needed. This flexibility can promote better work-life balance, reducing stress and exhaustion (Brynjolfsson and McAfee 2014). Consequently, the proposed hypothesis in this research is:

Hypothesis 2: Employee emotional exhaustion is negatively related to workplace robots' effects.

Robots can take over dangerous or physically demanding tasks, improving workplace safety and reducing the risk of injuries. This can enhance job satisfaction, promote overall employee well-being, and reduce their turnover intentions. Robots can contribute to the organization's overall success leading to increased wages, bonuses, and other benefits for employees, incentivizing them to remain with the organization (Acemoglu and Restrepo 2020). Additionally, robots can alleviate stress caused by factors such as heavy workloads, tight deadlines, and repetitive tasks. By taking on these burdens, robots can create a less stressful work environment, improving employee well-being and reducing turnover intentions. Consequently, the proposed hypothesis in this research is:

Hypothesis 3: Workplace robots' effects are negatively related to employee turnover intentions.

Figure 1 illustrates the research framework used in this paper.

3. Methodology

3.1. Research Technique

The field research was conducted using a questionnaire technique for data collection. At the beginning of the questionnaire, the key goal of the research and a prerequisite for participation – the deployment of workplace robots in the organization were stated. The first part of the questionnaire consisted of profile questions such as gender, age, education, length of working experience, and the country in which respondents work. The second part of the questionnaire included three measurement scales with statements that respondents answered by selecting one of the options on a seven-point Likert scale (1 – completely disagree, 7 – completely agree). The first scale, "Emotional Exhaustion" (EE), was based on Maslach Burnout Inventory, focusing on the dimension of Emotional Exhaustion among employees (Maslach, Jackson, and Leiter 1996). The second scale, "Turnover Intention" (TI), included three statements from the Michigan Organizational Assessment Questionnaire (Cammann et al. 1983). To facilitate interpretation and presentation of results, all statements in this scale were formulated in a negative tone. The third scale, "Workplace Robots' Effects" (WRE), consisted of three statements derived from previous literature and field research regarding robots in the workplace and their key positive effects. The final questionnaire contained a total of 15 statements, which are presented in Table 4.

3.2. Procedure

The pilot study was conducted after the completion of the initial version of the questionnaire. It included 30

Figure 1. Research Framework
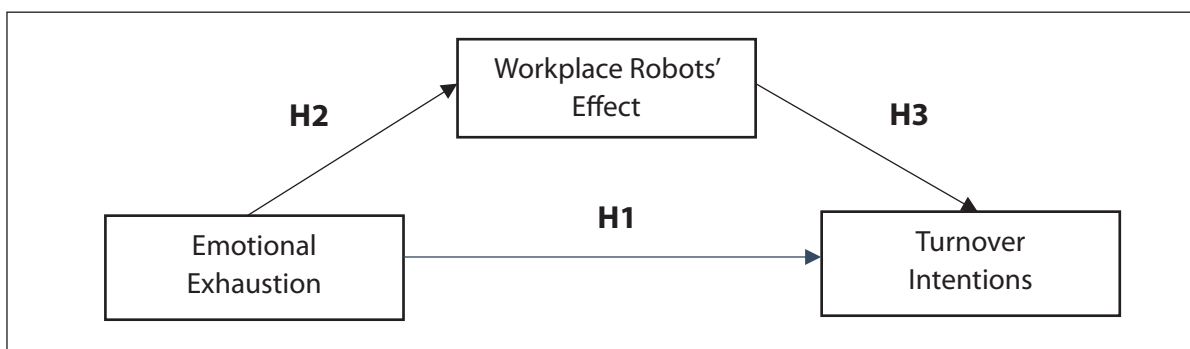
Source: Authors

respondents who work in organizations from the hospitality industry that use workplace robots, with the goal of determining the questions' comprehension, clarity, and unambiguity. Following a few minor stylistic changes suggested by respondents during the pilot research, the questionnaire was improved and completed, showing a high level of reliability of the measurement scales (the Cronbach alpha coefficient for all three scales was greater than 0.7).

The final questionnaire was conducted online using Google Forms. Data collection lasted from January 2024 to May 2024. The questionnaire was sent to managers of hospitality establishments in four Southeastern European countries (Serbia, Croatia, Montenegro, Bosnia and Herzegovina) with a kind request to distribute it to their employees for completion. During this period approximately 1,200 employees from hospitality establishments received the questionnaire. A total of 582 respondents participated in the research, making a response rate of 48.5%, which is considered satisfactory in the field of social science, bearing in mind that the acceptable response rate ranges from 30 to 70% (De Vaus 2013). In accordance with the "ten times" rule (Barclay, Higgins, and Thompson 1995), which states that the minimum sample size should be ten times the number of independent variables in the most complex regression in the model, the sample size obtained in this research is more than sufficient (10 x 9 = 90, while 582 respondents participated in this research).

The collected answers were processed and analyzed using Statistical Software for Social Sciences (SPSS) version 21.0 and SmartPLS software version 4.0. The proposed hypotheses were assessed using the partial least squares method for structural equation modeling (PLS-SEM).

3.3. Respondents

Table 1 shows the key characteristics of the respondents who participated in this research. Slightly more women (52.1%) than men (47.9%) participated in the research. In terms of age structure, the largest number of respondents were between 30 and 50 years old (62.5%), followed by respondents who were under 30 years old (23.9%). A small number of respondents (13.6%) were over 50 years old. The largest number of respondents who participated in the research had completed secondary school (63.8%). Another 25.6% of respondents completed high school, and 8.2% had completed university-level education. Regarding the length of work experience, the largest number of respondents had been working for more than 10 years (48.3%), followed by those who had been working for 5 to 10 years (22.5%) and those who had been working for 1 to 5 years (22.0%). Respondents from Serbia (30.8%), Croatia (18.0%), Montenegro (27.3%) and Bosnia and Herzegovina (23.9%) participated in the research.

Table 1. Key characteristics of respondents

Characteristics		N	%
Gender	Male	279	47.9
	Female	303	52.1
Age	Below 30	139	23.9
	From 30 to 50	364	62.5
	Above 50	79	13.6
Education	Primary School	14	2.4
	Secondary School	371	63.8
	High School	149	25.6
	University	48	8.2
Length of working experience	Up to 1 year	42	7.2
	From 1 to 5 years	128	22.0
	From 5 to 10 years	131	22.5
	Above 10 years	281	48.3
Country	Serbia	179	30.8
	Croatia	105	18.0
	Montenegro	159	27.3
	Bosnia and Herzegovina	139	23.9

Source: Authors' own calculations

4. Results

4.1. Reliability, Validity, and Descriptive Statistics

Reflective indicator loadings for the structural model were calculated and presented in Table 2. All values of the reflective indicator loadings are higher than the threshold value of 0.708, indicating that the reliability criterion is satisfied (Hair et al. 2021).

Table 3 shows Cronbach's alpha coefficient, Composite Reliability (rho_a and rho_c), and Average Variance Extracted (AVE) values used to establish indicator and construct reliability and validity. Cronbach's alpha for the Emotional Exhaustion (EE) scale was 0.983, with rho_a and rho_c both at 0.985,

while the Average Variance Extracted (AVE) was 0.878. Cronbach's alpha for the Turnover Intentions (TI) scale was 0.961, with rho_a of 0.961, rho_c of 0.975, and Average Variance Extracted (AVE) of 0.928. For the Workplace Robots' Effects (WRE) scale, Cronbach's alpha was 0.940, rho_a was 0.955, rho_c was 0.961, and the Average Variance Extracted (AVE) was 0.892. The obtained results for each of the scales indicated significant scale reliability as well as construct reliability and validity, since Cronbach's alpha and Composite Reliability (CR) were greater than 0.7, and the Average Variance Extracted (AVE) exceeded the threshold value of 0.5 (Fornell and Larcker 1981).

Table 2. Reflective indicator loadings

	EE	TI	WRE
EE1	0.949		
EE2	0.925		
EE3	0.950		
EE4	0.950		
EE5	0.968		
EE6	0.954		
EE7	0.862		
EE8	0.920		
EE9	0.951		
TI1		0.974	
TI2		0.978	
TI3		0.939	
WRE1			0.931
WRE2			0.955
WRE3			0.948

Source: Authors' own calculations

Table 3. Scale reliability and construct reliability and validity

Scale	Cronbach's alpha coefficient	rho_a	rho_c	AVE
Emotional Exhaustion (EE)	0.983	0.985	0.985	0.878
Turnover Intention (TI)	0.961	0.961	0.975	0.928
Workplace Robots' Effects (WRE)	0.940	0.955	0.961	0.892

Source: Authors' own calculations

Table 4. Mean (M) and Standard Deviation (SD) for scales and statements

Scales	M	SD
Emotional Exhaustion (EE)	**2.35**	**1.939**
I feel emotionally drained from my work (EE1)	2.22	2.004
I feel used up at the end of work day (EE2)	2.63	2.080
I feel fatigued when I get up in the morning and have to face another day on the job (EE3)	2.08	1.914
Working with clients all day is really a strain for me (EE4)	2.38	2.042
I feel burned out from my work (EE5)	2.11	1.995
I feel frustrated by my job (EE6)	1.96	1.930
I feel I am working too hard on my work (EE7)	2.85	2.389
Working directly with people put too much stress on me (EE8)	2.63	2.233
I feel like I am at the end of my strength (EE9)	2.29	2.071
Workplace Robots Effects (WRE)	**6.21**	**1.571**
Workplace robots are more efficient and faster compared to humans (WRE1)	6.07	1.676
Workplace robots lead to significant savings (WRE2)	6.22	1.578
Robots' free up employees from repetitive and manual tasks (WRE3)	6.35	1.459
Turnover Intentions (TI)	**1.97**	**1.726**
I often think of leaving the organization (TI1)	1.86	1.695
It is highly likely that I will look for a new job next xyear (TI2)	1.93	1.778
If I may choose again, I will not choose to work for the current organization (TI3)	2.14	1.906

Source: Authors' own calculations

Table 4 shows mean (M) and standard deviation (SD) for each of the measurement scales and their respective statements. The mean value for the entire Emotional Exhaustion (EE) scale was 2.35. The statement that employees feel they are working too hard had the highest mean value (2.85), while the statement that employees feel frustrated with their job had the lowest mean value (1.96). The mean value for the entire Workplace Robots' Effects (WRE) scale was 6.21. The statement that robots free up employees from repetitive and manual tasks had the highest mean value (6.35), while the statement that workplace robots are more efficient and faster than humans had the lowest mean value (6.07). The mean value for the Turnover Intention (TI) scale was 1.97. The statement that employees would not choose to work for their current organization again if given the choice had the highest mean value (2.14), while the statement that

employees often think of leaving the organization had the lowest mean value (1.86).

4.2. Discriminant Validity and Variance Inflation Factor

Three approaches were used to examine discriminant validity: cross-loading indicators, the Fornell-Larcker criterion, and the heterotrait-monotrait (HTMT) correlation ratio (Ab Hamid, Sami, and Sidek 2017). Table 5 shows the cross-loading results. The results demonstrated that the loading of each item on its related measurement scale was greater than the loadings of items on other measurement scales, indicating the presence of discriminant validity (Barclay, Higgins, and Thompson 1995).

Table 5. Discriminant validity: Cross-loadings results

	EE	TI	WRE
EE1	0.949	0.672	-0.121
EE2	0.925	0.599	-0.113
EE3	0.950	0.635	-0.118
EE4	0.950	0.596	-0.108
EE5	0.968	0.664	-0.104
EE6	0.954	0.657	-0.103
EE7	0.862	0.511	-0.065
EE8	0.920	0.558	-0.082
EE9	0.951	0.602	-0.104
TI1	0.625	0.974	-0.183
TI2	0.632	0.978	-0.182
TI3	0.635	0.939	-0.170
WRE1	-0.095	-0.174	0.931
WRE2	-0.084	-0.155	0.955
WRE3	-0.127	-0.191	0.948

Source: Authors' own calculations

Table 6 shows the results for discriminant validity as determined by the Fornell-Larcker criterion. The results demonstrated that the square root of the Average Variance Extracted (AVE) had a higher value than all correlations with the latent variable (Fornell and Larcker 1981). Consequently, discriminant validity, according to the Fornell-Larcker criterion, was satisfied.

Table 6. Discriminant validity: Fornell–Larcker criterion

	EE	TI	WRE
EE	0.937		
TI	0.655	0.963	
WRE	-0.110	-0.185	0.945

Source: Authors' own calculations

Table 7 shows the results of discriminant validity using the heterotrait-monotrait (HTMT) correlation ratio. The obtained results were below the specified threshold of 0.85 (Henseler, Ringle, and Sarstedt 2015), indicating that discriminant validity, according to the heterotrait-monotrait correlation ratio, was satisfied.

Table 7. Discriminant validity: heterotrait–monotrait (HTMT) ratio of correlation

	EE	TI	WRE
EE			
TI	0.671		
WRE	0.111	0.193	

Source: Authors' own calculations

Table 8 shows the results for the Variance Inflation Factor (VIF) for the inner model. All values were lower than the treshold of 3 (Hair et al. 2021), indicating that collinearity did not pose a problem in this research model.

Table 8. Variance Inflation Factor (VIF)

	Variance Inflation Factor (VIF)
EE -> TI	1.012
EE -> WRE	1.000
WRE -> TI	1.012

Source: Authors' own calculations

## 4.3. Hypotheses testing and discussion of research findings

To test the structural model, 10,000 random sub-samples of the original data set were created (with replacement enabled). The results are presented in Figure 2.

Table 9 shows the results regarding PLS-SEM ratio coefficients and their level of significance, aimed at evaluating the relationships between the measurement scales. The results revealed that the relationship between emotional exhaustion of employees and their turnover intentions was positive and statistically significant ($\beta= 0.642$, t = 15.256, p = 0.000). The results also showed that the relationship between emotional exhaustion and workplace robots' effects was negative and statistically significant ($\beta= -0.110$, t = 2.669, p = 0.008). Furthermore, the relationship between workplace robots' effects and employee turnover intentions was negative and statistically significant ($\beta= -0.114$, t = 3.376, p = 0.001).

