EKONOMSKI VJESNIK

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EFOS

Josip Juraj Strossmayer
University of Osijek

**Faculty of Economics
and Business in Osijek**

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Review of contemporary business,
entrepreneurship and economic issues

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A PRACTICAL RESEARCH TO EXPLAIN THE IMPORTANCE OF WASTE RECYCLING AND RENEWABLE ENERGY GENERATION FOR INDUSTRIAL PRODUCTION AND SUSTAINABILITY

Abstract

Purpose: As an indicator of economic growth, industrial production's energy and raw material needs are subject to environmental studies. The link between the ecological harm caused by plastic waste and the concept of sustainable economic growth through renewable energy is a topic of current debate in the literature. This research aims to discover whether there is a connection between plastic waste and production.

Methodology: This paper investigates the links between plastic import, renewable energy generation, export, and exchange rates on industrial output in Türkiye by using the ARDL Bounds Test and causality analysis for 2008:Q1-2023:Q3.

Results: Research findings reveal that plastic waste import and export positively affect industrial output in the long run. While renewable energy generation decreases industrial production in the short run, it positively affects industrial production in the long run.

Conclusion: The study emphasizes the evaluation of renewable energy and circular economy opportunities to ensure sustainable economic growth, while underlining the transformation of threats into opportunities.

Keywords: ARDL, causality, industrial production, international trade, renewable energy, waste import

1. Introduction

The issues of global warming and environmental degradation threaten human health, nature, economy, and production (Wade & Jennings, 2016). Conversely, the increasing world population also requires additional consumption, negatively affecting the environment through waste. The steps taken to protect the environment become complex at this point. This is because the goal of providing clean air, organic food, healthy soil, and a peaceful and

sustainable living environment for all living beings, primarily pursued by developed economies for their own countries, ignores developing or underdeveloped countries.

The complex agenda has paved the way for the emergence of the circular economy concept. The concept of the circular economy represents a shift away from the traditional linear model of production and consumption, aiming to minimize waste and maximize resource efficiency (Corvellec et al., 2022). In a circular economy, products are designed with durability, repairability, and recyclability, ensuring that materials can be reused or regenerated at the end of their life cycle (Suzanne et al., 2020). This approach reduces the strain on finite resources and minimizes environmental pollution and greenhouse gas emissions associated with extraction, production, and disposal (Honic et al., 2019). The circular economy fosters a more sustainable and resilient economic system that benefits businesses

and the environment by promoting reuse, remanufacturing, and recycling. In this context, plastic waste and renewable energy are essential.

After China banned the import of plastic waste at the beginning of 2018 (Brooks et al., 2018), the risk of becoming a haven for waste for developing and underdeveloped countries increased further. Since economic activities are designed to meet the needs and desires of an increasing population, the increase in waste leads former waste-hosting regions to seek new disposal sites, as they no longer wish to accept more waste (Liu et al., 2018). As a developing economy, Türkiye increased its waste imports by over three times within a few years immediately after China's import ban. By opening its doors to these wastes, it has become a significant global waste center (ITC, 2024). This situation makes Türkiye an example that needs to be examined in many different contexts, especially regarding plastic waste imports.

Figure 1 Plastic waste import of Türkiye (in thousand USD, 2004-2023)
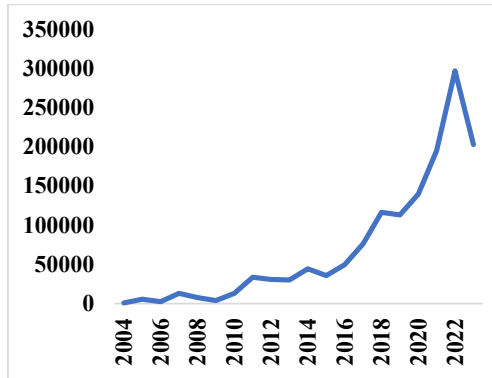
Source: trademap.org

Figure 2 Industry Production Index (%) of Türkiye in years

Source: tuik.gov.tr

Figure 1 illustrates the change in Türkiye's plastic waste import over the years. It can be said that China's ban on plastic waste imports in 2018 led to a significant surge in Türkiye's plastic waste imports in the following years. As a result of this surge, Türkiye has become the third-largest importer of waste in the world and now ranks first among developing countries (ITC, 2024). With this increase, environmental pollution in Türkiye has reportedly risen, adversely affecting many organisms, including marine life. Türkiye has become a dumping ground for European countries (Greenpeace, 2024). On the other hand, Türkiye's industrial production index,

as seen in Figure 2, has increased from around 60 to 160 levels over approximately 15 years.

Mass production and unlimited consumption result in more waste in modern societies. Most of the global population uses electronic devices daily (Shinde et al., 2023). Moreover, factories producing goods and services other than electronic devices also require energy for production (Ahmed et al., 2022). Therefore, the energy issue in the global economic system also stands out as another important topic concerning the environment. The environmental impacts of various energy generation methods are not only the subject of scientific

research but also of political agreements such as the Paris Agreement, the Kyoto Agreement, and the EU Green Deal. However, differing energy generation capabilities among countries often result in environmental concerns being overlooked.

Nevertheless, renewable energy sources, created to promote global sustainability, have become a trendy area of scientific research and a valuable opportunity for countries facing difficulties in energy supply. Indeed, the ability to transform the blessings offered by nature, especially solar and wind energy, into production opportunities can be expressed as an essential step. Thus, countries with suitable natural resources, whether underdeveloped or developing, will relax to meet their energy needs from abroad. Just as in the case of waste import, examining renewable energy sources is crucial for Türkiye's energy production. Türkiye, which lacks fossil fuel resources such as oil and natural gas, does not have an actively operating nuclear power plant either (Mukhtarov et al., 2022). Despite using alternatives with high environmental impacts, such as thermal power plants, hydroelectric power plants, and stations converting natural gas to energy, Türkiye has a high potential for renewable energy sources, such as wind, solar, and geothermal power, owing to its geographical advantages (Bilgili et al., 2022). Especially in recent decades, the Turkish government has invested in incentives towards these renewable energy production opportunities, indicating a valuable area where the effects of energy obtained from these sources on the economy need to be examined (Bölük & Kaplan, 2022; Kul et al., 2020).

In addition to environmental issues, as a developing economy, Türkiye must also have an exceptionally critical management model regarding its trade balance (Blavasciunaite et al., 2020). The long-standing trade deficit (Muratoğlu, 2020) has been seen as a significant obstacle to Türkiye's advancement from developing country status. The fact that imports exceed exports results in continuous currency depreciation in the country because of the need for exchange to sustain imports. Therefore, in addition to environmental issues, it is believed that exports and exchange rates are also concepts that must be considered in research on the economy of this country.

When the relevant literature is evaluated in general, it is worth noting that the number of studies directly examining the impact of waste imports and renewable energy on industrial production is quite limited. To resolve this gap in the literature,

this study investigates the effects of the amount of imported plastic waste and renewable energy production on the Turkish economy with data for the period 2008Q1-2023Q3, using the Autoregressive Distributed Lag (ARDL) Bounds Test and causality methods. The study aims to contribute significantly to the existing literature. In the remaining parts of the paper, the theoretical framework will be drawn, and a summary of the literature on the subject will be presented. The following section introduces the data and method used in the study. Following the section presenting the empirical findings of the research, the final part of the paper will provide the conclusion, discuss policy implications, and offer recommendations for future research.

2. Theoretical framework and literature review

The Environmental Kuznets Curve (EKC) stands out as an important approach used to explain the model of the study. Initially proposed by Kuznets (1955) in his study examining the relationship between income inequality and economic development, the concept suggests a reversed U-shaped curve later associated with the ecological footprint by Grossman and Krueger (1991). It is believed that a rise in income leads to a reduction in environmental degradation. There are numerous studies in the literature aimed at testing the validity of this belief (Zhang et al., 2019; Destek & Sinha, 2020; Dogan & Inglesi-Lotz, 2020; Pontarollo & Muñoz, 2020; Ahmad et al., 2021). An increase in income is related to becoming a developed country, and the process of development is the process that shapes the curve. Considering that there are more developing and underdeveloped countries in the world (UN, 2024), the analyses to be conducted for the EKC will provide great opportunities to test the theory in the future. These significant opportunities to be obtained within the research context also draw attention to the variables, another vital aspect of scientific research.

Data representing environmental degradation or regulation can potentially be a variable for environmental and economic studies, particularly in EKC research. Similarly, when looking at the data used to contemplate the state of the environment in the literature, it is observed that carbon dioxide (CO_2) emissions (Akadiri & Adebayo, 2022; Kirikkaleli et al., 2022; Raihan et al., 2022a; Zahoor et al., 2022)

are predominantly used as an environmental variable. However, the concept of the environment is not limited to air alone. Just as air is not the only element in nature affected by pollution, soil and water also suffer from contamination. Therefore, various methods to measure environmental pollution should be considered in scientific research. While waste is frequently highlighted in the literature as a noteworthy topic, it often needs to be addressed.

Walter and Ugelow's (1979) Pollution Haven Hypothesis (PHH), which builds on Pethig's (1976) study from a few years earlier, represents another theoretical approach examining the relationship between environmental pollution and the economy. According to this theory advocated by Antweiler et al. (2001), waste tends to flow towards low-income countries. Bashir (2022) attributed this flow to multinational corporations (MNCs) preferring less developed or developing countries with lower environmental standards. Baek (2016) and Ma et al. (2022) also reported that businesses generating poor environmental conditions tend to migrate to countries with weaker regulations. As can be seen, the PHH primarily associates investments with the environment. This typical association draws attention to the fundamental problem of insufficient capital, which is one of the main issues for less developed and developing countries. Securing capital, regarded as one of the biggest challenges for economic development in these countries (Bashir et al., 2020), is crucial for increasing production and ensuring economic development (Ma et al., 2022).

As seen from the theoretical background, the EKC and the PHH offer a wide range of environmental and international economic research opportunities regarding their testing. Studies confirming or refuting these theories will be discussed below, but several essential points specific to this study need to be addressed. Firstly, Türkiye is classified as a developing country (UN, 2024). Additionally, Türkiye has experienced rapidly increasing plastic waste imports (ITC, 2024). Considering these two facts, it is believed that Türkiye's economy and environmental issues need to be examined from different perspectives and through various methods. Therefore, in this study, the industrial production index (IPI) has been taken as the dependent variable to indicate economic development, and the country's plastic waste imports (PIM) have been considered an explanatory variable from an environmental per-

spective. In this context, it is beneficial to also refer to the literature.

According to Brooks et al. (2018), finding an alternative country to accept plastic waste banned for import by China until 2030 does not appear feasible. This situation highlights global plastic waste recycling as a significant issue. Yu (2010) describes this problem as extremely dangerous in terms of pollution in economic and environmental systems. When examining scientific research on this issue, studies focusing on the flow of plastic waste (Ma et al., 2020; Xu et al., 2020; Olatayo et al., 2021; Siddique et al., 2022), plastic waste trade networks (Shi et al., 2021; Wang et al., 2020; Zhao et al., 2021), and research analyzing their environmental impacts (Huang et al., 2020; Wen et al., 2021) are noteworthy. Wang et al. (2021) examined the effect of waste recycling processes on economic growth from a unique perspective. They found that the rise in plastic consumption influences economic growth in certain countries. However, these countries also exhibit high rates of plastic waste separation. Indeed, Bishop et al. (2020) emphasized the importance of monitoring plastic waste, particularly in European countries, within the circular economy framework. Although these studies are crucial for monitoring waste management and trade, they also provide valuable guidance for research conducted on countries. In a survey of waste importation in Türkiye, Gündoğdu and Walker (2021) found that waste importation has the largest share in polluting Türkiye's seas. A study investigating the environmental impact of waste importation in Japan and China (Sun & Tabata, 2021) revealed that reducing waste importation in China resulted in increased CO_2 emissions. This increase was linked to implementing new production methods rather than waste recycling.

Additionally, the same study found that Japan's reduced waste exports decreased carbon emissions because of the utilization of recycled waste. Kuan et al. (2022) suggested in their research on waste importation in Japan and Malaysia that Malaysia emerged as the primary destination for waste following China's import bans. This study compared the laws related to environmentally friendly recycling of imported waste and concluded with recommendations. Similarly, Chen et al. (2021) highlighted waste management issues in Malaysia by studying the excessive importation of waste from Malaysia's perspective. In another study similar to the one conducted in Malaysia, Thapa et al. (2024)

emphasized the importance of considering socio-ecological factors when recycling the waste that Vietnam would import from the EU. In a study measuring the dynamics of plastic waste import and export in the Asian region after China's ban (Nakayama & Osako, 2024), it was reported that the increase in plastic waste imports led to water pollution and significant adverse environmental effects. At first glance, while studies examining the environmental impacts of waste trade, its relationship with the environment, trade flows, and networks can be more readily observed, it is more challenging to find studies examining the place of imported waste within the economy.

On the other hand, renewable energy has gained prominence in recent years in studies exploring the connection between the economy and the environment. While economic growth is found to increase pollution (Raihan et al., 2022a; Raihan & Tuspekova, 2022; Zahoor et al., 2022), it is noted that economic growth in developed countries reduces air pollution (Ahmad et al., 2021). In developing countries, the initial stages of economic growth are associated with a rise in air pollution (Khan et al., 2020; Fan & Hao, 2020; Ahmad et al., 2021; Kirikkaleli et al., 2021; Akadiri & Adebayo, 2022; Aslan et al., 2022; Raihan et al., 2022b; Raihan et al., 2022c;). Furthermore, the utilization of renewable energy is found to abate environmental pollution (Saidi & Omri, 2020; Anser et al., 2021; Kirikkaleli et al., 2022; Raihan & Tuspekova, 2022; Xue et al., 2022) and promote economic growth (Saidi & Omri, 2020; Shahbaz et al., 2020; Wang & Wang, 2020; Wang et al., 2022). Additionally, several studies indicate that both renewable and non-renewable energy consumption contribute to economic growth (Rahman & Velayutham, 2020), while others suggest that non-renewable energy consumption drives economic growth, with insignificant effects from renewable energy consumption (Ivanovski et al., 2021). These studies utilize various econometric models, time series, or panel data analysis methods. In some of these studies, despite including different variables such as technology and environmental policy in the models, it is noteworthy that CO_2 emissions are the sole variable considered in assessing the environment. As mentioned, this is a significant environmental and economic research limitation.

In addition to all these studies, it is known that some other factors besides the environment also impact economic growth and development. Among these issues, exports are particularly well-known, especially for developing countries. Studies directly examining the influence of exports on growth, conducted decades ago, are often cited (Emery, 1967; Marin, 1992; Al-Yousif, 1997). However, it cannot be said that there are no recent studies on the relationship between exports and economic growth. Mensah and Okyere (2020) determined a mutual relationship between exports and economic growth.

Similarly, Orhan et al. (2022) reached a comparable conclusion in their study. In some studies, exports are not considered in isolation; trade openness influences economic growth (Bahramian & Saliminezhad, 2020; Chen et al., 2022). Studies on the correlation between trade balance and economic development are also evident (Blavasciunaite et al., 2020). It is worth noting that relatively few recent studies directly examine the relationship between exports and economic growth, as this topic has naturally become a focal point in the historical development of economics. Nevertheless, examining individual studies conducted in various countries with different levels of economic growth, such as China (Kong et al., 2021), Nigeria (Omoke & Charles, 2021), Madagascar (Rasoanomenjanahary, 2022), Türkiye and South Korea (Demirel & İşcan, 2021), where the relationship between exports and economic growth has been empirically tested and observed, would facilitate progress in research.

Taking into account all the studies discussed in the theoretical framework in the literature, the analysis of the impact of variables such as plastic waste imports and renewable energy combined with waste energy, which are included in the model established for this research, on industrial production, and consequently on the economy, in conjunction with exports, presents an exceptionally unique research opportunity. Thus, the relationship between the environment, the economy, and foreign trade can be thoroughly understood, especially in developing countries like Türkiye.