Table 10 presents the coefficients of determination (R^2) in order to examine the percentage by which the independent variables explain the dependent variable. The results revealed that 44.2% of the variance in EE is predicted by TI (moderate value), while only 1.2% of the variance in EE is predicted by WRE (weak value).

Figure 2. Results from bootstrapping analysis (β and t values)
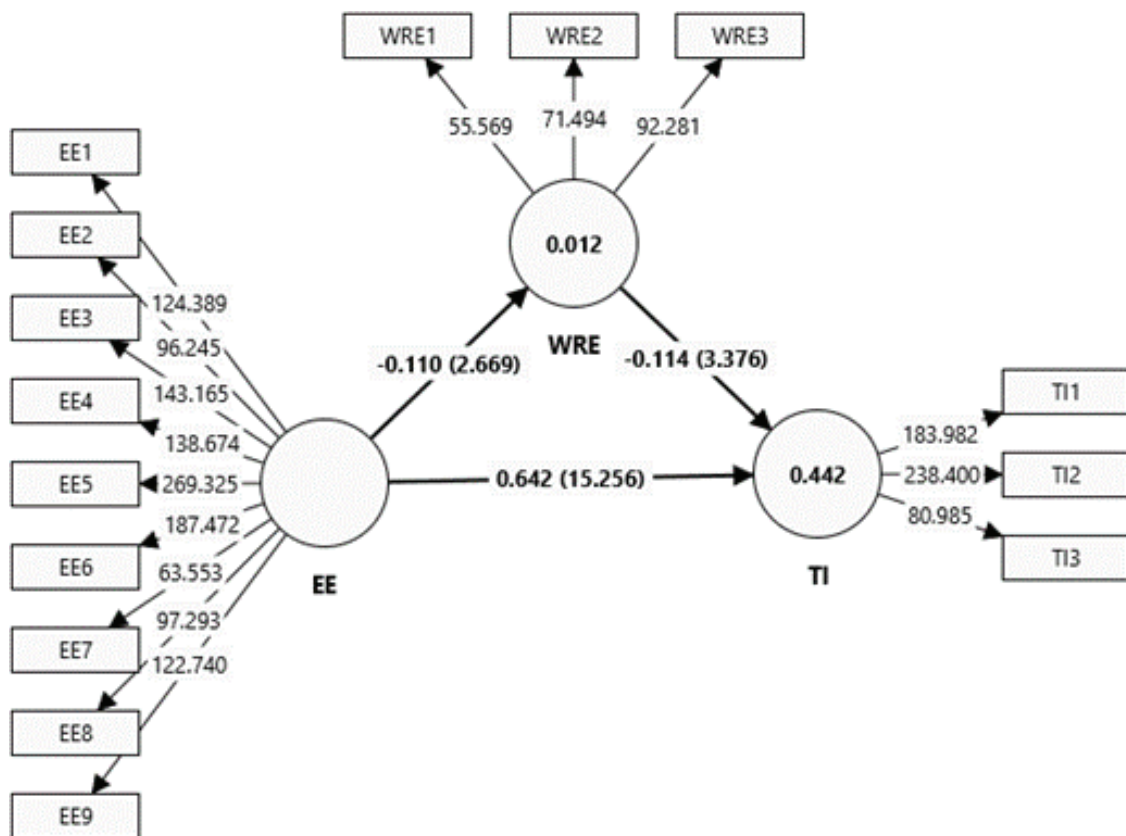
Source: Authors

Table 9. Statistical significance and hypotheses testing

	β	t	p	Hypothesis
EE -> TI	0.642	15.256	0.000	H1: Confirmed
EE -> WRE	-0.110	2.669	0.008	H2: Confirmed
WRE -> TI	-0.114	3.376	0.001	H3: Confirmed

Source: Authors' own calculations

Table 10. Coefficient of determination (R² results

	R^2	R^2 adjusted	Interpretation of values	Criteria (Hair, Ringle, and Sarstedt 2011)
TI	0.442	0.440	Moderate	R^2=0.25 weak
WRE	0.012	0.010	Weak	R^2=0.50 moderate
				R^2=0.75 substantial

Source: Authors' own calculations

Table 11. Effect size (f² results

	f^2	Effect size	Criteria (Cohen, 1988)
EE -> TI	0.730	Large	Above 0.35 large effect
EE -> WRE	0.012	Small	0.15-0.35 medium effect
WRE -> TI	0.023	Small	0.02-0.15 small effect

Source: Authors' own calculations

Table 11 presents the results regarding the effect size (f^2). The results revealed a large effect (0.730) of EE on TI, while the effect size of EE on WRE and WRE on TI is small (0.012 and 0.023 respectively).

The conducted statistical analysis, which used a partial least squares method for structural equation modeling (PLS-SEM), resulted in the acceptance of *Hypothesis 1* which states that the emotional exhaustion of employees is positively related to their turnover intentions. Furthermore, the research results showed that the emotional exhaustion of employees had a negative relationship with workplace robots' effects, confirming *Hypothesis 2*, and that workplace robots' effects were also negatively related to employee turnover intentions, confirming *Hypothesis 3*.

Multiple studies have consistently found a strong positive correlation between emotional exhaustion and turnover intentions of employees. This indicates that employees experiencing higher levels of emotional exhaustion are more likely to consider leaving their organization. A meta-analysis by Lee and Ashforth (1996) found a strong positive correlation between emotional exhaustion and turnover intentions across various occupations and industries. Empirical results revealed that employees' emotional exhaustion was a strong predictor of their intentions to leave the job and organization (Ducharme, Knudsen, and Roman 2008). For example, research conducted on a sample of 410 leaders of addiction treatment organizations found that increased emotional exhaustion was connected with higher turnover intentions among employees (Knudsen, Ducharme, and Roman 2009). Other studies have also demonstrated that employees' emotional exhaustion had a positive and statistically significant relationship with their turnover intentions (Green, Miller, and Aarons 2013; Ding and Wu 2023).

The second and third hypothese that workplace robots are negatively related to emotional exhaustion and turnover intentions of employees highlights the role and importance of robots in contemporary workplaces in the age of Industry 5.0. Workplace robots may perform not only "dull, dirty, and dangerous" tasks instead of humans (Parker and Grote 2019), but also physically demanding tasks that often lead to employee fatigue and discomfort. By taking over repetitive tasks, heavy lifting, and tasks requiring awkward postures, robots can reduce the physical strain on employees, which is a significant contributor to overall exhaustion. This can lead to improved physical well-being, increased energy levels, and consequently, reduced emotional exhaustion and turnover intentions. Furthermore, robots can operate continuously without the need for breaks, enabling companies to maintain round-the-clock operations without overburdening human employees. This can prevent burnout and exhaustion associated with long working hours (Brynjolfsson and McAfee 2014). Automation often leads to the redesign of job roles, allowing employees to focus on tasks that require human creativity, critical thinking, and emotional intelligence. This

job enrichment can increase employee satisfaction and engagement, reducing turnover rates.

The use of robots in Southeastern European countries is still in its early stages compared to more industrialized regions like Western Europe or East Asia. However, there is a growing interest in the adoption of robotics across various industries and regions. As technology advances and becomes more affordable, robots are expected to play an increasingly important role in every country and industry, especially in hospitality.

5. Conclusion

This paper examined and analyzed the relationship between workplace robots, employee emotional exhaustion and turnover intentions in the age of Industry 5.0 across four Southeastern European countries (Serbia, Montenegro, Croatia, Bosnia and Herzegovina). Empirical research was conducted between January and May 2024, including 582 respondents. The proposed relationships among variables in the research framework were tested using the partial least squares method for structural equation modeling (PLS-SEM, SmartPLS software). The research results confirmed that the emotional exhaustion of employees had a positive relationship with turnover intentions, while workplace robots' effects were negatively related to employee emotional exhaustion and their turnover intentions.

Theoretical implications of this paper include the fact that this is one of the first studies conducted in these four Southeastern European countries to address workplace robots' effects, employee emotional exhaustion, and turnover intentions in the age of Industry 5.0. Furthermore, this research uses a specific methodology (questionnaires and PLS-SEM) and encompasses a large sample size (582 respondents). The applied conceptual model, which integrated various theoretical perspectives to explain the complex relationships between workplace robots, employee emotional exhaustion, and turnover intentions, may serve as a foundation for future research in this area. The questionnaire was validated, and its reliability and validity were confirmed, providing a strong basis for future research on this topic. Consequently, this paper

deepens the understanding of organizational behavior by examining how technological change, particularly the adoption of workplace robots, impacts employee attitudes, emotions, and behaviors. By exploring how the introduction of robots (a technical change) affects employee exhaustion and turnover intentions (social aspects), the paper provides empirical evidence for sociotechnical systems theory and inform strategies for optimizing sociotechnical work systems in the age of Industry 5.0. Additionally, this research provides empirical support for job demands-resources theory explaining that in the context of workplace robots, employees experience lower emotional exhaustion and lower turnover intentions.

Beyond theoretical implications, this paper also has practical implications. Workplace robots are becoming more prevalent, and their impact on employee behavior and performance can be significant. Organizations that recognize the benefits of workplace robots can use them to reduce employee turnover intentions and emotional exhaustion. As a result, leaders, managers, and human resource professionals may benefit from the findings reported in this study, particularly during the decision-making process on how to prevent employee emotional exhaustion, ultimately contributing to long-term employee retention. Organizations planning to introduce workplace robots should exercise caution and be mindful of the potential negative consequences on employees and organizational behavior. To retain employees, organizations must design a clear plan and provide guidance for their professional development in accordance with the requirements of Industry 5.0.

This research has several limitations. First, the conceptual research framework used in this research included emotional exhaustion, workplace robots' effects, and employee turnover intentions and their relationships, without considering a broader range of other variables that may be important in organizational research. Variables such as leadership style, psychological safety, employee engagement, commitment, and career opportunities, among others, were not considered in this framework. Second, a questionnaire technique was used to collect data, rather than an interview approach, which might provide broader and deeper insights based on respondents' discussions.

Future research on this topic should incorporate

additional variables into the conceptual research framework to produce more comprehensive and all-encompassing results. In addition to the questionnaire technique for data collection, future research could be enhanced by incorporating interviews to provide more detailed findings. Furthermore, a longitudinal study would be useful in determining whether and how contemporary improvements in workplace robots influence employee behavior, particularly emotional exhaustion and turnover intentions. Finally, it would be beneficial to analyze the professional development of employees whose tasks are more prone to automation.

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THE IMPACT OF BUDGET TRANSPARENCY ON BUDGET CREDIBILITY: EVIDENCE FROM CROATIAN CITIES

María-Dolores Guillamón, Ana-María Ríos, Simona Prijaković

Abstract

This paper examines how budget transparency affects budget credibility, i.e., how it affects budget current revenue/expenditure deviations. Specifically, the first objective is to describe how budget transparency affects budget credibility or accuracy of the enacted budget at the local level. The second is to examine if and in which direction budget deviations are systematically biased. The third is to link the accuracy of enacted budgets with political budget cycles' literature. Budget transparency is measured by the number of published key budget documents on the City's official websites. Budget credibility is measured by the difference between the planned amount minus the actual amount divided by the actual amount. Our sample comprises balanced panel data for 120 Croatian cities during the period 2016-2021 and system GMM method was used. The findings indicate that cities with greater budget transparency typically underestimate their revenues and overestimate their expenditures. Less transparent cities, on the other hand, frequently overestimate their revenues and underestimate their expenditures, yet ultimately spend more than intended.

Keywords: *budget transparency; budget credibility; local governments; forecasting; enacted budget; year-end report*

JEL classification: *H71, H72*

1. Introduction

Any public financial management system should have budget credibility as a primary goal. It primarily shows how closely the enacted budget and budget outturns adhere to one other. As a result, strengthening budget credibility is essential to ensuring that local governments do not spend more or less than the enacted budgets (Elberry and Goeminne 2021). Alesina and Perotti (1996) argue that politicians are not motivated to employ the best practices in the budget process,

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despite Von Hagen and Harden's (1995) assertion that the optimal budget procedure relies on the political climate and the primary factor of uncertainty within the budgetary framework. If budget deviations deceive budget users, it may be necessary for independent auditors or other independent parties to monitor the budgeting process. Additionally, considering the tactics politicians use to manipulate the budget, these deviations might highlight the need to reevaluate the legislation requiring a balanced budget (Mayper, Granof, and Giroux 1991).

Politicians, according to Lago-Peñas and Lago-Peñas (2008) and Serritzlew (2005), manipulate budgets, particularly when budget procedures are soft; it is costly politically to break the promise of high spending and low taxes; and ex-post control by voters and the political opposition is ineffective. In this situation, utilising budget transparency as a mechanism for fiscal discipline can effectively address budget discrepancies. In reality, there are greater opportunities for politicians to influence budgets when the budget process is not transparent. Two theoretical considerations, which are further detailed below, suggest that politicians would typically choose to be confusing. On the one hand, the theory of fiscal illusion demonstrates that voters who lack knowledge and are ignorant underestimate the expenses of ongoing and upcoming public projects, especially in cases where budgets lack transparency. The principal-agent theory, on the other hand, contends that governments may distort budget estimates in order to suit their own preferences.

Budget transparency means being fully open with people about how public money is raised and used; some of the most important benefits of budget transparency are accountability, integrity, inclusiveness, trust, and quality (OECD 2017). The effect of transparency on various fiscal performance metrics, such as expenditures, debt or deficit, has been examined in earlier research (Tanzi 1994; Stein, Talvi, and Grisanti 1998; Alesina et al. 1999; Marcel and Tokman 2002; Alt and Lassen 2006; Bronić et al. 2022b; Mourão et al. 2023). However, very little empirical research has been done on the impact of transparency on budget deviations (see, for instance, Ríos et al. (2018) for local governments and Sarr (2015) or Elberry and Goeminne (2021) for central governments). In order to further this field of study, our paper looks at how budget transparency affects budget current revenue/expenditure deviations at the local level in Croatia from 2016 to 2021.

Our paper adds to the political-economic understanding of local fiscal policy in a number of ways. The first goal of this study is to explain how budget transparency affects the local level budget's credibility or correctness. To the best of our knowledge, this link has only ever been studied once locally, for Spanish municipalities, by Ríos et al. (2018). Our analysis, however, is done for a more recent time frame (2016-2021) and in a different setting – Croatian cities, which make up around 75% of the nation's population and are located in a post-communist European nation. Second, we study if budget deviations exhibit systematic bias, and if present, the direction in which they occur. Finally, we relate the research on political budget cycles to the accuracy of enacted budget.

This part is one of six that make up this paper. The literature on budget credibility and transparency is reviewed in Section two. The Croatian context is explained in Section three. There is a detailed explanation of the process in Section four. In Section five, the empirical results are covered. Section six concludes and proposes for further research.

2. Literature Review

The value of budget transparency is acknowledged by practitioners across many policy sectors. Transparency in the public sector results from institutions, practices, and policies that disseminate data in ways that increase political effectiveness, foster better public policy knowledge, and lessen policy uncertainty.

Taxpayers, who provide the majority of funding for the public sector, need open information to be able to keep an eye on how their taxes are being spent. Budget transparency aids societies in both maximising the benefits that come from their governments and resolving the issues that arise naturally from governmental activities. Information regarding policies serves as an essential input for various aspects of public governance, including ex-ante political management of the public sector, daily policy reactions,

and ex-post monitoring and evaluation. As a result, it plays a crucial role in ensuring effective public governance (OECD 2003).

Governments use budgets to achieve specific policy goals each year. Budgets in contemporary economies are extremely complicated, often excessively so. This complexity enables the use of techniques that conceal the true budget balance in order to sway public opinion. Additionally, legislators usually lack incentives to use the budget process' most open procedures (Alesina and Perotti 1996).

From a theoretical perspective, two theories attempt to elucidate the reasons behind the lack of pressure on politicians to employ the most transparent methods. The foundation of the fiscal illusion theory is the taxpayer's failure to fully internalise the cost of government initiatives. According to this theory, incumbents are compelled to conceal taxes, exaggerate the advantages of expenditures, and downplay government obligations (which would need further taxes). According to the principal-agent theory, politicians may gain an advantage in achieving their goals through the absence of transparency, as incumbents (agents) often prioritise their own interests, which may not align with maximising the welfare of the voters (principals). Governments may therefore alter budgets to further their own objectives, which undermines the credibility of the budget.

In a similar spirit, when budget transparency is attained in budget reports, decision-making is improved. In fact, according to Alt, Lassen, and Skilling (2002), transparency mitigates information imbalances among political actors, financial markets, and voters. They propose two solutions to address this issue: promoting voter education regarding decisions made by elected officials, as well as fostering collaboration on achieving balanced budget outcomes among the alternating political parties.

However, in order to have a transparent budget, managers and elected politicians must be motivated to provide accurate and comprehensive information (García and López 2003). Budgets may lose their credibility if politicians decide not to be as forthcoming about them as they are obligated to be throughout the budget process. Additionally, insufficient transparency in budget allocation can result in increased

confusion among voters and diminish politicians' dedication to practicing fiscal discipline. First, ineffective budget control may be hampered by voter uncertainty brought on by a lack of budget transparency. Second, even with a logical electorate, policymakers may gain from uncertainty. Policymakers can maintain a tactical edge against logical but incompletely informed voters by making it less obvious how policies translate into results. Therefore, the extent to which politicians strategically manipulate the budget process for opportunistic purposes may be directly proportional to the population's limited knowledge and understanding of the budget process (Benito and Bastida 2009; Ríos et al. 2018).

In this regard, it is standard practice to create too optimistic or pessimistic forecasts of budget variables, which will result in budget deviations (Mayper, Granof, and Giroux 1991; Goeminne, Geys, and Smolders 2008; Chatagny and Soguel 2012). Budget deviations (also known as budget forecast errors or biased budgeting) are discrepancies between enacted budgets and budget outturns in revenues/expenditures, according to Benito, Guillamón, and Bastida (2015) and Ríos et al. (2018). The actual level of government spending implemented during the fiscal year often deviates from the initially projected budgeted amount (Serritzlew 2005), as do the level of revenues collected by a government during the fiscal year (Goeminne, Geys, and Smolders 2008). If enacted expenditures/revenues are higher than the outturn ones, there will be expenditure/revenue overestimation. When enacted expenditures/revenues are lower than the actual outturn figures, it results in the generation of underestimated expenditure/revenue.

In accordance with various studies (Mayper, Granof, and Giroux 1991; Goeminne, Geys, and Smolders 2008; Chatagny and Soguel 2012), politicians may manipulate enacted budgets for a variety of reasons. First, governments may be able to provide a balanced budget or enhance services without having to immediately raise taxes by overestimating revenues (optimistic perspective) (Mayper, Granof, and Giroux 1991). By postponing voters' accurate assessments of the actual financial position, this nonetheless produces a fiscal illusion (Alesina and Perotti 1996; Benito and Bastida 2009). Furthermore, compared to

tax increases, optimistic revenue projections have a smaller political cost in terms of votes lost. Politicians are in a difficult position in that regard (Lago-Peñas and Lago-Peñas 2008). On the one hand, politicians can make optimistic revenue predictions to enhance their popularity and gain political support before elections, although there is a risk of reputational damage if they fail to meet those forecasts. On the other hand, they can opt for pessimistic budget revenue forecasts, which would enhance their reputation in retrospect but might lead to lower popularity beforehand. A buffer for unforeseen expenses or income shortfalls might be created by underestimating budgeted revenue, which would also demonstrate that cautious management produced year-end operational savings. Similar to underestimating budgeted expenditures (optimistic perspective), overestimating budgeted expenditures (pessimistic view) may favor fiscal balance and the preservation of a surplus that might be utilised in necessary circumstances (Cuadrado-Ballesteros, Guillamón, and Ríos 2022).

Previous research has attempted to identify the causes of these variances at the central, state, or local levels in diverse contexts (including, but not limited to, Denmark, France, Germany, Italy, Portugal, Spain, or Switzerland). Keeping in mind that local governance is what we are examining, Couture and Imbeau (2009), Bischoff and Gohout (2010), Serritzlew (2005), Goeminne, Geys, and Smolders (2008), Benito, Guillamón, and Bastida (2015), Anessi-Pessina et al. (2016), Boukari and Veiga (2018), Ríos et al. (2018) and Picchio and Santolini (2020) have provided political and socioeconomic explanations for the presence of variances in local budgeted revenue and/or expenditure. Budget transparency has, however, barely ever been experimentally investigated in prior studies as an explanatory component of budget deviations. Of the aforementioned research, only Ríos et al. (2018) include budget transparency as a determinant of budget deviations. In an analysis conducted on a sample of the 100 largest Spanish municipalities for the years 2008, 2009, 2010, 2012, and 2014, it was observed that municipalities with lower levels of transparency tend to overestimate their revenues. This enables them to allocate more resources towards public services without the immediate need to raise taxes. Furthermore,

these municipalities may also spend less than their budgeted amounts, as they are aware of the overestimation of their revenues.

There are not many researches that examine how transparency affects budget deviations in the case of central governments. In this context, Sarr (2015) demonstrates that more transparency is linked to better GDP growth and inflation estimates, higher budget execution rates in the education and health sectors, for a sample size of 73 developed and developing countries for 2012. Elberry and Goeminne (2021) have recently shown that lowering deviations from budgetary estimates in 57 developing countries for 2012 depends critically on strengthening the monitoring of fiscal risks coming from public sector enterprises.

3. Croatian context

3.1. Local Government in Croatia

Croatia is divided into 20 counties (Zagreb is classified as a county-city), 128 cities, and 428 municipalities. Counties are responsible for undertaking significant regional tasks, especially those related to healthcare, education, spatial and urban planning, economic development, infrastructure and transportation. They are also responsible for maintaining public roads, planning and developing educational, health, social, and cultural institutions, issuing construction and location permits, and overseeing various construction-related activities. Additionally, counties play a crucial role in implementing spatial planning documents and other relevant acts. Cities and municipalities make independent decisions on matters related to their residents' needs. The growth of communities and housing, urban and spatial planning, communal economies, childcare, social services, primary healthcare, early education, culture, physical culture, and sports, consumer protection, preservation and improvement of the environment, fire and civil protection, and local traffic are just a few of the topics that are specifically related to these. There are also significant cities, which are hubs for the growth of the surrounding area's economy, finances, culture, health, transportation, and science and have a population of above 35,000. Along with the aforementioned duties, they

also maintain public roadways and provide permits for building and preliminary planning as well as other construction-related paperwork and the execution of spatial planning documents.

In addition to the essential tasks mentioned above, large cities and county seats have the authority to perform tasks within their jurisdiction that fall under the responsibility of the county in their respective areas (Act on the Local and Regional Self-Government 2020).

Municipalities, cities, and counties all have executive (municipal heads, city mayors, and county prefects) and representational (municipal and city councils, county assemblies, and the city assembly in Zagreb) bodies. Every four years, members of representative bodies, municipal leaders, city mayors, and prefects are chosen by a secret vote in direct elections (Act on the Local and Regional Self-Government 2020).

According to the calendar and provisions defined in the Budget Act (2022), the budgets of local governments are adopted in accordance with the convergence program of the Republic of Croatia, the decision on the budgetary framework and the Ministry of Finance (MoF) budgetary instructions, all for the next three-year period. The convergence program – among others – contains the economic policy goals and the general government macroeconomic and fiscal framework, also for the next three-year period. The budget of local governments is enacted by a representative body and includes a plan for the next fiscal year (which in Croatia is the same as the calendar year) and projections for the following 2 years, i.e. the budget is adopted for three years. Budgets have to be balanced, i.e. total revenues must equal total expenditures, and if not, then there are surpluses or deficits.

Respecting certain legal constraints, by adopting budget proposals, cities have the right to set specific tax rates and determine the allocation of their generated revenues.[1] The enacted budget outlines the government's anticipated actions, as well as the projected levels of revenue and expenditure for the upcoming fiscal period. On the revenue/expenditure side, after budget revisions of the initial revenue/expenditure forecasts from enacted budget, the updated revenue/expenditure forecast shapes the final revised budget. After the fiscal year ends, every local government makes a year-end budget execution report which contains budget outturns at the end of the fiscal year. If the actual revenues and expenditures are not equal (the budget is not balanced), local governments have a surplus or a deficit. If local governments cannot settle or spend the transferred deficit or surplus by the end of the fiscal year, they are obliged to create a multi-year balancing plan for the period for which the budget is adopted. Therefore, this context is particularly suitable for analysing budget credibility – budget deviations between enacted and outturn revenues and expenditures. In addition, Croatian local governments have the autonomy to establish tax rates and decide on the spending level, which determines budget deviations.

3.2. Budget transparency in Croatia

Every year the Institute of Public Finance (IPF) examines all 576 local governments' websites to check how many of the five key budget documents are published and accordingly to produce the Open Local Budget Index (OLBI) which ranges from 0 (no budget document has been published) to 5 (all budget documents have been published). Among those documents, two – budget proposal and citizen budget – are recommended by the MoF for voluntary disclosure, and three – mid-year budget execution report, year-end budget execution report and enacted budget – must be published according to the Budget Act (2022) and the Act on the Right of Access to Information (2022).

As we see in Graph 1, the most published are enacted budgets and year-end reports, followed by mid-year reports and budget proposals. The least published, are citizen budgets.

The average OLBI for cities is improving every year, from 3.66 in 2016 to 4.73 in 2021 (Graph 2). In a breakdown of the graphs, in 2016, five cities still didn't publish any mandatory budget documents, while 96 published all three. In 2021 of the mandatory budget documents, one city published one, 18 published two and 109 cities published all three.

Graph 1. Budget documents published by cities from 2016-2021 (in %)
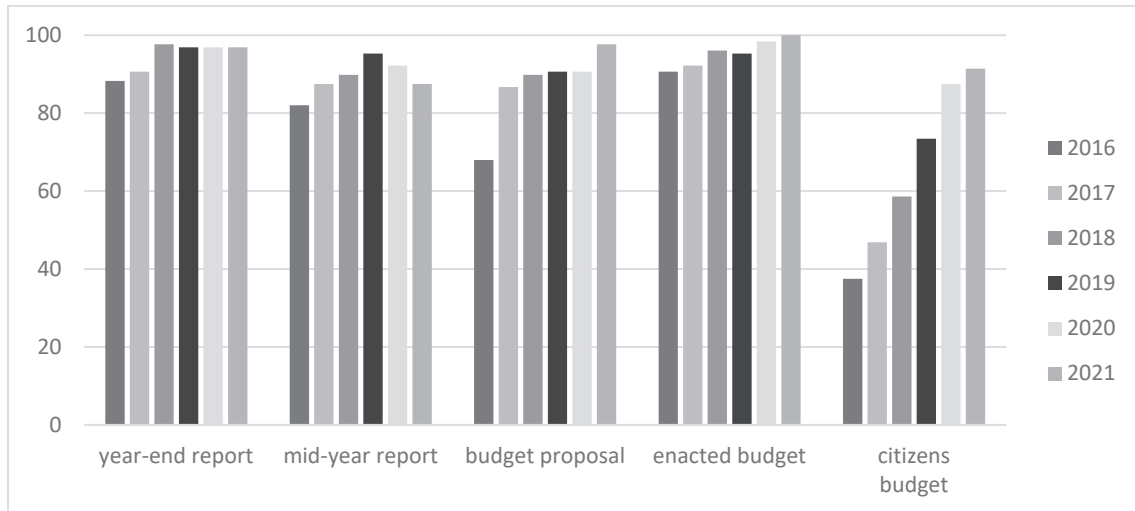
Source. Own elaboration from IPF (Bronić et al. 2022a)

Graph 2. OLBI for cities, average (0-5)
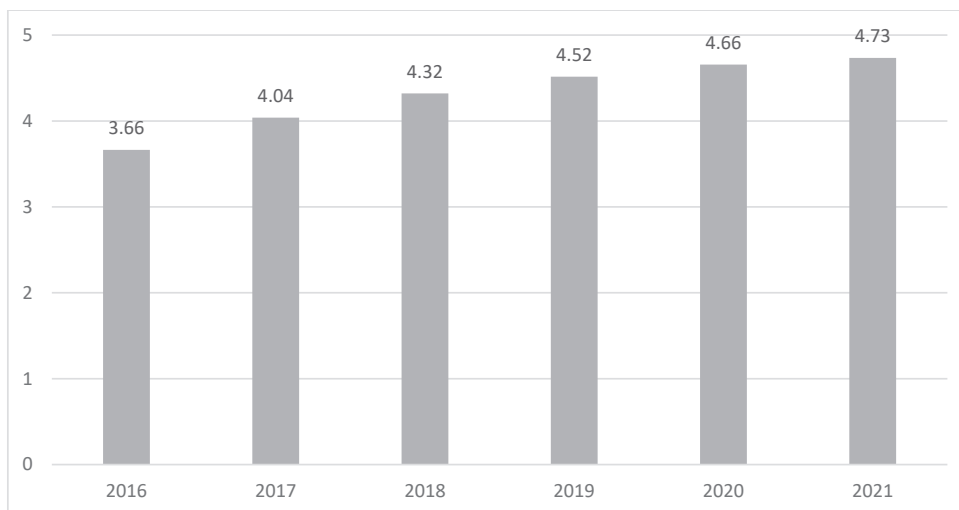
Source. Own elaboration from IPF (Bronić et al. 2022a)

4. Econometric process

4.1. Defining the sample

This research is dealing with 120 Croatian cities in 2016-2021 (720 observations) and a single, highly balanced database has been created.