3. Data and methodology

3.1 Data

In this study, the Autoregressive Distributed Lag (ARDL) Bounds Test and causality analysis will be performed to reveal the effects of explanatory variables on the dependent variable in the long and short term. The study dataset consists of up-to-date data on the Turkish economy from 2008:Q1-

2023:Q3. Explanations regarding the data used in this study are given in Table 1. The industrial production index has been evaluated as a proxy for production level and economic growth. This paper aims to empirically test the impact of plastic waste imports and renewable and waste energy generation on production levels and growth. In addition, the model also included exports of goods and services and the exchange rate as additional explanatory variables.

Table 1 Definition of the variables

Variable	Variable description	Unit	Data source
IPI	Industry production index	Index	tuik.gov.tr Turkish Statistical Institute
PIM	Plastic imports	Thousand USD	ITC, trademap.org
EXP	Exports of goods and services	Billion USD	tuik.gov.tr Turkish Statistical Institute
RWEP	Renewable + waste energy production	GWh	teias.gov.tr Türkiye Electricity Transmission Inc.
EXC	Exchange rate	TRY/USD	evds.tcmb.gov.tr Electronic Data Delivery System / Central Bank of the Republic of Türkiye

Source: Authors

3.2 Methodology

This study employs ARDL methodology to examine the interaction between variables in the research model. The most significant benefit of the ARDL method is that it allows the investigation of the cointegration relationship between stationary variables at different levels. For this reason, this research used the ARDL method because it is novel and shows the long- and short-term interactions of variables at various levels of stationarity.

$$(IPI)_t = \beta_0 + \beta_1 PIM_t + \beta_2 EXP_t + \beta_3 RWEP_t + \beta_4 EXCt + \varepsilon_t \tag{1}$$

The long-run form of the model is given in Eq. 1. represents the slope, and to indicate the coefficients of independent variables in Model 1. ε_t stands for the residuals.

$$\Delta IPI_t = \theta_0 + \rho_0 IPI_{t-1} + \beta_1 \Delta PIM_t + \rho_1 PIM_{t-1} + \beta_2 \Delta EXP_t + \rho_2 EXP_{t-1} + \beta_3 \Delta RWEP_t + \rho_3 RWEP_{t-1} + \beta_4 \Delta EXC_t + \rho_4 EXC_{t-1} + ECT_{t-1} + \varepsilon_t \tag{2}$$

$$\Delta \ln (IPI)_t = \alpha_0 + \sum_{i=1}^{p} \phi_i \Delta \ln (PIM)_{t-i} + {} + \sum_{i=0}^{p} \theta_i \Delta \ln (EXP)_{t-i} + \sum_{i=0}^{p} \lambda_i \Delta \ln (RWEP)_{t-i} + \sum_{i=0}^{p} \varphi_i \Delta \ln (EXC)_{t-i} + ECT_{t-i} + e_t \tag{3}$$

Eq. 1 shows the effect of the change in explanatory variables on the dependent variable in level form. The lagged value of the dependent variable and the impact of changes in the explanatory variables on the dependent variable are shown in Eq. 2., while the effect of changes in the logarithmic values of the explanatory variables on the dependent variable is explained in Eq. 3. *ln* shows the natural logarithm of the variables, Δ represents the first difference operator, and *p* indicates the optimal lag length in Eq. 3. Additionally, the error correction term (ECT) representing the conditional error correction (EC) component of the ARDL model is predicted as part of the ARDL Bounds Test (Pesaran et al., 2001). The F-test is employed to determine the long-term effect of the independent variables on the dependent variable.

If there is no cointegration between the variables in the equations above, the null hypothesis is $H_0 : \delta_1 = \delta_2 = \delta_3 = \delta_4 \ldots = 0$, and the alternative hypothesis is $H_1 : \delta_1 \neq \delta_2 \neq \delta_3 \neq \delta_4 \ldots \neq 0$.

Considering the theoretical and technical connections, plastic imports have a positive impact on industrial production, exports of goods and services have a positive impact on the industrial production index because they increase the demand for indus-

trial production, renewable energy production has a positive effect on the industrial production index by providing cheaper energy to the industrial sector, and the exchange rate has a positive impact on the demand side. It is expected to affect the industrial production index positively and negatively because the industrial sector increases its costs due to input imports.

4. Empirical outcomes

4.1 Preliminary statistics

Table 2 presents the basic descriptive statistics for all variables, including measures of central tendency, variability, and the results of normality tests for each country.

Table 2 Descriptive statistics

Variable	N	Mean	Median	SD	Min	Max	Skewness	Kurtosis
IPI	63	4.580	4.583	5.032	0.263	3.975	-0.230	2.223
PIM	63	8.287	8.254	10.375	1.22	5.160	-0.520	2.760
EXP	63	5.012	5.017	5.460	0.268	4.553	-0.121	1.927
RWEP	63	5.001	5.053	6.731	1.197	2.768	-0.201	1.824
EXC	63	1.242	1.064	3.289	0.184	0.830	0.788	2.595

Note: N and SD stand for the number of observations and the standard deviation, respectively.

Source: Authors' own calculations

Table 3 represents the correlation matrix. This table indicates a positive and robust correlation between IPI, PIM, EXP, EXC, and RWEP.

Table 3 Correlation matrix

Variables	IPI	PIM	EXP	EXC	RWEP
IPI	1.00000				

PIM	0.93365	1.00000			
	0.00000	----			
EXP	0.95744	0.90868	1.00000		
	0.00000	0.00000	----		
EXC	0.88832	0.85720	0.89462	1.00000	
	0.00000	0.00000	0.00000	----	
RWEP	0.94829	0.92202	0.94648	0.92816	1.00000
	0.00000	0.00000	0.00000	0.00000	----

Source: Authors' own calculations

The unit root tests give information about the stationarity structures of the variables. Table 4 gives unit root test results for all variables at both levels and first differences. The results indicate that most variables are stationary after differencing, supporting the use of the first-differenced data in the analysis.

Table 4 Stationarity test results

Variable	Level							
	ADF				PP			
	Intercept		Trend and intercept		Intercept		Trend and intercept	
	t-Statistics	Prob.	t-Statistics	Prob.	T-Statistics	Prob.	T-Statistics	Prob.
lnIPI	-0.3198	0.916	-2.7831	0.2093	0.8423	0.799	-5.8878	0.0000***
lnPIM	-1.2969	0.625	-3.3453	0.0686*	-1.0679	0.723	-3.4060	0.0598*
lnEXP	-0.9291	0.772	-4.5845	0.0025***	-0.5236	0.878	-4.6261	0.0022***
lnRWEP	-1.4259	0.563	-0.1436	0.9928	-1.4559	0.549	-2.3789	0.3866
lnEXC	2.9701	1.000	0.4157	0.9988	5.3136	1.000	1.4950	1.0000
1st differences								
lnIPI	-9.7289	0.000***	-9.6346	0.0000***	-27.9338	0.000***	-25.9640	0.0001***
lnPIM	-8.5204	0.000***	-8.4546	0.0000***	-9.5642	0.000***	-9.5622	0.0000***
lnEXP	-9.8189	0.000***	-9.7364	0.0000***	-11.7442	0.000***	-11.5943	0.0000***
lnRWEP	-4.7795	0.000***	-5.0357	0.0007***	-8.5959	0.000***	-8.7483	0.0000***
lnEXC	-6.0035	0.000***	-6.8486	0.0000***	-6.0035	0.000***	-6.7986	0.0000***

Note: ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

Source: Authors' own calculations

Table 5 Lag selection for the ARDL model

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1200.602	NA	1.29e+13	41.53802	41.68012	41.59337
1	-1028.533	314.4714	5.93e+10	36.15632	36.86682	36.43307
2	-1009.403	32.32289	5.37e+10	36.04839	37.32729	36.54655
3	-985.4595	37.15429	4.17e+10	35.77446	37.62176	36.49402
4	-929.0058	79.81378	1.08e+10	34.37951	36.79520	35.32047
5	-895.1625	**43.17944***	**6.22e+09***	33.76422*	36.74831*	34.92659*

Note: * indicates lag selection.

Source: Authors' own calculations

The F-bounds test reveals the long-run relationship between the variables. If the F value is more significant than the critical values, these results gauge a long-run cointegration between the variables. Table 6 shows the F-statistic and essential limits for the model. This table verifies the long-run cointegration. Consequently, the long-run ARDL model can be estimated.

Table 6 ARDL Bounds Test results

k	F-stat.	Critical values		
		Sig.	Lower limit	Upper limit
4	8.1559	1%	4.412	5.545
		5%	4.323	4.333
		10%	3.31	3.668

Source: Authors' own calculations

Table 7 presents the ARDL long-run results, verifying that plastic import, renewable and waste energy, and exports of goods and services positively affect the industrial production import for Türkiye at a 1% significance level.

Table 7 Long-run ARDL model results (dependent variable: lnIPI)

Variables	Coefficient	T- Stat.	prob.
C	2.203552	4.567189	0
LNIPI(-1)	-0.344757	-1.933263	0.0595**
LNPIM	0.053946	3.094866	0.0034*
LNEXP(-1)	-0.302409	-1.879623	0.0666**
LNEXC	-0.009426	-0.459403	0.6482
LNRWEP(-1)	0.094988	3.231759	0.0023*
D(LNIPI(-1))	-0.481232	-3.425203	0.0013*
D(LNIPI(-2))	-0.516758	-3.721686	0.0005*
D(LNIPI(-3))	-0.709538	-6.708069	0*
D(LNEXP)	0.351886	3.789391	0.0004*
D(LNEXP(-1))	0.321234	2.569807	0.0136*
D(LNEXP(-2))	0.37092	3.119127	0.0032*
D(LNEXP(-3))	0.376466	4.014426	0.0002*
D(LNRWEP)	-0.12048	-1.51112	0.13770

Notes: ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

Source: Authors' own calculations

Table 8 presents the short-run results for the ARDL model. The UECM model was estimated to have a maximum lag of 4, and a model with lag components (4.0.4.0.1) was selected based on the Schwarz Information Criterion. Critical values represent the essential values derived from Pesaran et al. (2001). According to the short-run ARDL model findings, exports of goods and services in- crease the industrial production index by 1%, and renewable and waste energy generation raises the industrial production index by 5%. Moreover, the error correction term (ECT) is negative and statistically significant at 1%.

Table 8 Error correction coefficient model results (dependent variable: lnIPI)

Predicted			
Variables	Coefficient	T-stat.	prob.
D(LNIPI(-1))	-0.481232	-6.124642	0.00*
D(LNIPI(-2))	-0.516758	-5.443115	0.00*
D(LNIPI(-3))	-0.709538	-8.940275	0.00*
D(LNEXP)	0.351886	4.593693	0.00*
D(LNEXP(-1))	0.321234	3.590105	0.00*
D(LNEXP(-2))	0.37092	4.008069	0.00*
D(LNEXP(-3))	0.376466	4.924277	0.00*
D(LNRWEP)	-0.120481	-2.276526	0.027*
ECT(-1)*	-0.344757	-7.3738	0.00
R-square	0.844767		
Adj. R-square	0.819929		
N	59		
Simulations	2500		
Prob.	0.000		
F-statistics	8,155939		
RMSE	0.9818		

Note: * and ** denote significance at the 1% and 5% levels, respectively.

Source: Authors' own calculations

Table 9 gives the stability diagnostic test results for the ARDL model. The model stability conditions confirm a higher explanatory power and normality, and the model has no autocorrelation, heteroscedasticity, or omitted variable bias problem.

Table 9 Diagnostic tests

Tests	Coeff/prob.
R^2	0.844767
Durbin–Watson test	1.596204
Jarque–Bera normality test	0.4490 (0.7989)
Heteroskedasticity test: ARCH	0.989 (0.4761)
Breusch–Godfrey LM test	1.509 (0.2324)
Ramsey Reset Test (F-statistic)	0.0005 (0.9818)

Source: Authors' own calculations

Figure 3 represents the CUSUM and CUSUMQ graphs. The graphs show that the estimated parameters remained stable throughout the sample period, with no evidence of structural changes.

Figure 3 CUSUM and CUSUMQ diagrams
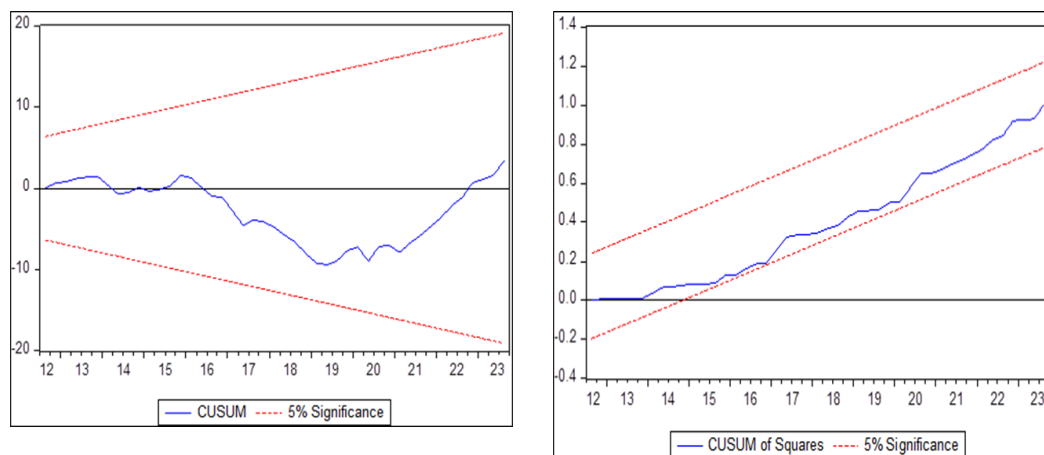
Table 10 gives the results of causality analysis between the variables used in the model. The Toda-Yamamoto causality test provides significant convenience, allowing causality analysis even if the variables are not stationary. In addition, it offers a crucial advantage as it will enable causality analysis even if there is no cointegration relationship between the variables. When the causality relationship between the variables in the model is examined, it confirms that there is a one-way causality relationship from plastic waste imports to the industry index, one-way causality from the industry index to exports, and one-way causality from the industry index to renewable energy production. It also shows a one-way relationship from the exchange rate to the industrial index and from plastic imports to the industrial index. Again, plastic imports, exports, and renewable energy production have a one-way causality relationship. In addition, while there is a bidirectional causality relationship between exports and renewable energy production, there is no causality relationship between renewable energy and the exchange rate. These findings prove that plastic imports and exchange rates are essential indicators for industrial production.