We collected the data for the dependent variable – budget current revenue/expenditure deviation – from enacted budgets which we collected from the official web pages of local governments for 2016-2021 period. Even though OLBI has been available since

2014, there was a systematic change in 2016 when local governments were legally obligated to include budgetary users' own revenues in their planned budgets. This is why the sample period finally used for this paper is 2016-2021. Although we intended to investigate all 128 Croatian cities, eight cities had to be excluded from the analysis because they did not include budgetary users in the planned budget since 2016. Thus, we ended up with 120 cities in the 2016-2021 period.

4.2. Variables

4.2.1. Dependent variables

To examine the impact of budget transparency on the budget credibility of Croatian cities, we use the regression specification presented below. Our dependent variables are budget current revenue/expenditure deviations (*dev_cur_rev, dev_cur_exp)*, defined as the difference between the amount in the enacted budget minus the amount in budget outturns divided by the amount in the enacted budget,

$$y_{it} = \frac{enacted_{it} - outturns_{it}}{enacted_{it}}, i = 1, ..., N, t = 1, ..., T,$$

where *enacted* refers to amounts to be seen in the enacted budget, a final budget, budget proposal with amendments. In contrast, *outturns* stand for the final, real and realisation of budget, which is in the year-end budget execution report. Therefore, a positive value of the dependent variable y_{it} indicates that the forecasters overestimated the city's budget, while a negative value indicates an underestimation of the city's budget. Thus *i* represents the city (N=120) and *t* is the year of observation during the period 2016-2021.

Table 1 presents the interpretation of the dependent variables' budget current revenue and expenditure deviations.

From Graph 3, we can conclude that for all years (2016-2021), budget current revenue deviations are positive, which means that current budgeted revenues are higher than actual values at the end of the year. This means that Croatian cities overestimate their current revenues. For the period from 2016-2019, budget expenditure deviations were negative, indicating that current budgeted expenditures were lower than actual values at the end of the year. That means that Croatian cities underestimate their current expenditures. In 2020 and 2021, budget current revenue deviations were positive due to the pandemic of Covid-19, and current expenditures were overestimated.

Table 1. Interpretation of budget current revenue and expenditure deviations

budget current revenue deviations (*dev_cur_rev*)	enacted < outturns	Underestimate	Pessimistic	Favourable
	enacted > outturns	Overestimate	Optimistic	Unfavourable
budget current expenditure deviations (*dev_cur_exp*)	enacted < outturns	Underestimate	Optimistic	Unfavourable
	enacted > outturns	Overestimate	Pessimistic	Favourable

Source: Ríos et al. (2018)

Graph 3. Budget current revenue/expenditure deviations, cities from 2016-2021 average values (in %)
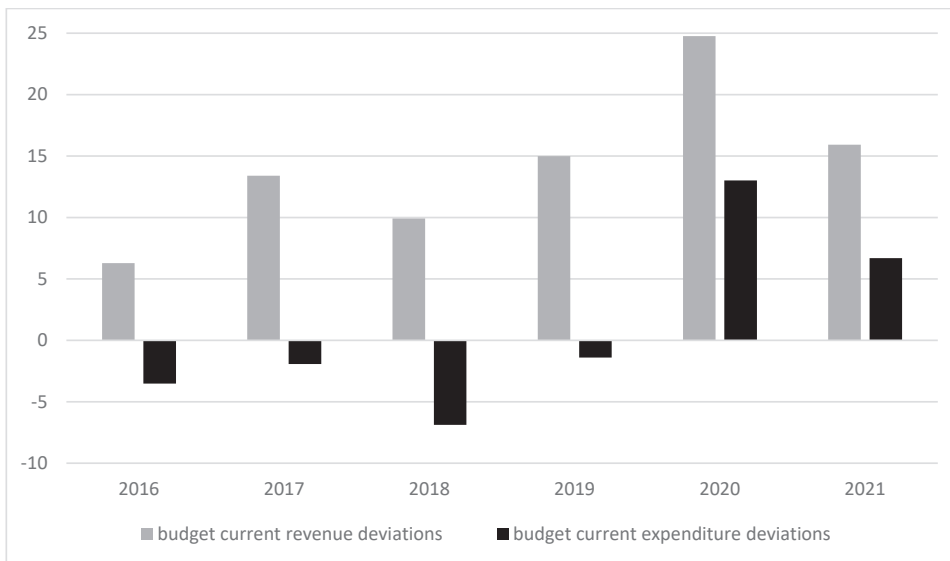
Source: Authors' calculations

Graph 4. Deviations in total revenues and expenditures, cities from 2016-2021 average values (in %)
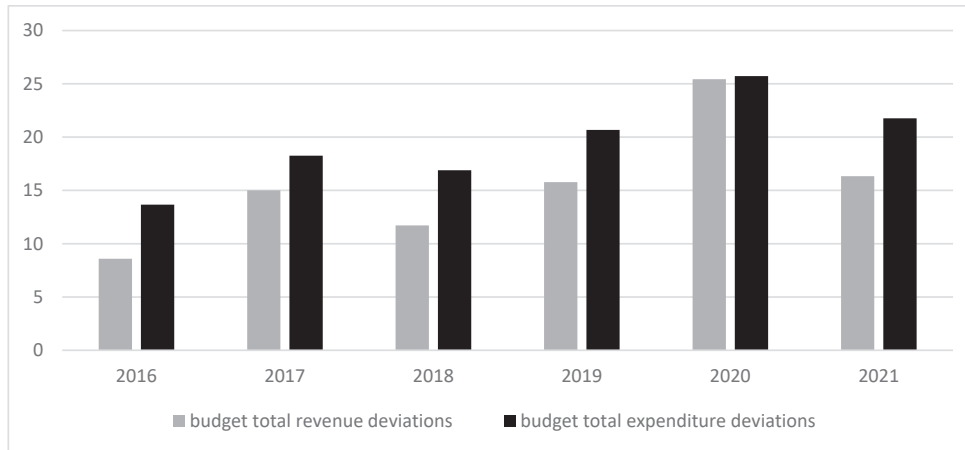
Source. Authors' calculations

Graph 4 shows the deviations in total revenues and total expenditures. Total revenues include current revenues plus revenues from the sale of nonfinancial assets, while total expenditures include current expenditures plus expenditures for the acquisition of nonfinancial assets. It can be concluded that deviations in total revenues/expenditures are positive, which means that the budgeted amount is higher than the actual amount and that Croatian cities overestimate their budgets.

4.2.2. Independent key variable

The OLBI created by the IPF (Bronić et al. 2022a) is the main independent variable in our model. It measures the yearly online accessibility of five crucial budget documents available on the websites of cities, with values ranging from 0 to 5, depending on the quantity of published budget documents.

4.2.3. Control variables

Based on pertinent research, theoretical explanations, and ensuring the soundness of the system GMM model in regression specification, control variables are introduced on the right-hand side of the regression equation along with the OLBI.

First, we consider the potential effects of the political budget cycle, according to which shrewd incumbents manage the budget in the run-up to and

during elections to increase their probabilities of winning reelection (Bischoff and Gohout 2006; 2010; Galli and Rossi 2002). As a result, the variable for the preelection year is a dummy variable that has a value of 1 during the preelection year and a value of 0 otherwise. In order to examine if budget transparency affects the impact of the political budget cycle on budget current revenue/expenditure deviations, this model additionally incorporates the interaction between the variables budget transparency and preelection year as a regressor (preelection_OLBI).

We also take into account the variable budget balance, which is determined by dividing (total revenues minus total expenditures) by total revenues. Budget balance largely depends on fiscal, political, and socioeconomic pressures within local governments, as demonstrated by Działo et al. (2019). Furthermore, not all deficits (including indirect debts) are unneeded or opportunistic deficits (for instance, if they are utilised for development initiatives that would boost future GDP). Consequently, we expect a negative relationship between budget surplus/deficit and fluctuations in current revenue, as well as a positive relationship between budget surplus/deficit and deviations in current expenditure.

Croatian cities' economic situations and levels of development are described by their variable income. According to research on public choice, low income levels harm citizens' perceptions of the government. Governments might thus alter spending to make

up for the drop in popularity. In other words, we anticipate that the incumbent will be more tempted to overstate revenues and/or underestimate expenditures as the local economy becomes direr (Ríos et al. 2018).

Additionally, we account for grants that the cities have received as well as their fiscal capacity, which is calculated as current revenues minus all grants. According to the research, various funding options might have an impact on budget variances (Couture and Imbeau 2009; Mayper, Granof, and Giroux 1991). Indeed, local governments that collect more taxes (have greater fiscal capacity) and get more grants are anticipated to be more cautious in their budget predictions, according to Ríos et al. (2018). As a result, we anticipate that enhanced fiscal capacity and grants will result in conservative budget projections, which underestimate revenues and overestimate expenditures.

We also consider the mayor's political stance, which is a moving target. According to the Partisan Politics Matters thesis, right-wing parties aim budget reductions while left-wing parties favour public spending increases (Cusack 1997). In this regard, right-wing incumbents, favoring a smaller public sector, may underestimate their government revenue, and thereby press down spending. In reality, Couture and Imbeau (2009) find that right-wing parties significantly underestimated government revenues, and Ríos et al. (2018) demonstrate that same parties frequently overestimate their expenditures.

As a gauge of political strength, we use the Herfindahl index. A greater political strength suggests majority rule by incumbents from a single party, whereas a lower political strength suggests that there are many parties represented on the city council. As indicated by Roubini and Sachs (1989), weaker governments are predicted to have larger deficits and expenditure levels. To enhance their expenditure levels, weak governments may be motivated to overstate revenues (Lago-Peñas and Lago-Peñas 2008). Weak governments are likely to overspend their budgets in terms of deviations from the budget. In fact, according to Serritzlew (2005) and Ríos et al. (2018), overspending is more likely to occur when political rivalry is more intense.

The population has also been factored into the model because larger cities may benefit from economies of scale. The administration of (taxes) is often more extensive in these places, hence tax performance is probably going to improve. In comparison to planned revenues, these boosts collected revenues (Bischoff and Gohout 2006; Ríos et al. 2018). Serritzlew (2005) shows that as the population grows, overspending on expenditures reduces.

Table 2 presents the definitions of all variables and their descriptive statistics.

Table 2. Definition of variables and descriptive statistics

Variable	Description	Calculation	Source	Mean	St. Dev.	Min.	Max.
Dependent variables							
(*dev_cur_rev*)	Budget current revenue deviations	(enacted budget current revenues – budget outturn current revenues)/ enacted budget current revenues	Authors' calculations are based on data from the MoF and data on enacted budgets from the city's official website	14.21	23.62	-83.88	91.01
(*dev_cur_exp*)	Budget current expenditure deviations	(enacted budget current expenditures – budget outturn current expenditures)/ enacted budget current expenditures	Authors' calculations are based on data from the MoF and data on enacted budgets from the city's official website	0.99	19.13	-93.55	52.16

Table 2. Continued

Variable	Description	Calculation	Source	Mean	St. Dev.	Min.	Max.
Independent variable of interest							
OLBI	The yearly Open Local Budget Index implies five budget documents (year-end report, mid-year report, budget proposal, enacted budget, and citizen budget) accessible online.	Takes value from 0 to 5, depending on how many budget documents are published	IPF	4.32	0.99	0	5
Control variables							
preelection	Preelection year	Takes a value 1 in the preelection year and 0 otherwise	Authors' calculation	0.33	0.47	0	1
preelection_OLBI	Interaction variable preelection year with OLBI	Takes a value of OLBI when it is a preelection year; otherwise, 0.	Authors' calculation	0.33	0.47	0	1
budget balance	Budget balance consolidated* (surplus or deficit)	(Total revenues -total expenditures)/ total revenues	Authors' calculations are based on data from the MoF	-1.64	15.40	-125.35	42.79
income	Residents' average annual income per capita (PC)	Income plus profits of craftsmen calculated PC	Ministry of Regional Development and EU Funds. PC amounts are based on the Croatian Bureau of Statistics (CBS) population estimates	33,925.09	5,784.26	20,013.73	52,909.57
fiscal capacity	Fiscal capacity consolidated PC	Current revenues minus all grants PC	Authors' calculations are based on data from the MoF. PC amounts are based on the CBS population estimates	4,263.18	2,140.80	1,039.46	12,320.50
grants received	Revenues received from grants consolidated PC	Total revenues from received grants PC	MoF. PC amounts are based on the CBS population estimates	1,748.14	1,353.42	38.29	8,777.08
political ideology	The political ideology of the city's ruling party	The political ideology of the city's government (left=1 and other=0)	Authors' calculations are based on data from the State Election Commission (SEC)	0.29	0.45	0	1
political strength	The political strength of the city's ruling party	Calculated as Herfindahl index: $\sum_{i=1}^{n} \frac{S_i^2}{S^2}$, where S is total number of city council seats, and S_i is the number of seats held by the party in the city council. Takes values from 0 to 1	Authors' calculations are based on data from the SEC	0.37	0.09	0.18	0.64
population	Estimated population of the city	Taken from the Croatian Bureau of Statistics	CBS	23,310.88	74,846.71	1,395	809,235

Source: Authors' calculations

*consolidated budgets include budgetary users of cities

4.3. Specification of the model

The objective of this paper is to examine the influence of budget transparency levels on budget credibility. Building upon the theoretical framework, we employ a dynamic panel data model in which budget deviations are dependent variables because we have strongly balanced panel data. Included is the lagged variable of the dependent variable to capture persistence in budget deviations. The regression models to be estimated are:

$$dev\_cur\_rev_{it} = \alpha + \beta_1\ dev\_cur\_rev_{i,t-1} + \beta_2 OLBI_{it} + \beta_3 preelection_{it} + \beta_4 preelection_{it} \cdot OLBI_{it} + \beta_5 budget\ balance_{it} + \beta_6 income_{it} + \beta_7 fiscal\ capacity_{it} + \beta_8 grants\ received_{it} + \beta_9 political\ ideology_{it} + \beta_{10} political\ strength_{it} + \beta_{11} population_{it} + \varepsilon_{it}, \qquad (1)$$

$$dev\_cur\_exp_{it} = \alpha + \beta_1 dev\_cur\_exp_{i,t-1} + \beta_2 OLBI_{it} + \beta_3 preelection_{it} + \beta_4 preelection_{it} \cdot OLBI_{it} + \beta_5 budget\ balance_{it} + \beta_6 income_{it} + \beta_7 fiscal\ capacity_{it} + \beta_8 grants\ received_{it} + \beta_9 political\ ideology_{it} + \beta_{10} political\ strength_{it} + \beta_{11} population_{it} + \varepsilon_{it}, \qquad (2)$$

where i indicates city; t represents years; α is a constant; $\beta_1, ..., \beta_{11}$ represent the parameters to be estimated; ε_{it} represents random disturbances.