Table 10 Toda-Yamamoto causality test results

Variables	Lag	Chi-square	Prob.	Results
PIM → IPI	5	22.14524	**0.0004**	*There is causality*
EXP → IPI	5	55.53975	1.0107	There is no causality
RWEP→ IPI	5	34.34522	2.0323	There is no causality
EXC→ IPI	5	13.69841	**0.0176**	*There is causality*
PIM→EXP		23.40516	**0.0002**	*There is causality*
PIM→RWEP		14.38812	**0.0133**	*There is causality*
PIM→EXC		9.851841	0.0795	There is no causality
EXP→IPI		55.53975	1.0107	There is no causality
EXP→PIM		44.14490	2.1645	There is no causality
EXP→RWEP		14.82574	**0.0111**	*There is causality*
EXP→EXC		30.42721	1.2150	There is no causality
RWEP→IPI		34.34522	2.0323	There is no causality
RWEP→PIM		30.27557	1.3016	There is no causality
RWEP→EXP		18.87559	**0.0020**	*There is causality*
RWEP→EXC		10.44204	0.0636	There is no causality
EXC→IPI		13.69841	**0.0176**	*There is causality*
EXC→PIM		12.81401	**0.0251**	*There is causality*
EXC→EXP		14.56130	**0.0124**	*There is causality*
EXC→RWEP		6.954116	0.2240	There is no causality
IPI→EXC		7.058540	0.2163	There is no causality
IPI→EXP		18.94047	**0.0019**	*There is causality*
IPI→PIM		41.36816	7.9056	There is no causality
IPI→RWEP		16.00339	**0.0068**	*There is causality*

Source: Authors' own calculations

5. Discussion & conclusion

The findings of this study, when viewed in the context of the EKC and the PHH, have different implications regarding the relationship between Türkiye's economic development, represented by increased production and the environment. It has been found that as production increases, indicating economic growth, renewable energy production also increases in Türkiye. As a developing country, Türkiye may be seen as deviating from the EKC approach. Furthermore, from the perspective of the PHH, it is observed that as production increases, waste imports do not increase; conversely, an increase in waste imports is associated with a decline in production. This situation suggests that the PHH may not be applicable to Türkiye. Therefore, as a developing country, Türkiye aims to mitigate the environmental degradation implications suggested by the EKC and PHH approaches and transform these challenges into opportunities.

The findings obtained from the ARDL test results show that plastic imports and exports of goods positively affect the industrial production index in Türkiye in the long term. While renewable and waste energy production have a negative impact on industrial production in the short term, this effect becomes strongly positive in the long term. The findings from the ARDL analysis prove that plas-

tic waste imports significantly contribute to the increase in industrial production. While renewable energy production has a negative effect in the short term, it strongly supports increased industrial output in the long term. These findings provide vital information for policymakers.

The study proves that the circular economy offers essential opportunities, especially with the use of plastic waste in the industry, to solve the production problems of developing countries and reduce the damage caused by industrial production to the environment. Similarly, to prevent the damage caused by fossil fuels to the environment, renewable and waste energy is an excellent alternative to meet the energy needs of industrial production. To increase industrial production and promote growth in developing countries like Türkiye, policymakers should create strategies regarding the circular economy, waste management, and waste recycling in their countries. They should also provide funds, training, and regulations to support the development of technologies that will facilitate the use of waste as raw materials and inputs in industry. In addition, developing countries should develop long-term programs and policies to expand renewable and waste energy use to achieve sustainable de-

velopment goals in industrial production. For this purpose, plans and investment programs should be developed to build infrastructure for renewable energy production and to promote the development of national technologies.

As the empirical findings of this study indicate, developing countries locally and the whole world globally will be able to act in line with common interests for a sustainable and livable world with strategies such as circular economy management, waste recycling, and the expansion of renewable energy production.

This study draws attention to the importance of plastic waste and renewable and waste energies for industrial production. This study was specifically designed for Türkiye, one of the largest importers of waste. When evaluating the relevant literature, it is noteworthy that the number of similar studies is relatively limited. Future research should be planned using different data sets, analysis methods, and comparable studies across various countries or country groups. By comparing the findings from studies conducted for other countries and country groups, valuable insights can be provided to policymakers to create various development and economic growth strategies.

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CIRCULAR PACKAGING INNOVATION FROM BUSINESS AND CONSUMER PERSPECTIVES: DESIRABLE DIRECTIONS FOR INNOVATION IN SMALL AND MEDIUM-SIZED ENTERPRISES

Abstract

Purpose: The aim of the paper is to identify desirable circular packaging innovations for fast-moving consumer goods in small and medium-sized enterprises.

Methodology: We carried out two quantitative surveys among 60 enterprises and 200 consumers in two separate phases. The data were processed by exploratory analysis and the significance of the detected differences was verified by confirmatory analysis (ANOVA, Friedman test).

Results: We found that the main innovation drivers are consumers themselves and reduction in packaging costs. The main barriers to innovation are concerns held by businesses regarding unacceptable product prices and consumer unwillingness to engage in collection, sorting and return of packaging, and to accept packaging-free sales. Replacing non-recyclable materials in packaging with 100% recyclable or biodegradable alternatives can be considered the most appropriate packaging innovation that is preferred by businesses and consumers. However, consumer attitudes depend significantly on their inclination to protect the environment. In other words, it is also advisable for green customers to implement use of returnable packaging.

Conclusion: The most successful innovations will be those that require minimal changes in consumer shopping behaviour and are not overly burdensome for businesses. The results can help companies develop packaging innovations under the circular economy paradigm.

Keywords: Circular economy, circular packaging, fast-moving consumer goods, packaging innovation, small and medium-sized enterprises, sustainable packaging

1. Introduction

Packaging must be understood as a sustainable practice to develop a circular economy (CE) (Meherishi et al., 2019). Leaving the linear business model behind and adopting a circular model could constitute the basis of a new concept for use of packaging (Casarejos et al., 2018).

The main effect of this change in packaging approach may occur in volume reduction, in particular in solid waste in cities and municipalities. It is therefore important to focus on products whose packaging makes up a large part of this waste. This particularly concerns fast-moving consumer goods (FMCG), i.e. products sold at relatively low prices to meet everyday needs. According to Urbinati et al. (2017), FMCG product categories particularly include food (such as smoked meats, biscuits, pasta, fruit and vegetables, etc.), alcoholic and non-alcoholic beverages, cleaning and laundry products (including fabric softeners) and pet food. Research to date has tended to focus on the packaging of selected items within the framework of FMCG products, in particular food (e.g., Palsson & Sandberg, 2022); however, this research has already shown specific barriers to sustainable packaging innovation depending on the type of product (Palsson & Sandberg, 2022).

Research in the field of sustainable packaging has, for the time being, not been overly focused on specifics related to the size of the company. Yet it is known that small and medium-sized enterprises (SMEs) are more flexible, dynamic and have the capacity to create the desired innovations (Hansen, 2016). But unlike large companies, they usually have less information about legislation in the given field, different strategic priorities relating to sustainable packaging, different reasons for these investments, different levels of investment, different expectations of return on invested capital, and their decision-making is more heavily influenced by considerations regarding cost (Mattia et al., 2021; Afif et al., 2022). At the same time, there are doubts as to whether companies of different sizes face the same problems. This is why Afif et al. (2022), who have already revealed that drivers and barriers depend on the size of the company, recommend further investigation to help us understand how decisions in the field of sustainable packaging vary depending on the size of the company. The article presented here also aims to contribute to this area, as the existing literature has mainly focused on large enterprises (Palsson & Sandberg, 2022).

The aim of the paper is to identify desirable circular packaging innovations for FMCG products in SMEs. In order to achieve this objective, it was necessary to identify and compare attitudes towards circular packaging innovation among both businesses and consumers.

This dual approach to the issue in question is unique compared to the existing literature, as previous studies have addressed sustainable packaging innovations either from the customers' perspective or solely from the business perspective (Wandosell et al., 2021).

2. Theoretical background

Innovation of packaging constitutes an important part of CE practices in SMEs. For example, within the framework of the research performed by Mura et al. (2020) into CE practices in Italian SMEs, 20 CE practices were identified, 3 of which were associated with packaging. This concerned "reduction of material content in packaging, recovery/reuse of plastic and derivative packaging, and use of biodegradable materials (i.e. no plastics and derivatives) for packaging". It is clear from the essence of the CE and the examples mentioned above that any innovation of packaging contributing to reduction of resources needed for the manufacturing of packaging (reduce innovations), prolonging the length of its life cycle (reuse innovations) and ensuring better utilisation of waste from packaging as input raw materials for further manufacturing (recycle innovations) may be regarded as packaging innovations.

2.1 Reduce innovations

Reduce innovations can primarily be used to reduce material and energy input into manufacturing of packaging (Chen, 2008). Saving raw materials and optimising logistics are the most frequent sustainable practices adopted by companies to improve the circularity of packaging (Cozzolino & De Giovanni, 2023).

The basic methods to achieve material reduction include resizing the packaging, changing the amount of product per packaging, changing the number of primary packaging per secondary packaging and/or tertiary packaging, standardising materials and dimensions, and changing the packing

process (García-Arca et al., 2017). These options aimed at reducing the material needed for packaging are feasible even for SMEs. However, they typically require closer collaboration with the packaging supplier (Vognarova et al., 2024). Reduction of packaging size through product innovation can also be regarded as a specific approach to reducing packaging materials, for example, by increasing the concentration of liquid products (Van Sluisveld & Worrell, 2013). However, this option is difficult to implement for SMEs if they do not have their own research and product development (Branská et al., 2020).

Businesses reduce consumption of the packaging material through design changes affecting the weight and thickness of packaging (Lekesiztürk & Oflaç, 2022). This reduction of packaging materials is usually associated with minimisation of the amount of waste that is generated. However, an appropriate redesign of packaging can achieve several other positive impacts in the CE (Svanes et al., 2010). For example, reducing the weight of packaging can reduce transportation costs, energy consumption and greenhouse gas emissions (Hanssen et al., 2017). On the contrary, excessive minimisation of packaging thickness may endanger its protective function or increase demands on other packaging levels, the result of which could be much greater losses during transportation and handling (Verghese et al., 2015). Reducing packaging weight and/or thickness is feasible for SMEs if they manufacture their own packaging or if their packaging supplier implements such forms of packaging innovation (Vognarova et al., 2024).

When redesigning packaging, consumer behaviour and habits should also be taken into consideration (Gustavo Jr. et al. 2018), particularly the relationship between packaging size and the amount of product actually consumed (Silvenius et al., 2014). For example, according to Williams et al. (2012), 20-25% of consumer waste from food is linked to incorrect packaging design (difficult to empty and too big packaging). Therefore, the most effective method to reduce losses in the CE is through packaging innovation that minimises waste generation, not only in manufacturing and distribution, but also in consumers' households.

2.2 Reuse innovations

A key activity in the CE, which prevents waste generation, is reuse of packaging (Rigamonti et al.,

2019). According to Greenwood et al. (2021), reusable packaging can be classified into two main categories - returnable packaging and refillable packaging (at home with auxiliary products or in the packaging-free shops). Both options are feasible for SMEs. However, returnable packaging poses a greater challenge for them, both organisationally and financially.

The literature focused on reusable packaging in the field of FMCG addresses return flows of packaging within the supply chain. Rigamonti et al. (2019) propose a methodology for collecting data to compare countries in achieving objectives related to packaging reuse. Comparison of the expediency of using reusable packaging as compared to disposable packaging is, for example, addressed by Kuo et al. (2019). The literature also addresses systems of imposing a deposit on packaging and the problems associated with this, particularly in the case of drinks (Simon et al., 2016; Zhou et al., 2020).

Barriers to and drivers of the development of the zero-packaging concept are presented by Beitzen-Heineke et al. (2017). Salkova and Regnerova (2020) and a study by Price, Waterhouse and Co (2015) also present the main reasons for shopping in packaging-free shops. The study by Price, Waterhouse and Co (2015) also draws attention to the fact that although the majority of consumers do view packaging-free shops positively, only the minority would be prepared to pay a higher price. The professional literature also addresses changes in the method of sale (e.g., Fuentes et al., 2019).

2.3 Recycle innovations

The recycle category comprises innovations which allow either direct chemical or mechanical reworking of waste material or reuse of resources after biological transformation (e.g., after composting). However, any direction or specific type of innovation should ensure or preserve the packaging characteristics such as availability from renewable sources, recyclability, and compostability. Packaging should, at the same time, be easily adaptable for a wide range of uses and be cost-effective (Farooque et al., 2019). The current trend is to introduce new sustainable packaging materials such as biodegradable and bio-renewable materials, bio/compostable inks and natural pigment, lacquers with a microbial barrier and biopolymers (Mattia et al., 2021; Lekesiztürk & Oflaç, 2022) and to use recycled materials (Mattia et al., 2021). These options are feasible for

SMEs, but they typically require an adequate supply of packaging from suppliers (Vognarova et al., 2024).

Studies addressing the use of alternative or reusable materials are frequently focused on plastics. They address the issue of how to replace plastic, for example with glass, paper or metal (Almeida et al., 2017; Branska et al., 2020), and the advantage of such alternatives from an economic and environmental point of view (Simon et al., 2016). Other studies address replacement of plastics with bioplastics. It is anticipated that this could be one of the most frequently used packaging materials in the future (Dobrucka, 2019). The issue of plastics is, for example, addressed by Casarejos et al. (2018), Dobrucka (2019), Farooque et al. (2019). Interest in reduction or elimination of the volume of plastic waste from packaging has also given rise to an effort to produce an alternative and renewable raw material for manufacturing packaging plastics (Dow, 2020) or efforts to replace petrochemicals in the manufacturing of packaging plastics with widely available mineral fillers (Civancik-Uslu et al., 2019).

Some studies address complete or partial replacement of plastics with recyclable plastics (Civancik-Uslu et al., 2019; Branska et al., 2020). Usability in relation to packaged products is usually addressed alongside their combination with other materials. These studies also include a study focused on the quality of recyclable plastics, the presence of contaminants in them (e.g., Brouwer et al., 2019) and safety aspects of recycled packaging (Geueke et al., 2018).

3. Research methodology

As far as businesses are concerned, it has already been revealed that CE principles are being promoted in packaging innovation (Mura et al., 2020), but it is not yet clear which specific directions of packaging innovation are preferred by SMEs and why. For this reason, the research questions were determined as follows:

RQ1: What is the scope of adoption of different types of circular packaging innovations in SMEs?

RQ2: What are the main drivers for the introduction of circular packaging in SMEs?

RQ3: What are the main barriers to the introduction of circular packaging in SMEs?

In order to be successful in the market, packaging innovation must first and foremost be accepted by end consumers (Ma et al., 2020). For certain types of circular packaging innovation, this requires the involvement of consumers in the sorting of packaging waste or the reuse of packaging in packaging-free shops. This is why the following research questions were formulated:

RQ4: Which circular packaging innovations do consumers prefer when buying FMCG?

RQ5: What challenges do consumers face when sorting waste from packaging?

RQ6: What challenges do consumers face when buying goods in packaging-free shops?

Two-phase quantitative research was proposed in order to fulfil the research objective and find answers to the research questions (see Figure 1).

Figure 1 Research framework
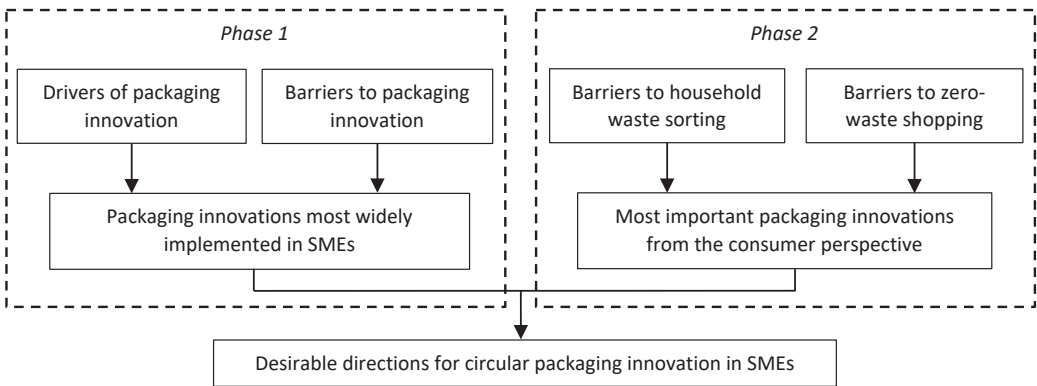
Source: Authors

Because attitudes towards circular packaging innovations can be significantly influenced by the lifestyles of the consumers (Popovic et al., 2020), data analysis focused on identifying differences between regular and green customers. Synthesis of the findings ascertained from both quantitative surveys and their comparison with the professional literature allowed us to identify the desirable directions for circular packaging innovation in SMEs.