We used the dynamic panel data estimator and the two-step system generalised method of moments (system GMM) approach (Arellano and Bover 1995; Bundell and Bond 1998; Roodman 2009) to estimate those two models. This helps mitigate the endogeneity of the lagged dependent variable, i.e. when the explanatory variable is correlated to the error term. This technique also accounts for unobserved panel heterogeneity, measurement errors, heteroskedasticity, omitted variable bias and autocorrelation.

5. Results

The results for the estimation of budget current revenue deviations (Table 3) indicate that the budget transparency variable OLBI is significant at the 5% level and negatively related to our dependent variable budget current revenue deviations (β_2 = −7.26, p=0.03), indicating that cities with higher

transparency tend to underestimate (or overestimate less) their current revenues. It is in line with Ríos et al. (2018), who show that municipalities with higher levels of transparency appear to exercise greater caution in estimating their revenues, as they tend to underestimate their revenues, collecting more than they budgeted.

As for the influence of the political budget cycle, we observe that in preelection years current revenues are more underestimated (*preelection*). However, this effect is reduced in the case of the most transparent cities (*preelection_OLBI*).

The variable *budget balance* is in a negative and significant relationship with the dependent variable budget current revenue deviations. It means that better budget balances lead to more current revenue underestimations. In the same way, the variables *fiscal capacity* and *grants received* are in a negative and significant relationship with the dependent variable, showing that improvement of fiscal capacity and the grants received lead to more current revenue underestimations. This could be because if cities want to collect more taxes and receive more grants, they are more prudent in their estimations and do not overestimate their revenue budgets.

As for political variables, we find that the variable *political strength* is in a negative and significant relationship with budget current revenue deviations, indicating that governments with a majority tend to underestimate their current revenues. In other words, we find that weak governments may be tempted to overestimate revenues in order to increase their expenditure levels, which is in line with Lago-Peñas and Lago-Peñas (2008).

Finally, note that the income of the cities' citizens, the ruling party's political ideology and the population's size do not appear to have an impact on the current revenues estimations.

In order to significantly corroborate our basic short-run outputs, we additionally estimated the long-run impacts for each variable that emerged important in the basic short-run estimations (Table 3). Long-term effects on our dependent variable, budget current revenue deviations, are also caused by the values of OLBI, preelection, preelection·OLBI, budget balance, grants received, and political strength.

Table 3. Results of the dynamic panel data system GMM estimation, budget current revenue deviations

	Short-run	Long-run
dev_cur_rev	0.37***	
(dependent lagged)	(3.88)	
OLBI	-7.26**	-11.50**
	(-2.23)	(-2.42)
preelection	-118.50***	-187.76***
	(-3.33)	(-2.97)
preelection_OLBI	26.03***	41.24***
	(3.40)	(2.98)
budget balance	-0.30***	-0.48***
	(-3.68)	(-3.20)
income	0.00	
	(0.06)	
fiscal capacity	-0.00*	-0.01
	(-1.75)	(-1.60)
grants received	-0.01**	-0.01**
	(-2.45)	(-2.27)
political ideology	3.14	
	(0.33)	
political strength	-173.30*	-274.58*
	(-1.83)	(-1.90)
population	-0.00	
	(-0.29)	
constant	129.60**	
	(2.05)	
Number of observations	600	
Number of groups	120	
Number of instruments	21	
AR (1) (p-value)	0.00	
AR (2) (p-value)	0.52	
Hansen test (p-value)	0.18	
F-statistic	31.52***	

Source: Authors' calculations

Note: In the short run t-statistics are in parentheses, in the long-run z-statistics are in parentheses. The long-run coefficients are calculated as follows: β (significant short-run variable)/(1−β (lagged dependent variable)). Significance levels: 1%, ***; 5%, **; 10%, *.

The results for the estimation of budget expenditure deviations (Table 4) indicates that the budget transparency (variable OLBI) is positively and significant at the 1% level associated with budget expenditure deviations ($\beta_2 = 11.22$, p=0.01), indicating that a higher level of the city's budget transparency increases the likelihood of overestimating current expenditures.

As for the impact of the political budget cycle, we observe that in preelection years current expenditures are more overestimated (preelection), although this effect is reduced in the case of the most transparent cities (preelection_OLBI).

The variable budget balance is in a positive and significant relationship with budget expenditure deviations, indicating that improvement of budget balance means higher overestimations in current expenditures. In the same sense, we find that those cities with higher fiscal capacity are those that tend to overestimate current expenditures. However, the level of grants received does not affect budget expenditure deviations.

With regard to the variable income, we find a negative and significant relationship with budget expenditure deviations. It means that the higher income of their citizens leads cities to underestimate their current expenditures.

Regarding political variables, our results show that the variable *political ideology* is positively and significantly related to the budget expenditure deviations, indicating that left-wing incumbents are more prone to overestimate current expenditures, i.e., budgeting more than they spend. For its parts, the variable *political strength* has a negative and significant relationship with the dependent variable, indicating that strong government underestimated their current expenditure, spending more than budget.

Finally, the variable *population* has a positive and significant relationship with the dependent variable, budget expenditure deviations, indicating that cities with higher populations tend to overestimate their current expenditures.

Note that the income of the cities' citizens, the ruling party's political ideology and the population's size do not appear to have an impact on the current expenditures estimations.

In order to strongly validate our basic short-run outputs, we additionally estimated the long-run impacts for the variables that stood out in the basic short-run predictions for each individual variable (Table 4). Our dependent variable, budget current revenue deviations, is likewise long-term affected by the values of OLBI and income.

Table 4. Results of the dynamic panel-data system GMM estimation, budget current expenditure deviations

	Short-run	Long-run
dev_cur_exp (dependent lagged)	0.47** (2.32)	
OLBI	11.22*** (2.67)	21.05* (1.88)
preelection	133.04* (1.88)	249.53 (1.44)
preelection_OLBI	-15.43 (-1.00)	
budget balance	0.93** (2.14)	1.75 (1.47)
income	-0.01** (-2.51)	-0.02* (-1.82)
fiscal capacity	0.01** (2.15)	0.02 (1.60)
grants received	0.00 (1.32)	
political ideology	31.43** (2.01)	58.94 (1.54)
political strength	-118.66* (-1.83)	-222.54 (-1.52)
population	0.00* (1.97)	0.00 (1.54)
constant	296.94** (2.42)	
Number of observations	600	
Number of groups	120	
Number of instruments	24	
AR (1) (p-value)	0.00	
AR (2) (p-value)	0.35	
Hansen test (p-value)	0.17	
F-statistic	5.83***	

Source: Authors' calculations

Note: In the short run *t*-statistics are in parentheses, in the long-run *z*-statistics are in parentheses. The long-run coefficients are calculated as follows: β (significant short-run variable)/(1−β (lagged dependent variable)). Significance levels: 1%, ***; 5%, **; 10%, *.

We also monitor other conditions for meeting the validity of the GMM estimator, that the number of instruments is less than the number of groups, and the Hansen test of overidentifying restrictions. The Hansen test in the model specification in Table 3. (p = 0.18) and Table 4. (p = 0.17) confirms that the instruments used can be considered valid (Roodman 2009). Finally, the F-statistic in estimations strengthens the correct model specification, showing that the overall regression specification is significant (F = 31.52; 5.83; p = 0.00).

6. Conclusions

Diligently conducting a budget process is key to achieving greater budget credibility. To this end, it is crucial to ensure that this process is carried out with transparency. In this regard, the objective of our paper is to analyse whether budget transparency influences budget current revenue/expenditure deviations. For this aim, we use a sample of 120 Croatian cities for the period 2016-2021.

According to our findings, cities with higher levels of transparency often underestimate their current revenues while overestimating their current expenditures. Conversely, cities with a lower level of budget transparency tend to overestimate their revenues, allowing them to inflate their expenditure budget and spend more. In fact, we find that these cities spend more than they budget (i.e., they underestimate their expenditure budget).

We believe that our results have important implications for different stakeholders. First, prior to taking any appropriate action, we believe it would be worthwhile to examine the causes of these variations (including, but not limited to, technological flaws, political agendas, and contingencies). Second, since transparent cities have a more prudent strategy, allowing them to have healthier finances, transparency plays a crucial role throughout all stages of the budget process. Therefore, strategies, legislation, etc., should be put in place to promote budget transparency during the process. Furthermore, given the importance of transparency in public management to reduce deviations, opposition parties and other levels of government should demand more information on the city's

budget process in time to allow for better monitoring of it. We also think that independent auditors and institutions keeping an eye on the budget during the budget process would be a good method to guarantee political independence. Similarly, specialists who operate independently and are not connected to the government are welcome to participate in the budget development process and share their expertise. Finally, we believe that the local government should also provide more information to citizens about the budget process and the deviations that occur in its execution. This could lead to a greater involvement of citizens in the processes related to cities' finances and to greater budgetary credibility. Moreover, if citizens are more informed about their city's expenditure and revenue needs, it could go some way towards reconciling them with the taxes they pay.

It is important to recognise certain limitations associated with this study. The first limitation may stem from measuring budget deviations. To calculate the dependent variable – budget deviations, we need to know data from the enacted budget, which we collected from the official pages of local governments. Collecting data for municipalities was challenging because most of them are not very budget-transparent and there had been no data for the previous six years. Due to such problems with collecting data for Croatian municipalities, we made sure to gather all the data for all Croatian cities. The second limitation may stem from systematic changes in planning budgets from 2016. Even though the OLBI has been available since 2014, there was a systematic change in 2016 and from the planning budgets for 2016, local governments are obligated by law to include own revenues of budgetary users in the enacted budget of local governments. For this reason, the period used for this paper is 2016-2021. The third limitation concerns the index of budget transparency – OLBI – because it only measures the availability of five key budget documents but not their quality or public participation.

Given the above limitations, further research could (i) collect all data needed to calculate budget deviations for Croatian municipalities and investigate the impact of budget transparency on budget credibility for all local governments, (ii) efforts should be made to enhance the measurement of local budget transparency by placing greater emphasis on evaluating

the quality of budgetary documents; (iii) additional methodologies can be employed that leverage the available single panel database, among other resources, etc.

Note

1. Cities and municipalities have full autonomy to set tax rates only for the local tax on the use of public areas. For other cities and municipalities taxes, tax rates can be set by cities and municipalities, but within the range determined by the central government. Counties can set tax rates only on the local tax on inheritances and gifts, but again within the maximum rate set by the central government. Tax rates for other local taxes that belong to counties are determined by the central government. Local governments are not using enough local taxes as a source of their revenues (Bronić 2013).

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PORTER-TYPE REGIONAL AGGLOMERATIONS, EXPORT PERFORMANCE, AND INCLUSIVE REGIONAL POLICY: AN EMPIRICAL ASSESSMENT OF TURKISH MANUFACTURING SECTOR

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Abstract

This study aims to evaluate the medium-term impact of regional agglomerations in the manufacturing sector of Turkey on export performance. To this end, we identified Porter-type agglomerations in ISIC two-digit manufacturing sectors for 58 NUTS-3 regions and the 2008-2019 period. In the empirical analysis section, we used a two-way fixed effects panel data model to analyze the effects of these agglomerations on sectoral export performance. The findings indicate that the advantages of Porter-type agglomeration are limited to certain mid-tech sectors. Also, labor-intensive low-tech manufacturing sectors are found to have no agglomeration advantages in export performance compared to mid-tech sectors. The findings indicate a technology policy need and an inclusive smart specialization strategy (3S) to enhance productivity and export competitiveness.

Keywords: *agglomeration economies, export performance, manufacturing sector, Turkey*

JEL Classification: *F16, O14, R12, R58*

1. Introduction

Turkey has been pursuing an export-led economic growth strategy since liberalization in the 1980s. One of the critical points in this direction is the adoption of the Customs Union Agreement (CUA) in 1996. With the opening of the Turkish economy to the European market, there was a steady increase in the productivity of manufacturing and the export volume of especially textile and automotive sectors. Yet, the low-hanging fruits of the agreement were consumed in a short time (Özatay and Sak 2002). The transformative impact of integration did not last long, and a kind of developmental trap emerged. The international division of labor has become low and medium-technology sectors for Turkey. Towards the second half of the 2000s, economic policy began to turn towards alternative markets as well as the domestic market (See Figure 1).

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After three decades of export-led growth experience, one of the main results of international integration has been the deepening of regional agglomerations (Akkemik and Göksal 2014; Kaygalak and Reid 2016). Essentially, this has been a global phenomenon since the 1980s due to the liberalization of international trade and increasing competition in global markets (Hanson 1998; Scott and Storper 2003; Sjöberg and Sjöholm 2004).

On the theoretical background of regionalization, Porter (1990) laid out a new perception of international competitiveness. Instead of analyzing nation-level factor endowments and technology spillovers, his proposal was an analysis of industry-level dynamics (Porter 1990). Regarding the economic performance of regions and agglomerated industries, Porter (2000) claimed that specialized regions are expected to perform better than other regions. Many studies illustrated such impacts for creative and innovative industries (Ferreira et al. 2012; Gülcan et al. 2011; Gong and Hassink 2017).

From the practitioner's perspective, economic geography has come into prominence in policy making (Krugman 1998; Brenner 1999; Martin and Sunley 2011; Vanhove 2018). In line with globalization and economic integration policy of the EU, regional economies have become the key element of harmonization in the European periphery. The CUA and more recent smart specialization strategy (3S) approach in the EU cohesion policy have highlighted local dynamics in international competition for regions.

Considering both the need for a coherent regional policy strategy and national comparative advantages in manufacturing sectors, an inclusive assessment of regional agglomerations must embrace broader sectoral advantages and employment priorities (Christoperson et al. 2010; Hassink 2010; Boschma 2015). For a medium-size country like Turkey, regional policy strategy's transformative capacity and practicality necessitate focusing on existing relative dynamics and technology level instead of creating comparative advantages by specializing in niche smart sectors.

In the literature, one of the problems is the heterogeneous identification of regional priorities (Kemeny and Storper 2015; Di Cataldo, Monastiriotis, and Rodriguez-Pose 2022). For single-region cases, regional priorities are developed through region-based and absolute specialization methods. In this paper, we will conduct a relative sectoral analysis to capture national comparative advantages and inclusiveness. In this way, employment and export-related indicators will add inclusiveness to the analysis. Yet, the findings should be thought of as complementary to region-based identification rather than an alternative. Also, the paper will give methodological insight for policymakers and researchers by focusing on employment-related priorities which must be concerted with national export-led growth dynamics. Turkish case in this paper constitutes an example of a mid-size country that is dependent on exports in low and mid-tech manufacturing sectors for sustainable economic growth.

For such a developmental aim, we evaluate export performance of Turkish regions for ISIC Rev. 4 two-digit manufacturing sector agglomerations. Using panel data for 58 NUTS3 regions and for 2008-2019 period, we examine variation of agglomerated sectors in terms of export performance. We aim to uncover the sectors with agglomeration advantages and to show the nexus between regional agglomerations, technology level, and export competitiveness.

This paper is organized as follows. The second section summarizes the literature review on agglomeration economies and stylized facts on Turkish manufacturing industry from a regional perspective. The third section explains dataset and identifies agglomeration structure of Turkish manufacturing. The fourth section presents the econometric model and preliminary tests. The fifth section assesses the findings, and the last section concludes.

2. Literature review

2.1. Regional agglomeration and economic performance

The main idea of spatial specialization can be taken back to Alfred Marshall's "Principles of Economics" published in 1890. Marshall focuses on the advantages of concentrating firms in certain regions that compete in similar industry branches. Marshallian positive externalities which lead to economic advantage can be summarized with the following 3 points:

– Knowledge diffusion: the concentration of firms operating in similar industries supports knowledge diffusion within the industry.

– Labor Pool: The concentration increases the presence of skilled and educated workforce in that region and/or sector and facilitates the access of companies to skilled workforce.

– Cost advantages: It provides cost advantages for firms within an industry, such as the effective use of production resources, the formation of supply chains, and innovation ecosystems.

Marshallian approach highlights supply-side factors and industrial relatedness within a spatial context (Glaeser et al. 1992). After Marshall, literature branches into two core directions: technological relatedness and industrial dynamics (Boschma, Balland, and Kogler 2015). While the first direction splits from the Marshallian idea and draws on the benefits of diversity (i.e., Jacobian externalities), the second direction expands agglomeration and spillover effects (Van der Panne 2004; Frenken and Boschma 2007).

A more recent substantial contribution to the literature is Porter's (1990) approach that practices both types. So far, Porter's contribution has also evolved from Marshallian supply-side externalities and clustering model to an export-oriented, and hence demand-side, explanation of competitive power (Porter 2003; Simmie 2008). With his explanation of industrial agglomeration, clusters are defined as industrial groups concentrated in a certain geographical region, connected both vertically and horizontally, sharing common resources such as technology and human capital (Porter 1990, 2000; Feser 1998; Feser and Bergman 2000).

Although some recent absolute measures of agglomeration focus on the scale of an industry in a geographical region (for a detailed discussion, see Kemeny and Storper 2015), Porter-type relative measuring gives the ability to capture relative changes, i.e. in terms of employment share, between sectors in a specific region. So that in-time common effects can be eliminated by this analysis. About international competition, Porter's approach to regional agglomeration distinguishes three types of industries as traded, resource-dependent, and local industries (Porter 2003). If specialization increases with export performance, this confirms Porter-type agglomeration economies that lead to specialized clusters and indicate an overall national competitiveness.

Many studies amplify Porter's approach to economic performance of agglomerated industries.

Spencer et al. (2010), for instance, shows the impact of location on economic performance whether the cluster is in an urban region or not. The study positively differentiates city-region clusters from others in terms of various economic performance indicators.

Two recent studies examine Porter-type impact of agglomeration for the US and European cases. Firstly, Slaper, Harmon, and Rubin (2018) investigate the impact of industrial diversity, specialization strength, and growth of employment on several economic performance indicators in both local and traded industries for the US metropolitan areas. The indicators have a solid impact especially on per employee growth and per capita income growth. Yet, the study is essentially based on employment data and does not reflect monetary dynamics. The second study by Ketels and Protsiv (2021) reviews the European Cluster Observatory dataset for 28 countries. The economic performance indicators in this study are sectoral wages and regional GDP per capita. For that matter, the study assesses cluster-level impact of sectoral wages and region-level effects by economic growth. While wage-effect is found to be valid, regional effect is not so straightforward and is dependent on the quality of business environment.

Several other studies in the literature also choose definite performance indicators other than economic growth-related variables. Falcıoğlu and Akgüngör (2008) explore the evolutionary nature of industrial concentration. Their study investigates whether regional disparities in terms of industrial concentration have deepened through time. Wennberg and Lindqvist (2010) analyze the impact of clustering on new firms' performances. Similarly, Delgado, Porter, and Stern (2010), using firm-level data, examine entrepreneurship performance by focusing on start-ups.

The literature on Turkish case shows an increasing concentration pattern, especially after the 2000s (Akgüngör 2006; Kirankabeş and Arik 2014). For further analysis, productivity increase and reorganization of the Turkish manufacturing sector with export-oriented industrial policies necessitate an evaluation of the performance of regional industries in terms of international competition and sectoral resilience. For this aim, our paper focuses on the export performance of Porter-type agglomerations with a broader sectoral perspective.

2.2. Road to international competition in Turkish manufacturing

Considering the rapid liberalization process in the 1980s, the transformative impact of export-led growth strategy on the structure of the Turkish economy became limited in the next two decades (Arıcanlı and Rodrik 1990; Müftüler 1995). The CUA which was put into effect in 1996 is considered as a reference point in Turkey's international trade policy after the 1980s switch from import-substitution developmentalism (Togan 2015). Reforms in both national and regional level economic policy-making shaped Turkey's integration objective in this route. Due to the available protection spectrum in agriculture, the agreement is supposed to push specifically manufacturing industries to competition.

Early literature focuses on the trade and productivity effects of the agreement on the Turkish side. Neyaptı (2007) finds a positive effect of the CUA in both total export and import volumes while controlling macroeconomic determinants of international trade. According to the findings of the study, the income elasticity of trade decreased after 1996 which tied a stronger trade relationship with the EU.

Taymaz and Yılmaz (2007), in their study on the Turkish manufacturing sector, examine the productivity impact of the CUA. They found that productivity increases were largest in import-competing sub-sectors compared to export-oriented and non-tradable sub-sectors. Akkoyunlu-Wigley and Mihci (2006) considers import-export rates to sectoral outputs and concentration indexes to evaluate the change in pricing, competition, and efficiency in manufacturing industry. Their study provides evidence for decreasing price cost mark-ups and concentration ratios for import sectors in the manufacturing industry.

In brief, the customs union agreement conduced to a more competitive manufacturing sector in Turkey. The findings in the early literature demonstrate an increase in competition and accordingly increase in efficiency and welfare (See also Müftüler 1995; Yılmaz 2011; Togan 2015 for trade effects of the CUA).

Figure 1 shows the evolution of export shares of main trade partners for the last 30 years. The period from the first years of the 2000s to today has become the years of export diversification attempt (See Erguzel et al. 2016). From Figure 1, it is seen that the share of the EU-27 countries in total trade volume, still the

Figure 1. Percentage share of total exports and trade volume in manufacturing - main trade partners
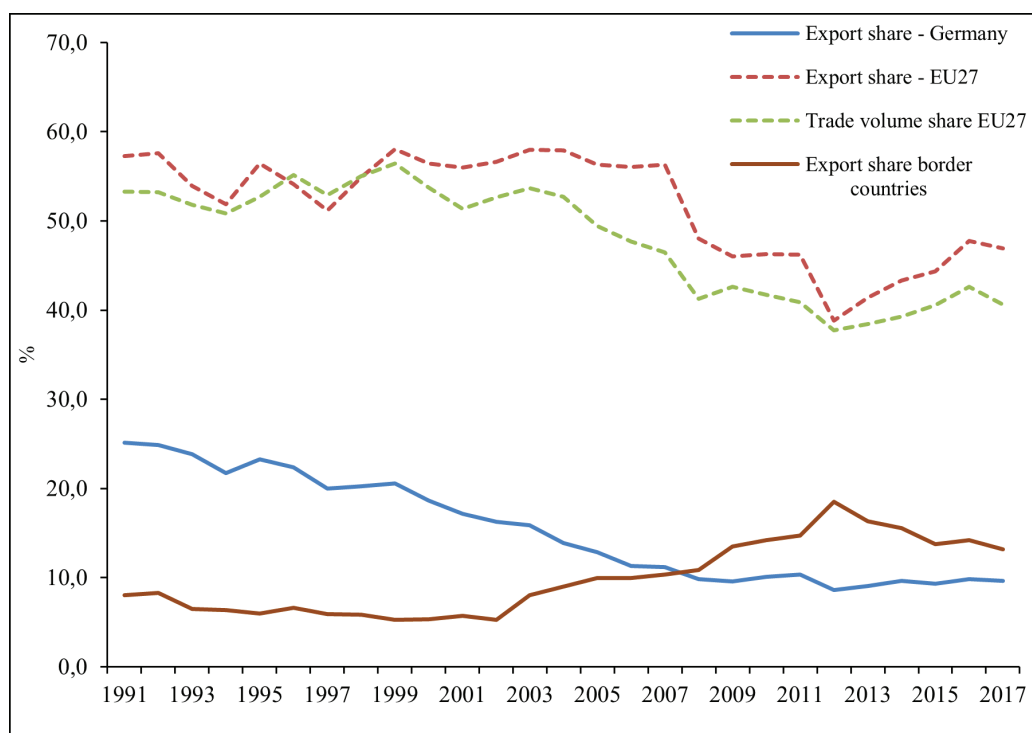
Source: Turkish Statistical Institute (2024)

largest trade partner, declined from 59 percent in 1999 to 39 percent in 2013. The export share of Germany, still Turkey's leading trade partner at the country level, also followed a similar trend to that of the EU-27. In the same period, the export share of the border countries climbed from 5 percent to 17 percent. Iraq, Georgia, and Russia emerged as new trade partners.

As shown by the studies in literature and international trade data, the productivity and competitive impact of the Customs Union Agreement resulted in a structural change in the composition of trade partners' shares. The period after the first years of the 2000s shows a trend of trade expansion with non-EU border countries.

2.3. Regionalization dynamics in manufacturing

Prior to the 2000s, Turkey's regional policy had focused on regional disparities, especially the east-west differentiation of the country. Since the establishment of the State Planning Organization in 1960, infrastructural investments have been the main instrument of regional planning agenda (Ertugal 2018). The EU cohesion policy became the main factor that brought a reform initiative for Turkish regional policy.

With the establishment of Regional Development Agencies (RDAs) in 2006, Turkey has acceded to regional policy-making amenable to EU cohesion standards, though with severe limitations (Lagendijk, Kayasu, and Yasar 2009; Sobaci 2009). To reform the governance of regional policymaking, RDAs were thought of as bottom-up policy institutions. However, as Young-Hyman (2008) showed, Turkish RDAs have been dependent on the central government for financial resources with limited contributions from local administrations. To comply with the EU harmonization process, NUTS2-level regions have been the primary unit of regional policymaking in the last two decades (Young-Hyman 2008; Ertugal 2018). Yet, in addition to the relative scarcity of NUTS2-level data, this spatial standardization is criticized for functionality and local administration capabilities. Since these NUTS2 regions mostly do not coincide with local governance entities, RDAs have limited autonomy in the decision-making process.

Though regional policymaking is *de jure* based on NUTS2 level classification, for especially 3S and investment planning agendas, NUTS3 level provinces, with local administrative capability and distinctive historical developmental paths, appear to be a more proper regional unit for analyzing regional development dynamics (Sat 2018; Sezgin 2018).