3.1 Collection of data from manufacturers

Data were collected via an electronic survey conducted among randomly chosen Czech businesses. Support for selection was based on the Administrative Register of Economic Subjects (The Ministry of Finance of the Czech Republic, 2021). From this register, companies in liquidation were eliminated, as were those with more than 250 employees or a turnover exceeding EUR 50 million, and businesses that did not have CZ-NACE codes 10+, 11+, 20+ (production of food products, production of drinks, production of chemical substances and chemical products) indicated as their primary field of economic activity. A total of 1,000 businesses from this database were contacted in March 2021 (a simple random sample) with a request that they participate in the survey. However, most of these businesses failed to participate in the research despite repeated calls to do so. After elimination of unsuitable respondents (businesses outside of the FMCG sector), 60 questionnaires were then submitted for analysis.

All circular packaging innovations which had been successfully introduced in the business over the past 5 years were first of all ascertained in the questionnaire survey. Respondents were able to indicate any number of responses they liked from the innovations which were specified in advance, with the option of identifying other innovations which were not included in the list. The main drivers of and barriers to the introduction of these innovations in the business were then identified. In both cases, respondents were able to indicate at most three alternatives from the list of drivers (or barriers) specified in advance with the option of identifying other drivers (or barriers) which were not included in the list.

3.2 Collection of data from consumers

Data were collected via an electronic survey conducted among Czech consumers aged 15-64 selected using the quota sampling method with quotas applied to age and gender of the respondent. The structure of the required quotas was determined on the basis of demographic data about the economically active population of the Czech Republic (Czech Statistical Office, 2021). Data were collected in the period March–June 2021, until the required size of the sample was achieved (200 respondents) in the required structure: 51.0% of male (7.5% aged 15–24, 10.5% aged 25–34, 13.0% aged 35–44, 11.5% aged 45–54, 8.5% aged 55–64) and 49.0% of female respondents (6.5% aged 15–24, 10.5% aged 25–34, 12.5% aged 35–44, 11.0% aged 45–54, 8.5% aged 55–64).

Attitudes towards six eco-attributes of packaging specified in advance were rated in the questionnaire survey using a five-point scale of importance (1 = very unimportant, 2 = unimportant, 3 = neutral, 4 = important, 5 = very important). The main problems with sorting packaging at home and problems associated with buying goods in packaging-free shops were subsequently identified. Respondents were able to specify at most three problems in each of the aforementioned areas. At the end of the questionnaire, the basic characteristics of the respondents were ascertained (gender, age, education, income), as well as eco-friendly aspects of their purchasing behaviour. The research sample consisted of 74.9% regular customers and 25.1% green customers (who repeatedly buy eco-friendly products).

3.3 Statistical data analysis

During data analysis, descriptive and inferential statistics methods were applied using the IBM SPSS Statistics 24 software. While evaluating the types of innovations implemented in businesses, content analysis of responses and analysis of multiple responses were used. This evaluation covered drivers of and barriers to innovation implementation in businesses, problems in sorting waste from packaging at home and issues associated with purchasing goods in packaging-free shops. The statistical significance of the differences in frequencies between regular and green customers was verified using Pearson's chi-squared test with a significance level of 5%.

The average was used to evaluate consumer attitudes towards the eco-attributes of packaging. The statistical significance of differences in the perceived importance of individual eco-attributes was verified using the Friedman test with a significance level of 5%. The statistical significance of differences between the attitudes of regular and green customers was verified using an ANOVA test with a significance level of 5%.

4. Results and discussion

4.1 Circular packaging innovations in SMEs

Primary research confirmed the conclusions of the previous research conducted by Mura et al. (2020) relating to the implementation of circular packaging innovations. These innovations are performed in SMEs. However, as opposed to previous research, this research identified the preferences of SMEs.

Table 1 contains the results of analysis of multiple responses to the type of innovations. SMEs pre-

ferred replacement of packaging materials used with biologically degradable materials (including reduction of the share of plastics in packaging) or 100% recycled materials. In the field of reuse type innovations, SMEs particularly emphasised options for packaging reuse by the consumer or the business (including repurposing for different uses). In the field of reduce type innovations, packaging redesign was preferred (e.g., changes in shape), which reduced the amount of material needed to pack the product.

Table 1 Circular packaging innovations implemented in SMEs over the past 5 years

Innovation	Responses		Percent of cases
	N	Percent	
Packaging from biodegradable materials	21	18%	35%
Packaging from 100% recycled materials	17	15%	28%
Reusable/refillable packaging	14	12%	23%
Returnable packaging	12	11%	20%
Packaging redesign	9	8%	15%
Filling method innovation	8	7%	13%
Packaging which is easier to recycle	8	7%	13%
Product innovation	6	5%	10%
Packaging-free sales	6	5%	10%
Others (no circular packaging innovation)	13	11%	22%
Total	114	100%	x

Source: Authors

The research also confirmed that drivers and barriers also exist in SMEs when implementing circular packaging innovations. However, it also revealed that some are significantly more important than others. Table 2 compares the importance of drivers based on the frequency with which they were mentioned by respondents in the survey.

Table 2 Importance of drivers for the introduction of packaging innovations in SMEs

Driver	Responses		Percent of cases
	N	Percent	
Consumer	30	25%	52%
Reduction of costs	26	21%	45%
Environmental certification	16	13%	28%
Legislative regulations	15	12%	26%
Vendors	14	11%	24%
Public and public organisations	11	9%	19%
Others (<5% of cases)	10	8%	17%
Total	122	100%	x

Source: Authors

The most important driver is the benefit for consumers (mentioned in 52% of cases). Together with cost reduction (45% of cases), these are the two most important drivers of circular packaging innovations identified in SMEs. The formulation of this research conclusion confirmed the previous conclusions drawn by Ma et al. (2020) relating not only to the customer as a driver of packaging innovations, but also to the importance of the customer relative to other drivers. Identification of another driver, i.e. cost reduction, confirms the previous findings by Gustavo Jr. et al. (2018), who state that cost reduction primarily concerns profit. This allows the conclusion that profit, as the fundamental aim of doing business, also represents the core driver for circular packaging innovations. From this point of view, circular packaging innovations can be seen as a means of generating profit, and for this reason, are likely to continue being adopted in the future.

Table 3 compares the importance of barriers based on the frequency with which they were mentioned by respondents in the survey. SMEs see the greatest barrier in concerns that customers will not accept the increase in price of innovated products (51% of cases). However, safety and hygiene standards, which are difficult to comply with for certain circular packaging innovations, can also be regarded as a major barrier (40 % of cases), as can a lack of investment capital to implement these innovations (37% of cases).

Table 3 Importance of barriers to the introduction of circular packaging innovations in SMEs

Barrier	Responses		Percent of cases
	N	Percent	
Increase in product price	29	22%	51%
Safety and hygiene standards	23	18%	40%
Lack of investment capital	21	16%	37%
Incompatibility of packaging with the product	19	15%	33%
Insufficient reverse logistics	14	11%	25%
Lack of know-how	9	7%	16%
Reduction of product functionality	9	7%	16%
Loss of product attractiveness	6	5%	11%
Total	130	100%	x

Source: Authors

This conclusion partially corresponds to the conclusion drawn by Mura et al. (2020), Ma et al. (2020) and Gustavo Jr. et al. (2018), i.e. that the main barriers to circular packaging innovations in SMEs are higher costs and lower revenue as a result of non-acceptance of innovations by the customer due to increased prices of innovated products and a lack of financial resources. As opposed to previous research (in particular by Gustavo Jr. et al., 2018), respondents in our survey are not overly concerned about the loss of product attractiveness (11% of cases).

4.2 Circular packaging innovations from the consumer perspective

Follow-up research among consumers made it possible to identify their preferences regarding selected circular packaging innovations and their attitudes towards changes in purchasing and consumer behaviour that are demanded by certain circular packaging innovations (sorting waste from packaging, returning used packaging and shopping in packaging-free shops).

Table 4 compares the perceived importance of selected eco-attributes of packaging which support the principles of the circular economy. The table also shows differences in the importance of attributes depending on how green the customer is, including the results of ANOVA tests used to verify the significance of the specified differences. Consumers regard the use of recyclable materials (total average of 3.73) and biologically degradable materials (total average of 3.67) during the production of packaging as the most important eco-attribute of the packaging that is decisive when they choose which FMCG to purchase. The least preferred alternative by consumers is the packaging-free sale of such goods (total average of 3.27).

Table 4 Importance of eco-attributes of packaging from the point of view of consumers

Eco-attribute	Average importance			ANOVA test	
	Total	Regular customers	Green customers	F	p
100% recycled materials	3.73	3.52	4.36	24.60	<0.001
Biodegradable materials	3.67	3.46	4.30	24.28	<0.001
Easy to recycle	3.65	3.43	4.30	25.84	<0.001
Returnable	3.60	3.35	4.34	35.70	<0.001
Refillable	3.41	3.27	3.84	10.08	0.002
Packaging-free	3.27	3.03	3.96	25.84	<0.001

Source: Authors

Customers are evidently inclined towards innovations, which do not restrict (or do not significantly restrict) their purchasing comfort. Change to the packaging material allows for standard, repeated purchasing at the same shop at the usual shopping time, so there is no need to change established shopping behaviour. However, alternatives involving innovation in reuse typically require changes in customer behaviour and have an impact on their comfort when shopping. Packaging-free sale, as the least preferred innovation alternative, has the greatest impact on comfort. This requires not only collection, washing and repeatedly taking packaging with you, but also often the need to shop in specialised shops. The customer has to make more complicated preparations and plans for their shopping and conduct the actual purchase under different conditions. This likely explains why this innovation alternative is assessed as the least important by customers.

A follow-up analysis of differences in consumer preferences confirmed the assumption that customer requirements for the environmentally friendly aspects of packaging are not entirely homogenous, but that differences exist depending on how green the customers are. According to the Friedman test, the importance of attributes perceived by all customers ($\chi^2 = 62.11$, $p < 0.001$), by regular customers ($\chi^2 = 47.94$, $p < 0.001$) and by green customers ($\chi^2 = 20.47$, $p = 0.001$) are significantly different. All packaging attributes are perceived by green customers as significantly more important (see the ANOVA test results in Table 4), although the priority of attributes does differ between regular and green customers.

Whereas regular customers clearly prefer packaging made from eco-friendly or 100% recycled material, green customers perceive these attributes as being of comparable importance to the use of returnable packaging or efforts to use recyclable packaging (i.e. packaging made from a single type of material, single-layer packaging, packaging without any undesirable additives, etc.). The least preferred attributes from the point of view of both groups of customers are attributes associated with the repeated use of packaging by consumers, i.e. their reuse at home (even for other purposes), or shopping in packaging-free shops.

When sorting waste from packaging, consumers encounter several problems. Table 5 compares problems based on the frequency of respondents who identified them in the survey. The table also shows differences in frequencies depending on how green the respondent is, including the results of chi-squared tests that verify the significance of the specified differences.

Table 5 Problems associated with sorting waste from packaging

Problem	Percent of cases			Chi-squared test	
	Total	Regular customers	Green customers	χ^2	p
Sorted packaging occupies a lot of space at home.	57%	55%	64%	0.191	0.662
Containers for sorting waste are crowded.	50%	48%	57%	0.207	0.649
Washing packaging is time-consuming.	43%	48%	29%	1.806	0.179
Washing packaging uses a lot of energy.	30%	26%	43%	1.116	0.291
Sorted packaging at home produces unpleasant odours.	27%	24%	36%	0.589	0.443
Handling sorted packaging is inconvenient.	18%	19%	14%	0.217	0.642
Sorted packaging has to be taken a long way to the recycling point.	18%	19%	14%	0.217	0.642

Source: Authors

It is clear from the results given in Table 5 that the differences ascertained in the perceived problems with sorting waste from packaging at home do not depend on how green the customer is (none of the ascertained differences are statistically significant). More than half of the consumers surveyed identify the fact that sorted packaging occupies a lot of space at home (57% of cases) as the main problem. They also see containers for sorted waste that are always full (50% of cases) and the time-consuming nature of washing used waste intended for recycling (43% of cases) as major problems.

An interesting possibility for prolonging the life cycle of primary packaging is its reuse by the consumer when purchasing FMCG in packaging-free shops.

This is the reason why a lot of specialised shops have opened all over the world in which it is possible to buy a wide range of FMCG without packaging. Nevertheless, only 31% of respondents have so far taken advantage of this possibility in the Czech Republic, whereas two thirds of them do not regularly shop in packaging-free shops (less than once per month). Table 6 compares the main problems associated with buying goods in a packaging-free shop based on the frequency of respondents who indicated them in the survey. The table also shows differences in frequencies depending on how green the respondent is, including the results of chi-squared tests that verify the significance of the specified differences.

Table 6 Problems associated with buying goods in packaging-free shops

Problem	Percent of cases			Chi-squared test	
	Total	Regular customers	Green customers	χ^2	p
Not enough shops	46%	50%	41%	0.264	0.608
Need to take your own containers	38%	38%	38%	1.033	0.310
Higher price of goods	32%	29%	38%	3.037	0.081
Narrow range of goods	20%	19%	21%	0.726	0.394
Need to plan shopping	14%	10%	21%	3.697	0.055
Time-consuming nature of shopping	13%	12%	14%	0.592	0.442
Hygiene demands difficult to comply with	10%	12%	7%	0.066	0.797
Uncertainty regarding the composition and quality of the product	7%	7%	7%	0.118	0.731

Source: Authors

It is clear from the results specified in Table 6 that the main problems associated with buying goods in packaging-free shops include the following: an insufficient number of these shops (46% of cases), the need to take your own containers (38% of cases) and the higher price of goods in packaging-free shops (32% of cases). None of the differences in attitudes between regular and green customers which were ascertained are statistically significant. Nevertheless, the frequent mention of higher prices in shops and the need to plan your shopping in the case of green customers is borderline significant. This may be attributed to their greater experience with shopping in packaging-free shops (70% of customers who regularly shop in packaging-free shops are green customers).

4.3 Desirable directions for circular packaging innovation for FMCG products in SMEs

Research conducted in enterprises has shown that sustainable packaging innovations in SMEs respect all three basic principles of the circular economy (i.e. reduce, reuse and recycle), although businesses prefer change to the packaging material. However, they are not only introducing packaging made of biodegradable materials, as stated by Mura et al. (2020), they are also introducing packaging made of 100% recycled materials. This may relate to the fact that change to the packaging material requires a relatively small scope of innovation from the point of view of the business. It is interesting that reuse type innovations are the second most preferred direction, even though they are demanding for the business. Surprisingly, reduce type innovations, which are usually cost-effective for businesses, are the least preferred direction. This may be linked to the fact that these innovations also require innovation of the product or may endanger its full utilisation.

The research also confirmed that drivers and barriers also exist in SMEs when implementing circular packaging innovations, some of which are very important. The most important driver is the benefit for consumers. Together with cost reduction, these are the two most important drivers for circular packaging innovations ascertained in SMEs. An interesting finding is the fact that orders and regulations imposed by government institutions were identified as the least important driver for circular packaging innovations and SMEs (together with the improvement of image and pressure from various stakeholders). The finding that the personal responsibility of the managers concerned, who wish to act in an environmentally friendly manner, also serves as a driver can be regarded as a contribution to current knowledge. Even though it is not one of the decisive drivers, it points to the fact that long-term formal and informal education of future managers can significantly support broader implementation of these innovations.

Research into the existing barriers showed that SMEs really do face various barriers, while implementing circular packaging innovations, particularly in the economic and legislative fields. Important barriers include concerns that customers will not accept increased prices of innovated products, difficulties in complying with established safety and hygiene standards and a lack of capital. Another important finding is that SMEs find it difficult to comply with safety and hygiene requirements. Environmental education of customers and ensuring support for environmentally focused innovations could contribute towards breaking down these barriers.