Figure 2 shows the contribution shares of 81 NUTS3 regions to total manufacturing production

Figure 2. Contribution to total manufacturing GDP (2002-2017 average) – NUTS3 regions
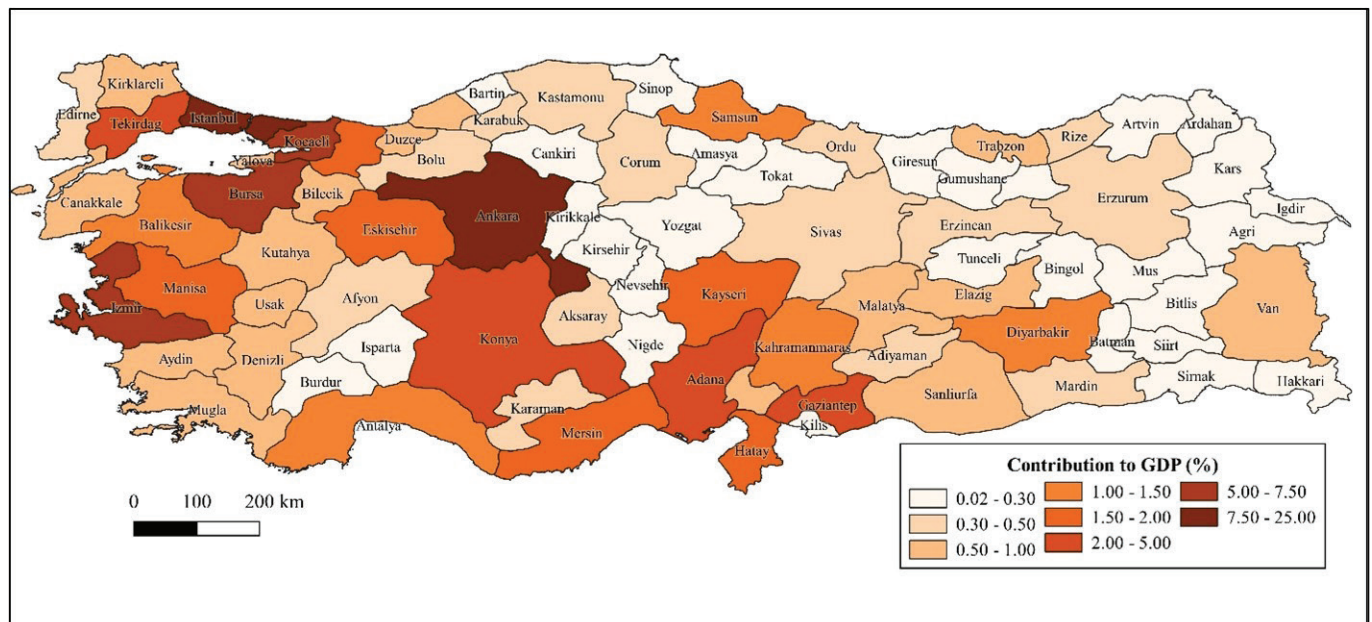
Source: Authors' computation

in Turkey for the 2002-2017 period. Istanbul, Ankara, Kocaeli, Bursa, and Izmir (top five regions) constitute nearly 50% of total production in the manufacturing industry. There are 20 regions out of 81 that exceed 1%. The aggregated contribution of these regions is 78%. Considering this fact, the geographic distribution of manufacturing production exhibits an uneven and highly concentrated pattern between regions.

Moreover, the manufacturing industry has become highly tradable for Turkish regions for the last two decades. Nearly half of the regions export 10% or higher rates of their total manufacturing production. Table 1 shows export intensities of some NUTS3 regions for the 2008-2019 period. Export orientation has been rising in each region during the period.

Considering the literature on agglomeration and economic performance of regions, internationalization of Turkish manufacturing, and increasing concentration of manufacturing production, this paper contributes to the literature with three main points. Firstly, the paper assesses agglomeration dynamics from a broader perspective by using ISIC

Rev. 4 two-digit sectors. Secondly, by using comparative assessment through three-star measurement of agglomeration advantages, the paper presents a complementary method, if not alternative, to absolute and single-region based specialization approaches to capture national inclusiveness priorities. Thirdly, the findings are thought to give insight to policymakers in terms of the nexus between industrial agglomeration, technology level of sectors, and export performance. In the next section, we outline the regional agglomeration structure of manufacturing sectors.

3. Dataset

3.1. Data sources

The empirical part of our study relies on two separate datasets. Firstly, regional sectoral employment and firm statistics are compiled from the official statistical yearbooks of the Social Security Institution of Turkey (SSI 2023). The earliest available series in this source goes back to 2008. Before this date, there were three

Table 1. Export intensities of NUTS3 regions in manufacturing

Region	2008	2014	2019	2008-2019 average
Gaziantep	31.46	42.33	54.88	41.42
Sakarya	33.14	25.57	58.98	32.39
Bursa	33.91	24.37	33.08	30.29
Kocaeli	30.32	26.72	35.81	30.01
Istanbul	31.55	28.46	36.71	29.43
Denizli	24.78	26.39	34.73	27.30
Hatay	17.62	18.27	31.27	20.10
Trabzon	14.86	18.58	21.81	18.08
Manisa	7.67	13.3	19.74	17.09
Izmir	16.31	17.04	21.86	16.86
Kayseri	9.48	13.67	20.42	13.11
Karaman	6.9	13.09	12.77	11.16
Karabük	1.71	11.68	22.61	10.97
Kırşehir	6.75	11.69	15.47	10.75
Kahramanmaraş	5.82	11.81	13.17	10.64
Adana	8.55	10.29	13.27	10.34

Source: Turkish Statistical Institute (2024)

Note: Table gives regions only over 10% on average. Export intensities are calculated as (regional export value)/(regional GDP).

Table 2. Descriptive statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
id	696	-	-	1	58
year	696	-	-	2008	2019
GDP (million TL, 2009 prices)	696	35702.7	101707.8	738.5	132630
Manufacturing GDP (million TL, 2009 prices)	696	6355.2	16248.2	32.98	197938
Total export (million TL, 2009 prices)	696	6831.9	32056.5	9.16	486916
Real exchange rate (TL/$)	696	2.64	1.34	1.29	5.67
Total employment in (selected) manufacturing sectors	696	201,727	493,338	5,073	4,130,578
Total number of firms in (selected) manufacturing sectors	696	26,317	62,623	721	537,982

distinct official social security institutions in Turkey: *SSK* for private sector employees, *Bağ-Kur* for private sector employers, and *Emekli Sandığı* for public sector employees. In 2006, these institutions were merged under the Social Security Institution of Turkey. Hence, NUTS3-level aggregated sectoral data is only available from 2008 onwards. Appendix 1 summarizes sectoral employment, firm number, and export data statistics according to the two-digit ISIC Rev4 classification.

The second source is Turkish Statistical Institute's database. NUTS-3 level statistics for GDP, manufacturing GDP, manufacturing export, and total export are derived from this source. Table 2 presents descriptive statistics for these indicators.

Based on our research to analyze regional dynamics of competitiveness, we conducted a preliminary elimination process. By calculating the export intensity of manufacturing sector for NUTS-3 regions, we excluded 23 provinces from the dataset which have intensity values below 0.5%. In the end, our final dataset is a panel of 696 observations with 58

cross-sectional units (NUTS-3 level provinces) and 12 years (2008-2019).

3.2. Identifying regional agglomeration and specialization

To conduct regression analysis, we first constructed some variables to represent regional specialization and agglomeration. In the literature, there are various methods to calculate such indicators based on employment, output, or export value data (See Nakamura and Paul 2009).

In this study, we follow the 3-star methodology of Sölvell, Ketels, and Linqvist (2008) on the EU regions. The study is an adaptation of Porter (2003) on the US clusters. As the name implies, three different criteria are calculated to determine Porter-type clusters/agglomeration. Specifically, these are size, dominance, and specialization. Table 3 shows how these criteria are calculated.

Table 3. Identification of Porter-type agglomeration

Criteria	Formula	Definition	Threshold
size	$\dfrac{emp_{ij}}{EMP_j}$	(Employment in sector *j* in region *i*) / (total employment in sector *j*)	2%
dominance	$\dfrac{emp_{ij}}{emp_i}$	(Employment in sector *j* in region *i*) / (total employment in region *i*)	5%
specialization	$\left[\dfrac{emp_{ij}}{emp_i}\right] / \left[\dfrac{EMP_j}{EMP_i}\right]$	(Ratio of employment in sector *j* in region *i* to total employment in region *i*) / (ratio of total employment in sector *j* to total employment in all regions)	2

Size measures the share of a region's employment in overall employment in a sector. *Dominance* represents the relative weight of a sector in a region, and *specialization* is the standard location quotient (LQ).

One of the issues in this methodology is the determination of threshold values for these criteria (See O'Donoghue and Gleave 2004; Tian 2013). If thresholds are set low, more stars will be detected than it is and vice versa. Such an inconsistency will lead to misleading implications. Considering previous studies and our dataset, we set the size threshold as 2%, the dominance threshold as 5%, and the specialization threshold as 2 (Sölvell, Ketels, and Linqvist 2008; Ketels and Protsiv 2021). By these threshold values, at least one star is given to the best 25% of each sector (See Table 3). We calculated these criteria for each year and each region. So, instead of attributing cluster quality for the whole period, we reflected possible yearly changes in these scores.

Table 4 shows the results of the 3-star analysis. A sector in a region that exceeds the threshold value in any one of the criteria receives one star, if exceeds in any two criteria receives two stars, and if exceeds in all three criteria receives three stars. According to the stars they received, sectors are called "mature cluster" if they received three stars, "potential cluster" if they received two stars, and "candidate cluster" if they received one star. We excluded highly concentrated and/or small-scale manufacturing sectors. These sectors either have a total employment number below 20,000 or are concentrated in 3 or lower number of regions. The cluster ratio is higher for the *manufacture of food products* and the *manufacture of non-metallic mineral products* (48% and 41%, respectively). These two sectors are more evenly distributed spatially than the others. Since this methodology is solely based on employment data, we do not interpret these labels as real clusters, i.e. as a hub of knowledge-intensive concentration, but as indicators of agglomeration level.

Table 4. Agglomeration in manufacturing sector

Sector (ISIC Rev4 classification)		No cluster	1-star	2-star	3-star	total
10 - Manufacture of food products	Freq.	361	92	142	101	696
	Percent	51.87	13.22	20.4	14.51	100
13 - Manufacture of textiles	Freq.	512	45	65	74	696
	Percent	73.56	6.47	9.34	10.63	100
14 - Manufacture of wearing apparel	Freq.	521	35	112	28	696
	Percent	74.86	5.03	16.09	4.02	100
20 - Manufacture of chemicals and chemical products	Freq.	549	71	76	-	696
	Percent	78.88	10.2	10.92	-	100
22 - Manufacture of rubber and plastics products	Freq.	539	81	69	7	696
	Percent	77.44	11.64	9.91	1.01	100
23 - Manufacture of other non-metallic mineral products	Freq.	406	180	58	52	696
	Percent	58.33	25.86	8.33	7.47	100
24 - Manufacture of basic metals	Freq.	488	128	36	44	696
	Percent	70.11	18.39	5.17	6.32	100
29 - Manufacture of motor vehicles, trailers and semi-trailers	Freq.	589	48	32	27	696
	Percent	84.63	6.9	4.6	3.88	100
30 - Manufacture of other transport equipment	Freq.	554	67	63	12	696
	Percent	79.60	9.63	9.05	1.72	100
31 - Manufacture of furniture	Freq.	568	99	19	10	696
	Percent	81.61	14.22	2.73	1.44	100

Source: Authors' calculation based on SSI (2023)

4. Econometric Model

The econometric analysis will be conducted based on a panel data model. The model considers Porter-type industrial agglomeration as explained by Simmie (2008). The model given by Equation 1 aims to test the hypothesis on sectoral export performance.

$$ln(EI)_{it} = \beta_0 + \beta_1 STAR_{it} +$$
$$\beta_2 ln(GDP)_{it} + \beta_3 ln(RER)_t + \varepsilon_{it} \tag{1}$$

where i and t denote NUTS3 regions and year respectively. The dependent variable is the logarithm of sectoral export intensity. Sectoral export intensities are calculated by using Equation 2.

$$EI_{ij} = \frac{export_{ij}}{GDP_i} \tag{2}$$

$STAR_{ij}$ is a dummy variable that takes values from 0 to 3 and represents sectoral agglomeration level according to Porter's star approach explained in section 3. Significant coefficients will show whether regions with related sectoral agglomerations differ from non-agglomerated ones in terms of export intensities.

$ln(GDP)_{it}$ and $ln(RER)_t$ are added as control variables. As in gravity modelling (Anderson, 2011), RER_t is added to the model to represent exchange rate related changes in competitiveness. Since RER_t is common to all regions of Turkey, cross-section indices are not added to the variable.

For estimating the econometric model consistently and efficiently, we should consider the panel structure of our dataset. The validity of econometric estimations depends on two conditions.

i. Heterogeneity among regions with various sizes and economic structures which can lead to region-specific time-invariant fixed effects,

ii. Spatial and/or temporal dependence of regions.

Accordingly, we will conduct some preliminary tests to choose a reliable estimation methodology. Firstly, we must decide whether region-specific fixed effects are valid or not. For this purpose, we conduct F-test to decide whether H_0 : individual estimates of intercept terms are equal (restricted pooled OLS) or H_1 : not (unrestricted FE). The null hypothesis assumes the validity of common effects while the alternative hypothesis shows the existence of different fixed effects among regions. F-test results for each regression are given at the end of related estimation results table in findings section.

For the second condition, we applied Pesaran's cross-section dependence test (Pesaran 2015). One of the advantages of this test over other residual-based tests, such as Friedman's FR test, Frees test, or Pesaran (2004) CD test, is that it can be applied to variable series instead of residuals (De Hoyos and Sarafidis 2006). The test statistic is given by Equation 3.

$$CD = \sqrt{\frac{2}{N(N-1)}}\left(\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\sqrt{T}\hat{\rho}_{ij}\right) \tag{3}$$

where $\hat{\rho}_{ij}$ denotes pair-wise correlation coefficients of x_{it} regressors for the (i, j) units (Bailey, Holly, and Pesaran 2016). According to the results of cross-sectional dependence test, mean correlations between regions show a strong nature in general (See Appendix 2). So that, we must use spatial correlation robust standard errors.