To reduce the risk of innovations not being accepted by the customers, the results of our research focused on the importance of the environmental aspects of packaging as value components for the customer can also be utilised. Customers prefer replacement of plastic packaging with biologically degradable materials or materials made of 100% recycled materials. On the other hand, they attribute less importance to innovations in the reuse direction. This is most likely linked to their shopping convenience and their willingness to sacrifice it. However, research showed that customer requirements for the environmentally friendly aspects of packaging are not entirely homogenous, but that differences exist depending on how green the customers are. It can be stated that the environmentally friendly aspects of packaging when purchasing FMCG are more important for green customers. Nevertheless, these customers also care about their shopping comfort. This is indicated by the fact that packaging-free sale is the least important for this customer segment, too.

From the point of view of circular packaging innovation success, this means that innovations which do not require any fundamental changes in the shopping behaviour of customers will be accepted much better. If such innovations are at the same time more favourable from the point of view of the demands they impose also for the businesses which implement them, their chance of success is even greater. Changing the packaging material poses a relatively

small burden on both sides. Customers do not need to change their shopping behaviour and businesses do not need to establish new distribution paths, methods of sale and/or systems for return of packaging after its use. This is probably why both sides prefer replacement of plastic packaging with biodegradable materials or materials from 100% recycled material. However, the fact that customer preferences for environmentally friendly attributes and innovations performed by SMEs are in harmony certainly works in favour of the development of packaging innovations.

As far as the perspective for innovations in the reuse direction is concerned, these will probably be better accepted by green customers who buy environmentally friendly products. They are more willing to sacrifice their comfort while shopping in return for greater product value given by the environmentally friendly aspects. Nevertheless, they too, like other customers, experience several problems associated with sorting packaging waste. Customers have the biggest problems with storage of used packaging be-

fore it is returned, with the fact that recycling bins are always full and washing of packaging. To ensure better acceptance of innovations in this direction (reuse), these problems must be perceived as barriers and attention must be given to breaking them down. However, it is also important to organise takeback at the point of sale of the product, as research has shown that customers prefer returning packaging when they next go shopping (as this is more convenient for them). However, it would be advisable to abandon imposition of deposits on packaging as customers are not well inclined towards this. As far as the introduction of sale in packaging-free shops is concerned, the number of shops must be increased. To ensure convenience in shopping, it would be advisable for these locations to be close to (or part of) sales areas for other regular shopping.

By summarising the research results and the conclusions drawn, it is possible to identify the most appropriate circular packaging innovations in SMEs (see Figure 2).

Figure 2 Synthesis of research results and proposal of desirable directions for circular packaging innovation
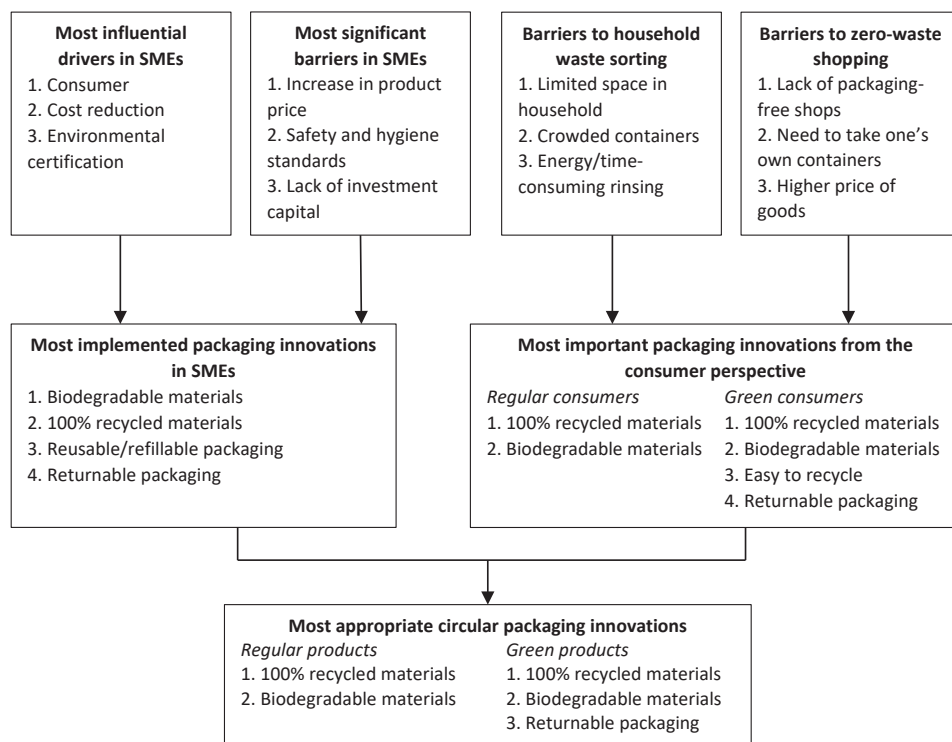
Source: Authors

The innovations identified in Figure 2 can be considered not only the most appropriate, but at the same time, as ones which can be most easily adopted by SMEs with respect to the identified drivers (consumers, cost reduction) and barriers (increase in product price, safety and hygiene standards). A more significant promotion of packaging innovations in SMEs would without a doubt be helped by more in-depth environmental education, both on the side of business managers and on the side of customers. Mutual interest will be an important (or even the main) driver of these innovations. It is, however, important that circular packaging innovations do not have a fundamental impact on the customers' comfort, as this always reduces the change of their successful acceptance. However, it is at the same time necessary to ensure enough funds for these innovations. Because this may prove to be a problem in view of the size of SMEs, it would be advisable to implement greater state support for them. If circular packaging innovations in SMEs expand at a slow pace, enforcement via legislation is a possible option.

5. Conclusion

This study focused on identifying appropriate types of packaging innovations based on CE principles in relation to SMEs in the FMCG sector. It first examined the scope of adoption of each type of innovation in companies, the drivers of and barriers to these innovations, and then revealed the importance of individual consumer requirements for packaging and their attitudes towards changes in consumer behaviour relating to the use of circular packaging. Comparison of research results with the professional literature and a unique synthesis of business and consumer attitudes enabled us to identify the most appropriate types of innovation for SMEs. Replacing non-recyclable materials in packaging with 100% recyclable or biodegradable alternatives can be considered the most appropriate packaging innovation for all customers. It transpires that customer attitudes towards environmental protection must be taken into account when innovating packaging. It is also advisable for green customers to implement the use of returnable packaging.

The paper develops current knowledge in the field of packaging innovation on the basis of the CE in several directions. As opposed to previous studies

concerned with different types of innovations without any link to their implementation rates (García-Arca et al., 2017; Beitzen-Heineke et al., 2017; Greenwood et al., 2021; Lekesiztürk & Oflaç, 2022; Cozzolino & De Giovanni, 2023; and others), this study quantifies individual types of innovations that have been implemented. In addition to that, it also develops the work of Gustavo Jr. et al. (2018), Ma et al. (2020), Mattia et al. (2021), Afif et al. (2022) and Palsson and Sandberg, (2022) by also indicating the relative importance of the different drivers and barriers on the side of businesses themselves. Also beneficial is the identification of the importance of individual customer requirements for sustainable packaging, which develops the work of Otto et al. 2021 and Koch et al., 2022. Identification of the most appropriate types of innovation also contributes to the development of knowledge in the field of sustainable management of SMEs. Research conducted in the Czech Republic contributes to revealing contextual differences (differences depending on the type of country)–a direction of research recommended by Palsson & Sandberg, 2022.

The results presented in the paper are also relevant for corporate practice. The findings enable managers, especially in SMEs, to understand customer requirements for sustainable packaging and partly also the reasons why some innovations are not very attractive to them. The proposal created for the most appropriate types of innovation offers a basis for innovation processes aimed at sustainable packaging in SMEs and can also become an inspiration for large enterprises.

Limitations of the research arise from its focus on only one selected sector of SMEs within the FMCG industry and its restriction to the territory of the Czech Republic. The conclusions drawn from the research are therefore valid for this sector and for groups of countries with similar environmental awareness, as well as economic and legislative environments comparable to those in the Czech Republic. Additionally, the relatively small sample size of 60 SMEs limits the generalisability of the results and introduces potential sampling bias.

Further research, particularly of a qualitative nature, could be conducted to advance knowledge in this area. Interviews or case studies could provide a deeper insight into the specific challenges faced by SMEs. In terms of future research directions, there is undoubtedly room for investigating the relationships between different drivers and barriers within

companies in the field of circular packaging innovations, as well as exploring strategies for overcoming these barriers or groups of barriers. Conducting similar research in large enterprises would allow for comparison and identification of differences with the results of this research. In order to uncover contextual differences, comparable research studies could also be carried out in other regions, including those similar in economic performance and environmental engagement, as well as in fundamentally different territories.

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THE USE OF THE DELPHI METHOD IN THE CREATION OF THE SERVQUAL MODEL FOR MEASURING THE QUALITY OF SERVICES IN FITNESS CLUBS

Abstract

Purpose: This study aims to explore the applicability of the Delphi method in developing a SERVQUAL model for evaluating service quality in the Serbian fitness clubs, while also providing a practical tool for this emerging fitness market.

Methodology: Building upon established SERVQUAL frameworks, a three-round Delphi process was conducted with 14 experienced fitness professionals from Serbia. Participants assessed and refined an initial 33-item questionnaire structured around the five SERVQUAL dimensions. The study applied strict consensus criteria and used statistical measures including the Shapiro-Wilk test, interquartile range (IQR), and boxplot analysis to validate the reliability and internal consistency of the instrument across iterations.

Results: The final model consists of 25 statements and demonstrates a high level of adaptability of the SERVQUAL framework to specific needs of the Serbian fitness market, while maintaining theoretical consistency.

Conclusion: The study confirms the Delphi method as an efficient tool for constructing reliable service quality measurement instruments in fragmented and under-researched markets. The resulting SERVQUAL model holds both methodological and practical value. As the Serbian fitness industry continues to grow, this validated instrument offers stakeholders a valuable basis for quality enhancement.

Keywords: Delphi method, research methodology, SERVQUAL model, fitness industry, service quality

1. Introduction

The increasing popularity of recreational exercise has amplified the need for effective service quality measurement in fitness clubs (Jasinkas et al., 2013). Understanding customer expectations and percep-

tions is crucial for maintaining competitiveness and improving customer satisfaction in this rapidly evolving industry (Douglas & Connor, 2003; Robledo, 2001). The SERVQUAL model, a widely used framework for evaluating service quality, has been

applied to fitness clubs worldwide (Peitzika et al., 2020; Soita, 2012); however, Serbia's fitness market presents unique characteristics that necessitate an adapted version of this model.

Despite the growing number of fitness clubs in Serbia, there is no unified or standardized approach to assessing service quality. The number of fitness clubs is difficult to establish due to irregular business registrations and non-disclosure of membership data. Estimates suggest that in 2017, Serbia had approximately 1,000 fitness clubs, with projections indicating an increase by 2024 (Matić et al., 2017). Additionally, fitness clubs often do not fully report their members, impacting revenue transparency (Tomašević et al., 2024). The Serbian Recreation and Fitness Association (SFRS, 2021) reports a post-pandemic increase in fitness participation, aligning with global trends emphasizing healthier lifestyles and improved physical appearance (Ratković et al., 2023; Thompson, 2022). Furthermore, due to the coexistence of profit-oriented and non-profit fitness clubs, there is inconsistency in service delivery standards and approaches to quality assessment. This lack of uniformity complicates data collection and makes reliable comparisons across clubs difficult. Consequently, it impacts the methodological validity of applying standardized instruments like SERVQUAL, requiring a carefully adapted model that accounts for such market-specific variability. These challenges underscore the importance and practical value of developing a tailored SERVQUAL model suited explicitly for the Serbian fitness context.

Although international studies have successfully employed SERVQUAL to measure service quality in fitness clubs (Peitzika et al., 2020; Lagrosen & Lagrosen, 2007), no specialized questionnaire designed exclusively for the Serbian fitness market has been created in the academic literature to date . The influence of media, particularly social media, has also impacted fitness service expectations, increasing awareness of global fitness trends but without a structured approach to evaluating service delivery (Deighton-Smith & Bell, 2018; Kumar et al., 2016). Furthermore, Serbia's fitness industry lacks a comprehensive service quality framework due to sociocultural differences that distinguish it from other markets (Nedeljković et al., 2018).

This study addresses this methodological gap by systematically employing the Delphi method, recognized for its capability in synthesizing expert judgment through iterative consensus-building, to develop a SERVQUAL model suited explicitly for the Serbian context. The Delphi method was selected due to its proven efficacy in systematically deriving expert consensus, particularly in contexts characterized by fragmented standards and subjective expert opinions. Specifically, this research employed a structured Delphi approach involving three iterative rounds with fourteen fitness industry experts from Serbia. The selection of these respondents, comprising fitness club managers and trainers, ensures the validity and relevance of the adapted SERVQUAL questionnaire for the local market.

Through this methodological approach, the research provides a validated measurement tool designed explicitly to improve service quality assessment, enhance customer satisfaction, and increase operational efficiency within Serbia's fitness industry. Moreover, by establishing a standardized measurement instrument, this study offers both a methodological contribution and practical value for business stakeholders. Fitness club managers can leverage the findings to measure and improve their service quality and increase customer satisfaction. Furthermore, this research provides insight into how Serbia's fitness market compares to international trends, highlighting the need for localized quality assessment tools.

2. Theoretical considerations

The fitness industry has experienced significant growth worldwide in recent decades, driven by rising health awareness, social media influence, and lifestyle changes (Kercher et al., 2022, 2023; Statista, 2023; Thompson, 2019; 2022). However, unlike highly regulated markets in some countries, Serbia's fitness club industry lacks formal oversight and standardized service quality evaluation. It is also important to recognize that not all fitness clubs are classified as profit-oriented organizations that offer services within the realm of recreation. As a result, understanding service quality expectations and differences between Serbia and other markets is essential for fitness clubs and industry development, as Serbia confidently follows the trend of increasing popularity of the fitness industry. The worldwide health and fitness club market was estimated to grow 7.67% annually between 2023 and 2030 (Statista, 2022). In addition, by 2030,

this industry was estimated to be worth approximately 169.7 billion U.S. dollars (Statista, 2022). The increasing popularity of fitness is unequivocally driven by two main factors: the ubiquitous presence of sports in people's lives globally and the media's unparalleled ability to promote and showcase various sports events. Today's modern media enhance global sports visibility and emphasize the importance of exercise. The sports market generates significant income, and the growing popularity of sports has resulted in increased recreational participation among the general population. The trends stem from the growing popularity of sports worldwide, supported by the media, and changes in the socio-cultural environment. Observations cannot be made in isolation. Trends like increased focus on health and physical appearance drive fitness engagement. Fitness clubs also serve as spaces for socializing and indicate social status.

Service quality assessment plays a crucial role in customer satisfaction and loyalty in fitness clubs (García-Fernández et al., 2018; Alexandris et al., 2004). A modern fitness club is highly efficient in using time and space in architecture and the simultaneous use of fitness technologies (Addolorato et al., 2020). Given the centrality of service quality to the mission of sports and recreation clubs, research toward a better understanding of the nature of service quality should be a primary concern for all organizations (Tsitskari et al., 2006).

Measuring tools are essential for the growth of the fitness industry. They will improve their service quality which will influence the health of users engaged in recreational fitness and increase profits for market participants. Therefore, measuring the quality of services provided, is the key to developing this industry. Creating scientific models used in this field, such as SERVQUAL, is necessary to achieve these goals.