Consider the model given by Equation 4.

$$y_{it} = x_{it}'\beta + \varepsilon_{it} \tag{4}$$

where x_{it} is vector of independent variables and β is vector of unknown coefficients. i and t denote cross-sectional units (NUTS3 regions) and time respectively. The error term ε_{it} is defined as given by Equation 5 to capture cross-sectional dependence of regions and time-invariant factors specific to each region.

$$\varepsilon_{it} = \alpha_i + \lambda_i f_t + v_{it} \tag{5}$$

In equation 5, $\lambda_i f_t$ and α_i constitute cross-section-specific components. f_t is unobserved factor common to all cross-sectional units and is assumed to cause correlated residuals. This factor can be any shock or policy change that all cross-sectional units are affected simultaneously. α_i represents unobservable time-invariant factors specific to each region that led group fixed effects. v_{it} is the regular error term.

In order to eliminate α_i from the equation, we subtract group averages of $\overline{y}_i$ and $\overline{x}_i$ in Equation 5. With this operation, we get the classical Within Group estimator given by Equation 6.

$$\tilde{y}_{it} = \tilde{x}_{it}'\beta + u_{it} \tag{6}$$

Heteroskedasticity and autocorrelation consistent (HAC) robust standard errors can be computed

by nonparametric kernel variance-covariance matrix estimators for Equation 6 (Bramati and Croux 2007; Stock and Watson 2008). Yet, HAC estimators of the covariance matrix assume that the explanatory variables and the error terms must be independent across cross-section units (no cross-sectional dependency). If this assumption is not satisfied, HAC estimations of the covariance matrix will be inconsistent. By using cross-section averages of residuals and regressors, the variance-covariance matrix can be computed as in HAC method (Vogelsang 2012). In order to overcome cross-sectional dependence, we use Driscoll and Kraay (1998)'s spatial correlation robust HAC standard errors (See Hoechle 2007).

5. Findings and Discussion

Our findings on the export performance of Turkish regions for two-digit manufacturing sectors are given in this section. The regression results on the impact of agglomeration on sectoral export performance are given in Table 5.

Each column in Table 5 presents two-way fixed effects regression results for the given manufacturing sector. According to the results, agglomerations in the manufacture of chemicals, plastics, transport, and furniture sectors have a positive relation with sectoral export performance. For the chemicals sector, all levels of agglomeration are positively related to sectoral export intensity. Plastics, transport equipment, and furniture sectors do not have a statistically significant relation with one-star agglomeration but have with all higher levels. Positive coefficients of agglomeration level dummies show export orientation and adaptation to broader factors, while negative coefficients can be interpreted as internal market orientation. In this case, the manufacture of food products has a negative relation, indicating an internal market orientation. Exports of other manufacturing sectors do not have a statistically significant relation with sectoral agglomeration.

Table 5. The effect of agglomeration on sectoral export performance

variable	food	textile	wearing	chemicals	plastics	nonmetal	metal	vehicle	transport	furniture
ln(GDP)	0.58***	0.61***	0.62***	0.65***	0.96***	0.58***	0.56*	0.96***	0.15	0.78***
	(0.15)	(0.01)	(0.22)	(0.23)	(0.14)	(0.12)	(0.31)	(0.24)	(0.39)	(0.12)
RER	0.04	0.05	-0.07	0.12*	0.02	0.15***	0.27***	0.21***	0.40***	0.12***
	(0.046)	(0.04)	(0.08)	(0.06)	(0.03)	(0.05)	(0.10)	(0.07)	(0.11)	(0.02)
star_1	-0.392**	0.11	-0.27	0.29***	0.20	0.16	0.17	-0.16	0.15	0.15
	(0.156)	(0.20)	(0.38)	(0.10)	(0.27)	(0.22)	(0.12)	(0.35)	(0.79)	(0.21)
star_2	-0.042	0.08	0.15	0.25*	1.16***	0.11	0.57	-0.01	0.93*	0.96**
	(0.034)	(0.42)	(0.27)	(0.14)	(0.29)	(0.29)	(0.42)	(0.16)	(0.47)	(0.38)
star_3	-0.12**	-0.55	-0.11	-	0.77**	0.20	1.25	-0.46	-	0.85**
	(0.045)	(0.61)	(0.17)	-	(0.30)	(0.29)	(1.32)	(0.30)	-	(0.34)
lag (1)	0.475***	0.34***	0.51***	0.45***	0.44***	0.27***	0.28***	0.09	0.11*	0.33***
	(0.069)	(0.06)	(0.10)	(0.03)	(0.07)	(0.06)	(0.05)	(0.07)	(0.06)	(0.07)
constant	-0.21	0.53	-2.41	-2.18	-6.84***	2.14	1.40	-2.27	8.27	-2.71*
	(2.56)	(2.15)	(4.01)	(3.20)	(1.81)	(2.03)	(4.81)	(3.19)	(6.05)	(1.14)
N	630	635	601	630	638	627	606	576	462	633
F	430	410	66.4	1017	1170	178	259	204	54.4	2742
R^2	0.54	0.30	0.29	0.56	0.52	0.36	0.32	0.26	0.14	0.44

Note: Values in parentheses are robust Driscoll-Kraay standard errors. The dependent variable is $ln(exp\,o\,rt\_int\,e\,nsity)$ of the given sector in each regression (See Equation 1). Chemicals and transport sectors do not have 3-star level agglomeration. ***, **, and * denote significances at 1%, 5%, and 10%, respectively.

These findings confirm the fact that the related sectors have resilience to integration and international competition. For the unrelated sectors, we cannot say that these are resource-dependent or local industries, according to Porter's classification (Porter 2003). However, as the manufacture of textile products, vehicles, metal products, and wearing apparels are respectively primary sectors of Turkish export (Gül 2021), it seems that these sectors have reached a developmental trap position. So much so that increasing trade opportunities do not contribute much to the expansion in these sectors. In other words, they have a stable market structure, and new challenges must be overcome for further expansion.

The findings from the analyses provide several implications related to the sectoral differentiation of Turkish manufacturing. Returning to our research question on agglomerated industries' regional export performance, we confirm the hypothesis for only several sectors of the manufacturing industry. For two-digit broad manufacturing sectors, the Porter-type impact of agglomeration is found to be limited to chemicals, plastics, metal, transport, and furniture industries. Previous studies on Turkish manufacturing have already illustrated this for creative and import-competing sectors (Akkoyunlu-Wigley and Mihci 2006; Taymaz and Yılmaz 2007; Gülcan et. al 2011). Also, Özsarı et al. (2022) and Emirhan and Turgutlu (2023) amplifies positive impact of exports on labour demand in manufacturing industries for the Turkish case. Their findings are stronger for low-tech and mid-tech subsectors.

Table 6 summarises the findings of our research. Turkish ISIC Rev4 two-digit classification manufacturing sectors can be grouped into three according to regional agglomeration characteristics. Each group is given in a row in Table 6.

The first group consists of only the food products sector. Agriculture-based food production shows local/resource-oriented characteristics. Hence, agglomeration and specialization dynamics are not sensitive to international trade. The sector is also one of the few sectors that were not fully liberalized during the CUA with the EU. This policy choice created a subsidized agricultural resource base for food products and, at least, prevented possible larger trade flows within the EU area (Larch, Schmeisser, and Wanner 2021).

The second group of manufacturing sectors are the ones that have Porter-type agglomeration structure. Except for furniture, all sectors in this group are medium-tech. Positive employment response to export is higher in this group compared to the two other groups of manufacturing sectors. Due to potential trade and cluster opportunities, these sectors are open to regional economic policy making and regional development strategies based on, for instance, 3S (See Abay and Akgüngör 2023 for 3S potential of Turkish regions). Compared to labour-saving high-technology industries, these sectors have the potential of application of inclusive regional development agenda that calls upon labour employment.

The third and last group consists of manufacturing sectors that have high export shares in Turkey's overall export volume and have a mature industrial structure.

Table 6. Summary of agglomeration effects analysis

sector (tech-level)	export impact	evaluation
food products (low-tech)	(-)*	Local/resource dependent industry; domestic market orientation
chemical products (med-tech) plastics products (med-tech) transport (med-tech) furniture (low-tech)	(+)*	Traded industry; Porter-type agglomeration; Trade and cluster opportunities
textiles (low-tech) wearing apparels (low-tech) basic metals (med-tech) non-metal (med-tech) vehicle (med-tech)	No impact	Mature industry; possible labor-substituting technological progress; global value-chains

Especially textiles and wearing apparels sectors have been the main sectors of the export-led economic growth policy of Turkey since the 1980s liberalization movement. The vehicle sector, which consists automotive subsector, also has been one of the main export items targeting the EU market since the adoption of the CUA in 1996. So far these sectors have been the locomotive of Turkish exports and have gained a steady market. In overall evaluation, these sectors are highly competitive, and it is hard to expand production and increase productivity without gaining technological competitiveness or a creative clustering agenda.

6. Conclusion

This paper assesses Porter-type regional industrial dynamics for Turkey's ISIC Rev. 4 two-digit manufacturing sectors. Using panel data for 58 NUTS3 regions and for the 2008-2019 period, we examine sectoral resilience to international competition and variation of agglomerated sectors in terms of export performance.

The findings reveal three groups of manufacturing sectors. The first group is uniquely composed of the food products sector which depends on highly protected agricultural production. Regional agglomeration in this sector has no positive impact on export performance. The second group of sectors are the ones that have Porter-type trade advantages and clustering opportunities. Namely, chemical products, plastics products, basic metals, transport equipment, and furniture are in this group. The third and the last group consists of mature manufacturing sectors that also have been the leading export sectors for Turkey. Regional agglomerations in the production of textiles, wearing apparels, non-metal products, and vehicles have no statistically significant relation with export performance.

Taking into account both the need for a coherent regional policy strategy and national comparative advantages in manufacturing sectors, it appears that regional agglomeration of certain sectors does not have a direct path towards agglomeration advantages. For a medium-size country like Turkey, regional policy strategy should focus on increasing transformative capacity in the second group of manufacturing sectors which have agglomeration advantages in trade,

instead of creating comparative advantages by specializing in niche smart sectors. The findings illustrate the need for technological upgrades in the mature low-tech sectors in the third group of manufacturing sectors. At this stage, a combination of national and regional economic policy also becomes decisive. On the one hand, these are low and mid-tech sectors that are open to technological progress. This can be accomplished through either targeted technology policy or partnerships within global value chains in these sectors. In this way, these mid-tech sectors can break down such path dependency. On the other hand, regional redistribution of these sectors, especially textiles and wearing apparels, to the regions with clustering and labor-cost advantages can contribute to export competitiveness.

Lastly, the implications of the paper are dependent on the assumption of the status quo of labor mobility and determined regional policy. Both points are crucial to executing inclusive regional policy and sustaining the resilience of regional agglomerations accompanied by 3S potentials.

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Appendices

Appendix 1. Summary of manufacturing sector data

Sector – ISIC Rev4 classification		Total Employment					Number of Firms					Export (million TL)				
Division Code	Definition	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
10	Manufacture of food products	696	6650.05	9255.41	164	68172	696	661.7	952.57	29	7355	690	442	1360	224	171000
13	Manufacture of textiles	696	6875.13	15499.4	1	81379	696	279.73	900.47	1	7584	694	627	2820	245	379000
14	Manufacture of wearing apparel	696	7603.61	32518.88	0	278769	696	545.36	2905.01	0	24437	672	568	3840	140	57000
20	Manufacture of chemicals and chemical products	696	1295.13	3277.26	1	23317	696	75.51	208.96	1	1770	690	360	2020	211	34800
22	Manufacture of rubber and plastics products	696	2989.47	8067.61	4	62766	696	201.21	616.24	2	5127	696	303	1410	421	20300
23	Manufacture of other non-metallic mineral products	696	3259.66	3788.67	41	25105	696	209.87	304.68	8	2397	689	183	755	205	11900
24	Manufacture of basic metals	696	2564.14	4685.61	0	29075	696	128.52	328.85	0	2819	673	852	4990	210	61900
29	Manufacture of motor vehicles, trailers and semi-trailers	696	2329.72	8026.73	0	69614	696	52.48	122.99	0	782	650	1070	5550	23	81300
30	Manufacture of other transport equipment	696	798.37	2146.07	0	19229	696	21.01	64.55	0	869	562	141	599	39	6730
31	Manufacture of furniture	696	2138.89	5343.5	0	35962	696	295.21	732.97	0	5638	693	298	1860	247	28200

Appendix 2. Cross-sectional dependence test results

Variable	CD-test	p-value	mean $\hat{\rho}$	mean abs ($\hat{\rho}$)
ln(GDP)	140.26	0.000	1.00	1.00
ln(EXP_M)	118.98	0.000	0.84	0.84
ln(GDP_M)	138.37	0.000	0.98	0.98
ln(RER)	140.84	0.000	1.00	1.00
ln(EI10)	89.55	0.000	0.64	0.72
ln(EI13)	41.39	0.000	0.29	0.46
ln(EI14)	12.16	0.000	0.08	0.42
ln(EI20)	84.42	0.000	0.60	0.64
ln(EI22)	81.33	0.000	0.58	0.62
ln(EI23)	66.36	0.000	0.47	0.53
ln(EI24)	57.04	0.000	0.42	0.50
ln(EI29)	52.69	0.000	0.40	0.48
ln(EI30)	17.95	0.000	0.13	0.36
ln(EI31)	70.88	0.000	0.50	0.56
SPEC10	-0.62*	0.531	0.00	0.46
SPEC13	4.33	0.000	0.03	0.43
SPEC14	-0.27*	0.788	0.00	0.52
SPEC20	-2.03	0.041	-0.01	0.49
SPEC22	16.02	0.000	0.11	0.55
SPEC23	0.07*	0.946	0.00	0.39
SPEC24	-0.24*	0.813	0.00	0.49
SPEC29	15.06	0.000	0.11	0.52
SPEC30	14.60	0.000	0.10	0.40
SPEC31	4.95	0.000	0.04	0.50

Note: Under the null hypothesis of cross-section independence, CD ~ N(0,1).
p-values close to zero indicate data are correlated across panel groups.
* indicates insignificant test statistics.

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