The SERVQUAL model is widely used in the academic literature to measure service quality (Lagrosen & Lagrosen, 2007; Peitzika et al., 2020; Šíma & Ruda, 2019; Wang et al., 2015). The SERVQUAL model measures service quality and gaps between perceived and expected quality through 22 statements across five dimensions: tangibles, reliability, assurance, responsibility, and empathy (Parasuraman et al., 1985). The use of the SERVQUAL questionnaire to measure the perception of the quality of services provided in the fitness industry has been demonstrated in numerous examples (Lagrosen &

Lagrosen, 2007; Peitzika et al., 2020; Šíma et al., 2020; Šíma & Ruda, 2019; Soita, 2012). In addition to this model and similar objectives, other scales are used in the sports market, such as the SQAS (Altinişik & Çelik, 2021; Polyakova & Mirza, 2016) or other measurement methods by Chao (2015) and Tsitskari et al. (2014). In Serbia, the SERV-QUAL questionnaire for measuring the quality of services in fitness clubs has not been used, i.e. no one has yet attempted to use the items (assertions) in this branch of the sports market. The dimensions of quality assessment in sports centers can differ significantly across various countries and distinct service sectors (Tsitskari et al., 2006), so applying the SERVQUAL model to Serbia requires adaptation due to the unique characteristics of the market. For example, Serbia's fitness clubs differ from those in Western Europe and the U.S. in terms of socio-cultural specificities (Nedeljković et al., 2018). The market includes a mix of profit and non-profit fitness clubs, which affects how service quality is perceived and delivered. Additionally, due to economic and cultural factors, Serbian fitness service users may prioritize certain service quality dimensions differently than in other countries (Jasinkas et al., 2013; Ruiz-Montero et al., 2015). Peitzika et al. (2020) found that in Greek fitness clubs, the physical elements, the reliability of promised services, the ability of fitness clubs employees to convey trust and confidence, and the individualized attention that these clubs provide to them are considered important elements of service quality. In Swedish fitness clubs, determined fitness quality dimensions are pleasure, mental change and physical change (Lagrosen & Lagrosen, 2007). Šíma et al.'s (2020) study findings led to the development of an enhanced four-factor SERVQUAL model tailored to the Czech fitness industry, indicated that local fitness service users primarily evaluate service quality based on facility conditions, service dependability, staff interactions, and program effectiveness. They developed an enhanced four-factor SERVQUAL model for Czech fitness clubs, where responsiveness, assurance, and empathy were merged into a single staff behavior factor, reflecting customer perceptions. The remaining dimensions, tangibles, reliability, and technical quality were retained. Soita's (2012) study from Uganda confirmed that there are significant gaps in service quality in Ugandan fitness clubs. The overall service perception score was negative, indicating that customer expectations were not met across all dimensions of service qual-

ity. The most critical service quality aspects for fitness service users were assurance (trust and confidence in staff), tangibles (facilities and equipment), and empathy (personalized attention), while fitness service users highly valued professional, knowledgeable, and courteous staff who ensure safety and provide reliable services.

Given these industry-specific challenges, this research used the Delphi method to create a SERVQUAL model tailored to the Serbian fitness market. In this study, the first questionnaire was created entirely based on other published research on service quality in fitness clubs. Many sources were used, following the nature of the service quality dimension defined by the SERVQUAL model. Four sources were used for the *tangibles* dimension, which consisted of eight statements in the first version of the questionnaire (Naik et al., 2010; Pi et al., 2022; Šíma et al., 2020; Xu et al., 2021). The *reliability* dimension is based on five statements and four sources in the initial version of the questionnaire (Naik et al., 2010; Peitzika et al., 2020; Šíma et al., 2020; Xu et al., 2021). The *responsibility* dimension is based on eight statements derived from three sources (Ko & Pastore, 2005; Naik et al., 2010; Xu et al., 2021). The *assurance* dimension is based on five statements and one source (Xu et al., 2021). The most prominent aspect of service quality in fitness clubs is the characteristic of assurance (Ojeh & Azizian Kohan, 2021). Defining claims related to assurance requires a clear understanding of the basic assurance aspects at the place of exercise (Adi Nurrohman & Rofiah, 2024). Following the assurance dimension, the empathy dimension is based on seven statements and six sources (Naik et al., 2010; Peitzika et al., 2020; Pi et al., 2022; Soita, 2012; Xu et al., 2021). The SERVQUAL questionnaire initially included 33 questions. Many other research studies have demonstrated the importance of the questions defined through this model.

The Delphi method is characterized by several distinct features related to the respondents and the repetition of the questioning procedure. The respondents are typically experts in the field and are highly relevant for defining research questions and assertions within the SERVQUAL model. To achieve a consensus among respondents, a minimum of three iterations of the questionnaire must be completed (Balasubramanian & Agarwal, 2012; Thangaratinam & Redman, 2005). Respondents must not collaborate or consult with each other

during the research. Their task is to rate the written statement on a scale, indicating their level of agreement (Murray & Jarman, 1987). A consensus may be achieved only if 90% of the questions in the questionnaire attain a median score of five. Furthermore, an additional requirement is that the mean score must be within the threshold of an excellent rating (4.50 and above).

The Delphi method has been employed for several decades as a forecasting technique that gathers data from specific research domains, relying on the insights and predictions of experts in those fields (Eret, 2017). Its primary advantages include obtaining expert opinions without the constraints of time and geography that often accompany alternative methodologies (De Meyrick, 2003). The Delphi method is particularly advantageous when physical meetings are not feasible (Humphrey-Murto et al., 2020). A key characteristic of the Delphi method is its recursive nature (Kari et al., 2011), which is a fundamental reason for its application in research, particularly in developing a questionnaire suitable for individual practitioners and those training in groups or one-on-one with a coach. Research by Costa (2005) demonstrates the validity of the Delphi method in the context of sports management, as it facilitates the exploration of new perspectives and opinions. Okoli & Pawlowski (2024) also highlighted the significance of the Delphi method in managerial decision-making.

The SERVQUAL model will be determined based on the characteristics of the population exercising in Serbia since local experts will be involved in the research. The SERVQUAL model is frequently employed in research about service quality in Serbia, particularly in the banking and postal sectors (Pavlović et al., 2018). Due to its wide applicability across diverse markets, its design to assess multiple dimensions of service quality, and its capacity for significant modification, this model has emerged as the most effective solution for this research. The capacity for modification was crucial, given that the study involved managers who also serve as trainers, conducting various forms of training ranging from personal sessions to small and large groups of participants. This necessity for adaptability is why the authors opted for the Delphi method in developing the SERVQUAL model. Specifically, the perception of service quality in fitness contexts varies according to the type of training, and only the Delphi method can facilitate a consensus among respond-

ents. The behavior of fitness service users in Serbia is correlated with global trends. The questionnaire indirectly integrates these specifics through the comments adopted on the proposed assertions during the implementation of the Delphi method.

3. Research methodology

The research was conducted in Serbia from June to November 2023 and involved 14 respondents (experts in fitness clubs: 10 trainers/managers, 4 trainers) aged 25 to 48. Each respondent had a minimum of 5 years of experience, with the majority having over 10 years of experience. The respondents hailed from various cities, predominantly Belgrade and Novi Sad. Iterations were documented with tables summarizing comments, changes, and rationales.

Based on a literature review of fitness service user satisfaction and service users in general, the first version of the questionnaire was developed comprising 33 statements. The questionnaire was based on a Likert scale ranging from 1 (lowest) to 5 (highest). The statements were grouped according to the five service quality dimensions in the SERVQUAL model. Each dimension was marked with a different color: *tangibles*, *reliability*, *responsiveness*, *assurance*, and *empathy*. Respondents were given space to explain the grades they assigned and to leave comments at the end of each dimension. The questionnaire was distributed to respondents with clear instructions to indicate their level of agreement with the statements. The instructions were also provided verbally to each respondent. The respondents did not consult each other about the research, as they did not know the identities of other participants in the study. MS Excel 2016 and SPSS v. 25 were used to process the questionnaires.

Respondents rated statements (a 1–5 scale) and suggested revisions. After interviews clarified misunderstandings, the second iteration refined the questionnaire to 28 statements. The initial report comprised ten pages and concluded with a note stating: "It was observed that coaches conducting individual training sessions in a space with only one athlete perceived certain statements quite differently from others; thus, these statements were modified to also apply to group, independent, and personal training." This issue was not identified in the subsequent questionnaire.

After conducting personal interviews and obtaining the necessary clarifications, respondents were sent a second questionnaire consisting of 25 statements developed from the results of the first two rounds, which was then distributed for a third iteration. This step was completed entirely online, without additional verbal explanations. The final version of the questionnaire comprises 25 statements and includes general questions about the sample of respondents and future research purposes when applying this model. A question about exercise motivation was added to the basic questions about gender, age, and education (Dong et al., 2012). Exploration of motivations for engaging in fitness activities provides insights into the potential for enhancing service quality and informing the content of promotional messages for fitness clubs (Ratković et al., 2023). Research indicates that common motivations include health improvement, aesthetic enhancement, social interaction, and other factors (Vartanian et al., 2012). Identifying motivation is essential for making decisions regarding the successful positioning of a fitness club (Wilson et al., 2008).

The described procedure fulfils the Delphi method's basic condition, i.e. a minimum of three iterations (Balasubramanian & Agarwal, 2012; Thangaratinam & Redman, 2005).

The results were processed using measures of central tendency and dispersion. The Delphi technique typically presents results using the median and interquartile range (IQR) as measures of central tendency and dispersion (Fish & Busby, 2005). High scores for all questions are expected, given the lack of normality and right-hand skewed curves. Since the median and IQR exclude extreme values, some authors recommend using the mean and standard deviation as alternatives (Thangaratinam & Redman, 2005). To ensure accuracy and account for divergent results, a boxplot diagram was included, illustrating data distribution, the IQR (a blue bar), the median (a bold line), outliers, and data distribution. This diagram effectively combines sensitivity and insensitivity to normality issues, enhancing Delphi data analysis.

Defining and identifying a consensus is a necessary step before commencing Delphi research. The Delphi technique assumes that respondents will reach a consensus after several rounds of research. However, it is important to note that this technique does not provide guidance on determining a consensus or the required number of research rounds. The Delphi technique usually involves three rounds

to achieve a consensus, but there is no limit to the maximum number of rounds (Landeta, 2006). The minimum number of rounds required to reach at least two is recommended. To determine a consensus, it is crucial to be realistic, as complete agreement among respondents is often unattainable. However, aiming for the highest possible percentage of agreement, even up to 90% (Landeta, 2006), is essential. This research aimed for respondents to agree on questions between 80% and 90%. Ideally, 90% of the questions in the questionnaire should have a median score of 5, with a minimum of 80%. The mean value must fall within the range of an excellent grade (4.50 and above) for the entire questionnaire and each of the five service quality dimensions in the SERVQUAL model. This is a crucial requirement for achieving high service quality standards.

4. Results

The questionnaire consisted of 33 questions (Table 1), and it was distributed to respondents in the initial round. Using the Shapiro-Wilk test in SPSS, the normality of the distribution of respondents' ratings was checked. Out of the 33 variables, only Q19 and Q20 met the normality conditions with $p > .05$. The analysis indicates that 32 variables (excluding Q20) display significant positive skewness, implying that their distribution is skewed to the right of the mean and that their curves are right-skewed, approaching the maximum. The respondents were instructed to rate their level of agreement with each assertion on a scale from 1 to 5 based on their experience and knowledge as fitness marks. The aim was to specify the form of the questions and the logic, correctness, and completeness of the questionnaire. All 14 respondents in the sample completed the questionnaire in full and provided 32 comments, demonstrating their full participation in the assessment.

Of the 33 questions, 81.82% had a median score of 5, while the mean score for all dimensions was 4.44, i.e. below the target of 4.50. Three of the five quality dimensions (reliability, responsiveness, and empathy) did not receive an excellent rating. Although the evaluators are not subject to examination, respondents 6 and 7 gave very low marks, with an average below 4.00.

Table 1 The results of the first round

Experts	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	E13	E14	Mean	SD	Max	Min	Range	Median	1st Q	3rd Q	IQR	RIR	∑ Mean
Questions																									
Examination of service quality - dimension of Tangibles:																									4,58
1. The fitness centre has modern equipment	5	5	5	5	5	3	4	5	5	4	4	5	5	5	4,64	0,63	5	3	2	5	4,25	5	0,75	0,15	
2. The fitness centre has all the necessary equipment and props	5	5	5	5	3	2	5	5	5	4	4	5	5	5	4,50	0,94	5	2	3	5	4,25	5	0,75	0,15	
3. The fitness centre is visually appealing	4	5	4	5	5	2	4	5	5	4	4	5	5	5	4,50	0,85	5	2	3	5	4	5	1	0,20	
4. The fitness centre has available parking	5	4	5	5	5	2	5	5	5	5	3	4	5	5	4,50	0,94	5	2	3	5	4,25	5	0,75	0,15	
5. Coaches and other employees have a neat and professional appearance	5	5	4	5	5	5	3	5	5	4	4	5	5	5	4,64	0,63	5	3	2	5	4,25	5	0,75	0,15	
6. Social media profiles are visually appealing	5	5	5	4	5	3	4	5	4	4	3	5	5	5	4,43	0,76	5	3	2	5	4	5	1	0,20	
7. The fitness center is clean	5	5	5	5	5	4	5	5	5	5	5	5	5	5	4,93	0,27	5	4	1	5	5	5	0	0,00	
8. I sleep better after training	5	5	5	5	5	5	2	5	1	5	5	5	5	5	4,50	1,29	5	1	4	5	5	5	0	0,00	
Explanation of ratings and comments:							K7	K9		K13	K18	K22													
Examination of service quality - Reliability dimension:																									4,29
9. Employees are reliable	4	5	3	5	5	4	3	5	5	4	5	5	5	3	4,36	0,84	5	3	2	5	4	5	1	0,20	
10. The fitness centre is reliable in providing customer service	5	5	3	5	5	2	2	5	5	4	5	5	5	3	4,21	1,19	5	2	3	5	3,25	5	1,75	0,35	
11. In the fitness centre services are performed flawlessly	4	5	5	5	5	2	3	5	5	4	4	5	5	3	4,29	0,99	5	2	3	5	4	5	1	0,20	
12. Employees provide prompt service	4	5	5	5	5	4	4	5	5	3	4	5	5	4	4,50	0,65	5	3	2	5	4	5	1	0,20	
13. The Fitness Center maintains error-free records	5	5	4	4	5	2	4	1	5	4	4	5	5	4	4,07	1,21	5	1	4	4	4	5	1	0,25	
Explanation of ratings and comments:		K1					K10	K14	K19		K25		K29												
Examination of service quality - Responsiveness dimension (responsibility, operability)																									4,29
14. The fitness centre is quick to respond to complaints	4	5	3	5	4	4	4	5	5	3	5	5	5	4	4,36	0,74	5	3	2	4,5	4	5	1	0,22	
15. Coaches and other staff are always willing to help	4	5	5	5	5	5	3	5	5	3	4	5	5	4	4,50	0,76	5	3	2	5	4	5	1	0,20	
16. Trainers are trained to respond to requests from service users	4	5	3	3	5	5	3	1	5	4	5	5	5	4	4,07	1,21	5	1	4	4,5	3,25	5	1,75	0,39	
17. Procedures for dealing with complaints are simple	5	5	4	5	5	4	5	4	5	4	5	5	5	4	4,64	0,50	5	4	1	5	4	5	1	0,20	
18. Working hours are appropriate	5	5	5	5	5	5	3	5	5	4	5	5	5	3	4,64	0,74	5	3	2	5	5	5	0	0,00	
19. Exercise equipment is always available	5	5	5	3	3	2	2	1	5	5	3	5	5	3	3,71	1,44	5	1	4	4	3	5	2	0,50	
20. The locker rooms are never crowded	4	5	5	3	3	2	3	2	5	3	3	5	4	3	3,57	1,09	5	2	3	3	3	4,75	1,75	0,58	
21. Social media information is regularly updated	5	5	5	4	5	5	5	5	5	4	5	5	5	5	4,86	0,36	5	4	1	5	5	5	0	0,00	
Explanation of ratings and comments:		K2	K4	K8			K11	K15	K20	K23	K26		K30												
Examination of service quality - Assurance dimension:																									4,63
22. Trainers instill confidence in service users	4	5	5	5	5	3	4	5	5	4	5	5	5	3	4,50	0,76	5	3	2	5	4	5	1	0,20	
23. Service users feel safe in training	5	5	5	5	5	5	4	5	5	4	5	5	5	4	4,79	0,43	5	4	1	5	5	5	0	0,00	
24. The coaches are knowledgeable and professional	4	5	5	5	5	5	2	5	5	4	5	5	5	3	4,50	0,94	5	2	3	5	4,25	5	0,75	0,15	
25. Exercise equipment and space are safe	5	5	5	5	5	4	4	5	5	5	5	5	5	3	4,71	0,61	5	3	2	5	5	5	0	0,00	
26. Personal belongings stored in changing rooms and lockers are secure	5	5	5	5	5	3	5	5	5	3	4	5	5	5	4,64	0,74	5	3	2	5	5	5	0	0,00	
Explanation of ratings and comments:			K5				K16			K27			K31												
Examining service quality - Empathy dimension:																									4,43
27. Employees assist customers individually	4	5	4	5	5	2	2	1	5	4	5	5	5	5	4,07	1,38	5	1	4	5	4	5	1	0,20	
28. Employees are friendly and polite	4	5	5	5	5	3	3	5	5	4	4	5	5	4	4,43	0,76	5	3	2	5	4	5	1	0,20	
29. Coaches work in the best interests of service users	4	5	5	5	5	4	2	5	5	3	4	5	5	3	4,29	0,99	5	2	3	5	4	5	1	0,20	
30. Trainers understand the needs of users of their services	4	5	5	5	5	4	3	5	5	3	4	5	5	4	4,43	0,76	5	3	2	5	4	5	1	0,20	
31. I feel happy after training	5	5	5	5	5	5	5	5	5	4	5	5	5	5	4,93	0,27	5	4	1	5	5	5	0	0,00	
32. Employees are always smiling	5	5	3	3	5	3	3	3	5	4	4	5	5	5	4,14	0,95	5	3	2	4,5	3	5	2	0,44	
33. Communication with employees is easy	5	5	5	5	5	3	5	3	5	5	5	5	5	5	4,71	0,73	5	3	2	5	5	5	0	0,00	
Explanations of ratings and comments:		K3	K6				K12	K17	K21	K24	K28		K32												
Average expert rating (mean)	4,58	4,97	4,55	4,67	4,79	3,52	3,58	4,27	4,85	4,00	4,36	4,97	4,97	4,12	4,44	0,83								Total	4,44

Source: Authors' work

The boxplot demonstrates the significance of utilizing both central tendency and dispersion measures. For example, in boxplot 1, the last two questions (32 and 33) and the first two questions (1 and 2) are worth considering. The last question has an average of 4.71 and a median of 5, while the penultimate one has a median of 4.5[1] and a below-average mean of 4.14 (Table 1). The graph demonstrates that the IRQ equals zero in the last question, as no blue column is present. However, in the penultimate question, the blue column extends from the third to the fifth division on the y-axis, resulting in a higher dispersion and an IRQ of 2. It is worth noting that the last question contains two outliers, as respondents 6 and 8 gave a score of 3, which the software

marked as an extreme value.[2] The average would be 5.00, not 4.71 if they did not exist. The case is even clearer for questions 1 and 2, which have an IQR equal to 1. In both cases, the software indicates that the rank of the data is equal to 2 (because the thin line[3] goes from the third mark on the y-axis). Question 2 has an outliner on the second mark of the y-axis, indicating a higher dispersion and a lower average (also noted in Table 1, where the rank is 3). Ideal positions are when the IQR equals 0 and the median equals 5 (of which there are 10 in boxplot 1). They are also desirable with an IQR equal to 1 and a median equal to 5, without a large negative influence of the outliner.

Figure 1 Boxplot 1: The graph of the distribution of the results of the first (initial) round

Source: Authors' work

Based on respondents' feedback, the questionnaire was reduced to 28 questions, with 20 statements modified across tangibles, empathy, and responsiveness dimensions (Table 2). They were then sent a comprehensive report with a table with all

respondents' ratings and detailed answers to their comments.

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1   SPSS and Excel use slightly different formulas for calculating the median, which may result in minor discrepancies between the results displayed in the graph and table. However, these discrepancies do not impact the final outcome.

2   An asterisk indicates an extreme value that is three times higher than the interquartile range (IQR). A circle indicates an outlier with a value greater than 1.5 times the IQR value.

3   Called a whisker.

Table 2 The results of the second round

Experts	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	E13	E14	Mean	SD	Max	Min	Range	Median	1st Q	3rd Q	IQR	RIR	∑ Mean
Questions																									
Examination of service quality - dimension of Tangibles:																									4,25
The fitness centre has modern equipment and diagnostic procedures	5	5	1	3	4	2	2	3	5	5	5	5	5	5	3,93	1,44	5	1	4	5	3	5	2	0,40	
The fitness centre has the necessary equipment and props	5	5	1	5	5	3	4	4	5	5	5	5	5	5	4,43	1,16	5	1	4	5	4,25	5	0,75	0,15	
The fitness centre is visually appealing	4	5	4	5	5	2	3	2	5	5	3	5	5	5	4,14	1,17	5	2	3	5	3,25	5	1,75	0,35	
It is possible to park near the fitness centre	5	4	4	5	5	4	3	2	5	5	4	4	4	5	4,21	0,89	5	2	3	4	4	5	1	0,25	
The fitness center is clean	5	5	1	5	5	4	5	4	5	5	5	5	5	5	4,57	1,09	5	1	4	5	5	5	0	0,00	
I sleep better after training	5	5	3	5	5	3	3	4	1	5	5	5	5	5	4,21	1,25	5	1	4	5	3,25	5	1,75	0,35	
Explanation of ratings and comments:			K1	K6		K8	K12	K16	K21		K26														
Examination of service quality - Reliability dimension:																									4,36
Employees are efficient	4	5	5	5	5	2	4	3	5	5	5	5	4	5	4,43	0,94	5	2	3	5	4	5	1	0,20	
The fitness centre is safe	3	5	1	5	5	2	4	4	5	3	3	5	5	5	3,93	1,33	5	1	4	4,5	3	5	2	0,44	
I get quality services in the fitness centre	5	5	4	5	5	4	4	5	5	5	5	5	5	4	4,71	0,47	5	4	1	5	4,25	5	0,75	0,15	
Employees are educated	4	5	5	4	5	4	3	4	5	5	5	5	5	3	4,43	0,76	5	3	2	5	4	5	1	0,20	
The fitness centre maintains error-free records	2	5	5	5	5	3	4	2	5	5	5	5	5	4	4,29	1,14	5	2	3	5	4	5	1	0,20	
Explanation of ratings and comments:			K2			K9	K13	K17	K22	K25	K27		K29												
Examination of service quality - Responsiveness dimension (responsibility, operability)																									4,50
The fitness centre is quick to respond to complaints	4	4	5	5	5	3	3	4	5	5	5	4	4	4	4,29	0,73	5	3	2	4	4	5	1	0,25	
Coaches and other staff are willing to help	5	5	5	4	5	3	4	5	5	5	5	5	5	4	4,64	0,63	5	3	2	5	4,25	5	0,75	0,15	
Trainers meet the demands of users	4	5	2	4	5	2	3	4	5	5	5	5	5	4	4,14	1,10	5	2	3	4,5	4	5	1	0,22	
The working hours are appropriate	5	5	5	5	5	4	4	5	5	5	5	5	5	5	4,86	0,36	5	4	1	5	5	5	0	0,00	
Some of the equipment I want to practice on is always available	5	5	4	5	5	3	4	3	5	5	4	5	5	4	4,43	0,76	5	3	2	5	4	5	1	0,20	
I have enough space in the dressing room	3	5	5	5	5	4	4	4	5	5	5	4	4	4	4,50	0,65	5	3	2	5	4	5	1	0,20	
Information on social networks is regularly updated	3	5	5	5	5	4	5	4	5	5	5	5	4	4	4,64	0,63	5	3	2	5	4,25	5	0,75	0,15	
Explanation of ratings and comments:			K3	K7		K10	K14	K18	K23																
Examination of service quality - Assurance dimension:																									4,49
Trainers give the impression of security	4	5	2	5	5	3	4	3	5	5	4	5	5	4	4,21	0,97	5	2	3	4,5	4	5	1	0,22	
I feel safe in training	5	5	3	5	5	3	4	4	5	5	5	5	5	4	4,50	0,76	5	3	2	5	4	5	1	0,20	
The coaches are experienced	5	5	2	5	5	3	3	4	5	5	5	5	5	4	4,29	1,07	5	2	3	5	3,25	5	1,75	0,35	
Exercise equipment and space are safe	5	5	4	5	5	4	4	5	5	5	5	5	5	3	4,64	0,63	5	3	2	5	4,25	5	0,75	0,15	
Personal belongings stored in changing rooms and lockers are safe	5	5	4	5	5	4	5	5	5	5	5	5	5	4	4,79	0,43	5	4	1	5	5	5	0	0,00	
Explanation of ratings and comments:			K4			K11	K15	K19					K30												
Examining service quality - Empathy dimension:																									4,64
Employees take care of each user	4	5	5	5	5	4	4	4	5	5	5	5	5	4	4,64	0,50	5	4	1	5	4	5	1	0,20	
The employees are friendly	4	5	5	5	5	5	4	5	5	5	5	5	5	4	4,79	0,43	5	4	1	5	5	5	0	0,00	
Experienced trainers understand the needs of the users of their services	5	5	5	5	5	4	5	3	5	5	5	5	5	4	4,71	0,61	5	3	2	5	5	5	0	0,00	
The employees are in a good mood	5	5	5	3	5	4	4	4	5	5	3	4	5	4	4,36	0,74	5	3	2	4,5	4	5	1	0,22	
Communication with employees is good	5	5	5	5	5	4	4	4	5	5	5	5	5	4	4,71	0,47	5	4	1	5	4,25	5	0,75	0,15	
Explanations of ratings and comments:			K5				K20	K24		K28															
Average expert rating (mean)	4,39	4,93	3,75	4,75	4,96	3,36	3,82	3,82	4,86	4,93	4,68	4,89	4,86	4,21	4,44	0,82								Total	4,45

Source: Authors' work

All 14 respondents from the sample participated in the evaluation, and a questionnaire with 28 questions was sent to them in the second round (Table 2). To ensure the validity of the evaluation, the normality of the distribution of the respondents' assessments was checked using the Shapiro-Wilk test. The results indicated that none of the variables had a normal distribution (p<.05), and all observed

variables were determined to have negative asymmetry (skewness). The overall score improved by 0.01 percentage points but did not meet the target level of 4.50.[4] Two quality dimensions achieved an excellent average, with responsiveness and empathy significantly improving from the first round, while reliability remained unsatisfactory. Averages for tangibles and assurance decreased, losing their excellent ratings. The number of questions with a median score below 5 remained at six. Reducing the total number of questions from 33 to 28 lowered the average score to 78.57%, below the 80% threshold. Respondents provided 30 comments, slightly fewer than in the first round.

The second round saw lower scores, with four respondents scoring below 4, possibly due to communication gaps and task misunderstandings.[5] The Delphi technique with controlled feedback is designed to minimize discrepancies and counterproductive group dynamics that may arise from group decision-making. Each subsequent iteration allows the respondents to reassess their positions, considering the group's responses as a whole, ensuring a more effective and efficient decision-making process.

Figure 2 Boxplot 2: The graph of the distribution of the results of the second round
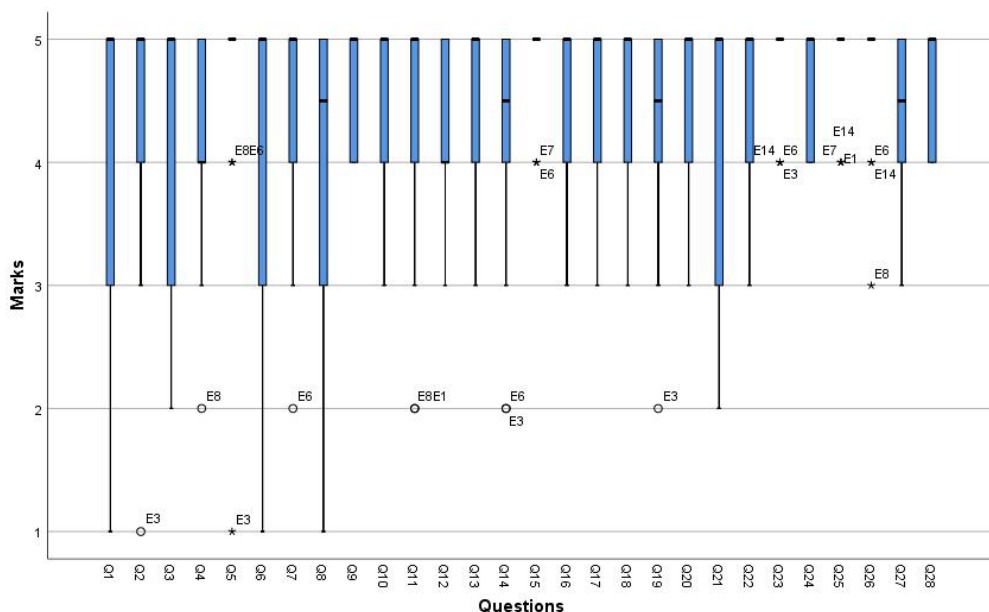
Source: Authors' work

Feedback revealed initial communication issues reflected in a drop in Question 1's mean score from 4.64 to 3.93 in the second round, despite a stable median of 5. Graphical representations demonstrate that the lower average resulted from an increased IQR and rank in the second round (boxplot 2), significantly impacting mark dispersion. Despite this, over half the respondents scored this question 5, keeping the median unchanged from the first round (boxplot 1), where the IQR was 1 and rank 2. Only five variables in boxplot 2 had ideal positions with IQR 0 and median 5.

The unsatisfactory result was caused by providing the respondents with too much information, including answers to negative comments not written by them specifically. This confused them as to whether they should also react negatively. Our communication strategy has changed to provide individual respondents with answers based on their comments instead of providing a table with the results of the research round to all respondents. The results of the third round showed that such a strategy was successful, as the consensus was reached that was defined as the research objectives.

4   The average expert rating does not even show this increase, but this is due to data rounding and not a calculation error.

5   In extreme cases, an inadequate selection of respondents may be the cause.

Table 3 The results of the third round

Experts	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	E13	E14	Mean	SD	Max	Min	Range	Median	1st Q	3rd Q	IQR	RIR	∑ Mean
Questions																									
Examination of service quality - dimension of Tangibles:																									4,57
1. The fitness centre performs modern diagnostic procedures	2	5	5	5	5	4	3	4	5	5	5	5	5	3	4,36	1,01	5	2	3	5	4	5	1	0,20	
2. The fitness centre has the necessary equipment and props	5	5	5	5	5	5	4	5	5	5	5	5	5	5	4,93	0,27	5	4	1	5	5	5	0	0,00	
3. The space in the fitness center is nicely decorated	4	5	5	5	5	4	3	5	5	5	5	5	5	4	4,64	0,63	5	3	2	5	4,25	5	0,75	0,15	
4. It is possible to park near the fitness center	3	5	5	5	5	5	3	5	5	5	5	5	5	3	4,57	0,85	5	3	2	5	5	5	0	0,00	
5. The exterior of the fitness center is attractive	3	5	5	5	4	5	2	4	5	4	5	5	5	3	4,29	0,99	5	2	3	5	4	5	1	0,20	
6. The fitness center is clean	4	5	5	5	5	5	4	5	5	5	5	5	5	3	4,71	0,61	5	3	2	5	5	5	0	0,00	
7. Ventilation works well	4	5	5	5	5	5	3	4	5	4	5	5	5	3	4,50	0,76	5	3	2	5	4	5	1	0,20	
Explanations of ratings and comments						K2	K4	K5	K6					K8											
Examination of service quality - Reliability dimension:																									4,79
8. Employees are efficient and professional	4	5	5	5	5	5	4	5	5	5	5	5	5	4	4,79	0,43	5	4	1	5	5	5	0	0,00	
9. I get quality services in the fitness center	4	5	5	5	5	5	4	5	5	5	5	5	5	4	4,79	0,43	5	4	1	5	5	5	0	0,00	
10. The fitness center maintains error-free records	4	5	5	5	5	4	5	4	5	5	5	5	5	4	4,71	0,47	5	4	1	5	4,25	5	0,75	0,15	
11. I have confidence in the coaches	5	5	5	5	5	5	5	5	5	5	5	5	5	3	4,86	0,53	5	3	2	5	5	5	0	0,00	
Explanation of ratings and comments:						K3								K9											
Examination of service quality - Responsiveness dimension (responsibility, operability)																									4,86
12. The fitness center is prompt in responding to complaints	4	5	5	5	5	5	5	5	5	5	5	5	5	3	4,79	0,58	5	3	2	5	5	5	0	0,00	
13. Coaches and other staff are willing to help	4	5	5	5	5	5	5	4	5	5	5	5	5	4	4,79	0,43	5	4	1	5	5	5	0	0,00	
14. Working hours are appropriate	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5,00	0,00	5	5	0	5	5	5	0	0,00	
15. There is always some of the equipment I want to practice on available	4	5	5	5	5	5	4	5	5	5	5	5	5	4	4,79	0,43	5	4	1	5	5	5	0	0,00	
16. I have enough space in the dressing room	4	5	5	5	5	5	4	5	5	5	5	5	5	4	4,79	0,43	5	4	1	5	5	5	0	0,00	
17. Social media information is regularly updated	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5,00	0,00	5	5	0	5	5	5	0	0,00	
Explanation of ratings and comments:							K7							K10											
Examination of service quality - Assurance dimension:																									4,86
18. Coaches give the impression of safety	5	5	5	5	5	5	5	4	5	5	4	5	5	4	4,79	0,43	5	4	1	5	5	5	0	0,00	
19. I feel safe in training	5	5	5	5	5	5	5	5	5	5	5	5	5	4	4,93	0,27	5	4	1	5	5	5	0	0,00	
20. Personal belongings stored in changing rooms and lockers are secure	4	5	5	5	5	5	5	5	5	5	5	5	5	4	4,86	0,36	5	4	1	5	5	5	0	0,00	
Explanation of ratings and comments:														K11											
Examining service quality - Empathy dimension:																									4,83
21. Employees take care of every user	4	5	5	5	5	5	4	4	5	5	5	5	5	4	4,71	0,47	5	4	1	5	4,25	5	0,75	0,15	
22. Employees are friendly	5	5	5	5	5	5	4	5	5	5	5	5	5	4	4,86	0,36	5	4	1	5	5	5	0	0,00	
23. Experienced trainers understand the needs of the users of their services	4	5	5	5	5	5	5	5	5	5	5	5	5	5	4,93	0,27	5	4	1	5	5	5	0	0,00	
24. Employees create a good atmosphere	4	5	5	5	5	5	4	5	5	5	5	5	5	4	4,79	0,43	5	4	1	5	5	5	0	0,00	
25. Communication with employees is good	5	5	5	5	5	5	4	5	5	5	5	5	5	4	4,86	0,36	5	4	1	5	5	5	0	0,00	
Explanations of ratings and comments:		K1												K12											
Average expert rating (mean)	4,16	5,00	5,00	5,00	4,96	4,88	4,20	4,68	5,00	5,00	4,88	5,00	5,00	3,88	4,76	0,47								Total	4,78

Source: Authors' work

In the third round, all 14 respondents evaluated the final 25-question version (Table 3). Shapiro-Wilk tests confirmed negative asymmetry. Respondents provided 12 positive comments, with one stating, 'That's it'. The research aimed to achieve a 90% agreement among respondents on questions posed by the median, with a minimum of 80%. Moreover, the mean value of the questionnaire, both as a whole and for each of the five dimensions of service quality in the SERVQUAL model, should be excellent (4.50 or higher). A consensus among respondents was successfully reached, and the results were obtained in the third round of testing. All 25 questions received a median score of 5, as shown in the yellow shaded fields in Table 3. The mean score was excellent at 4.78, as were all five quality dimensions, which ranged from 4.57 to 4.86.

The boxplot's ideal positions have an IQR of 0 and a median of 5, while desirable positions have an IQR of 1 and a median of 5. In the last test round, boxplot 3 achieved the ideal position for 19 out of 25 questions, while the remaining 6 had a desirable position. This is further indisputable evidence that a consensus was reached in the third round of the Delphi survey.

Figure 3 Boxplot 3: The graph of the distribution of the results of the third round
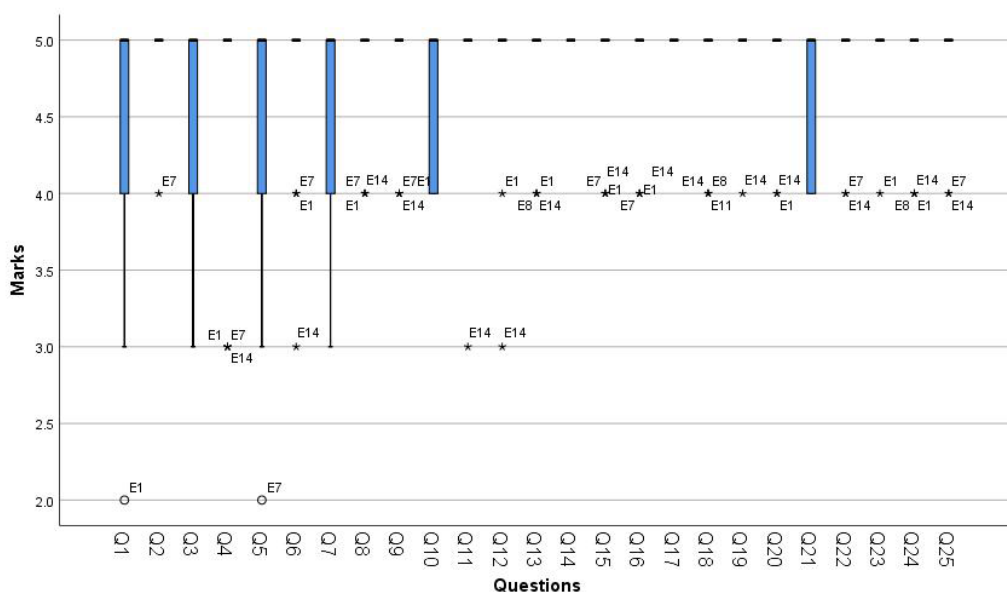
Source: Authors' work

5. Discussion and conclusion

This study confirms the effectiveness of the Delphi method in creating the SERVQUAL model to fit Serbia's fitness market. Although the research is based on the opinions of Serbian experts, the authors believe that the approach ensures its applicability at the international level.

SERVQUAL was selected as the foundation for the construction of the questionnaire due to its established effectiveness in various service sectors and its flexibility, as noted by Fernández & Bedia (2005) and Ramachandran & Chidambaram (2012). The SERVQUAL model has been deemed suitable for assessing service quality in contemporary research, as demonstrated by studies conducted by Lagrosen & Lagrosen (2007), Peitzika et al. (2020), Šíma & Ruda (2019), and Wang et al. (2015). The original SERVQUAL framework (Parasuraman et al., 1985) comprised 22 items that evaluate five quality dimensions, including tangibles, reliability, assurance, responsiveness, and empathy. The initial SERVQUAL questionnaire contained 33 items, but the final version was refined to include 25 statements. The application of the SERVQUAL questionnaire to assess the quality of services in the fitness indus-

try has been validated in numerous studies globally (Lagrosen & Lagrosen, 2007; Peitzika et al., 2020; Šíma et al., 2020; Šíma & Ruda, 2019; Soita, 2012), and it has now also been verified in Serbia.

This study successfully applied the Delphi method over three iterations to develop the SERVQUAL model, aligning with previous research (Balasubramanian & Agarwal, 2012; Thangaratinam & Redman, 2005). Notably, respondents did not collaborate or consult with one another throughout the study, as asserted by Murray & Jarman (1987). As Landeta (2006) indicated, striving for a high level of agreement, potentially reaching 90%, is crucial; this research achieved an even greater degree of consensus. This study corroborates Costa's findings (2005), which affirmed the efficacy of the Delphi method within the realm of sports management. Therefore, it can be concluded that the methodological contribution is undoubtedly significant, as it confirms the research that has already been carried out.

The questionnaire measures the quality of individual fitness clubs and overall service in Serbia, offering practical insights for industry improvement. As the fitness clubs' market in Serbia remains unregulated, accurate data on participant registration and involvement are difficult to obtain. However, this research aims to showcase the immense potential of this sector within the sports industry. Improving the quality of services leads to indirect benefits, indicating expansion and a more serious approach to business.

Therefore, the answer to the research question as to whether it is possible to create a usable SERVQUAL model based on the Delphi method is affirmative. The research conclusively demonstrates the effectiveness of the Delphi method in creating a usable SERVQUAL model.

The research clearly outlines the claims within the tangibles dimension, such as modern diagnostic procedures, necessary equipment and props, attractive decoration, convenient parking, an appealing exterior, and effective ventilation. Furthermore, it defines statements within the reliability dimension with precision and accuracy. Fitness club employees provide quality services with efficiency and professionalism. They maintain error-free records and inspire confidence in their clients. The following statements explore the next dimension of responsibility: the fitness club efficiently addresses complaints, with coaches and staff readily available to assist. Operating hours are suitable, and necessary equipment is consistently available. Adequate space is provided in the dressing room, and social media updates are frequent. Moving on, the assurance dimension is defined by the following statements: Trainers create a secure environment for personal belongings in lockers and changing rooms. The empathy dimension is evaluated through the following statements: Employees demonstrate care towards users, understand their needs, and foster a positive atmosphere through good communication.

This research covers all types of training, including personal, independent, and group training. This circumstance represented a difficulty when formulating individual statements because some trainers work exclusively with groups while others work exclusively with individuals. Additional explanations were provided to create a statement that can be applied to all types of training. This scale can be utilized for individual, group, and independent training sessions. As previously mentioned, following the initial iteration using the Delphi method, a discrepancy was identified among respondents regarding their preferences for personal versus group training. This issue was addressed through appropriate modifications to the statements in the subsequent questionnaire version.

Research limitations include delayed respondents' responses and the inability to calculate internal consistency via Cronbach's Alpha. Future surveys with fitness users are needed to validate the reliability of the SERVQUAL scale. The research is geographically limited to Serbia and therefore excludes information from other countries in the region. Limitations also include the undefined number of fitness clubs due to informal operations and insufficient categorization of services offered. Future research should map all recreational training providers in Serbia, categorize fitness clubs, and refine service quality assessments.

The finalized SERVQUAL model provides both methodological and practical implications of this research, which was shaped through consultations with fitness experts from Serbia, utilizing the Delphi method. Although specifically developed for the Serbian market, the methodological approach can serve as a template for other markets and industries internationally, particularly those experiencing similar fragmentation or a lack of regulation. Additionally, this study offers valuable practical insights, suggesting that fitness clubs should prioritize service quality dimensions most relevant to Serbian fitness service users, particularly empathy, reliability, and assurance. Fitness clubs can use the validated 25-statement SERVQUAL instrument to identify service gaps, directly addressing areas where customer expectations are unmet.

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EXPLORING THE ROLE OF PERSONAL CHARACTERISTICS IN MOBILE SHOPPING APPS USAGE

Abstract

Purpose: The influence of demographic characteristics on purchasing behaviour through mobile applications is a field of research that combines various scientific areas such as elements of consumer psychology, technology application and marketing. Personal characteristics that influence the purchase of mobile applications include age, gender, education level, individual differences in technology use and attitudes. The aim of this paper is to analyse the influence of personal characteristics on purchase intentions via mobile applications. In addition, we analysed the role of the same characteristics in the intention to recommend purchases via mobile applications. We also investigated the role of the time spent online on purchase and download behaviour.

Methodology: The research was conducted using primary data based on a purposive sample of respondents aged between 18 and 48 collected from May to September 2023. Based on the nature of the dependent variable, binary logistic regression is used.

Results: The results confirmed the importance of age and time spent online for the intention to download, while the level of education plays an important role for the intention to recommend mobile shopping apps.

Conclusion: App developers and companies should consider personal characteristics of users when developing mobile applications and focus on creating features that encourage recommendations for those who are not inclined to use mobile apps in the context of shopping. Understanding the role of personal characteristics in mobile app usage, recommendation and download can help businesses and app developers adapt their mobile app marketing strategies, design user-friendly interfaces and create personalised shopping experiences to increase customer satisfaction and sales.

Keywords: Mobile apps download, personal characteristics, recommendation intention

1. Introduction

Almobaireek and Alshumaimeri (2015) stated that mobile marketing is rapidly evolving and is the fastest growing marketing tool of the last decade. Mobile marketing has gained popularity due to its interactivity and availability. Lin and Chen (2019) found that mobile marketing has become an effective additional channel for companies' promotion and advertising to increase consumers' purchase intentions. Mo-

bile marketing tools have a direct impact on users' purchasing behaviour and decision-making process (Patsiotis et al., 2020) and companies recognise their great potential to influence consumer purchase intentions (Alameer et al., 2022). Therefore, the development of mobile technology has significantly changed consumer buying behaviour as mobile devices are available anytime and anywhere.

Mobile devices have influenced consumer behaviour and their mindset. Mobile devices are used in various daily activities and tasks of consumers and have been recognised as a new, additional communication channel. Mobile marketing represents a great growth opportunity for businesses, especially as an additional communication channel. Strauss (2016) found that companies perceive mobile devices as a highly effective source of communication with the market. It can therefore be seen as a tool for targeting, interacting and building relationships with consumers (Shabhu et al., 2016). Nowadays, more and more people own a mobile device and usually use it to find information about their brands or to make a purchase.

The information technology revolution has radically changed the way companies communicate with their customers. The rapidly growing number of internet users and the global availability of mobile applications are encouraging users to spend more time on their phones (Garg & Telang, 2013). Gitnux (2024) pointed out that 46% of smartphone users say they could not live without their devices and that mobile apps account for 57% of all digital media. The global proliferation of mobile applications has opened up some new opportunities for businesses to reach a new generation of users (Kim et al., 2013). Mobile apps can be seen as a convenient tool and are perceived as valuable by consumers, which can lead to higher purchase intention and ultimately future repeat purchases (Wang et al., 2015). In addition, Alam et al. (2015) found that consumers view mobile phones as personal devices that can be used conveniently because they are always close to them. With the increasing penetration of mobile phones and mobile internet, consumers are increasingly using their mobile devices for shopping (Rejali et al., 2024). Mobile apps provide consumers with instant access to their brands' stores. Worku (2020) reports that the number of global mobile phone users is expected to reach 4.68 billion by 2025. The evolution of innovation and accessibility associated with mobile apps has changed the way consumers experience and use mobile apps, particularly in their

purchasing behaviour (Narang & Shankar 2016). The key advantage of mobile apps over traditional retail channels is the ability to collect and analyse data in real time (Wilson & Green, 2023) and to provide a unified experience that users seek such as consistent shopping experience across all channels (Miller & White, 2023). Mobile apps could increase consumer reach by customising content, providing a wealth of information, ensuring 24/7 availability and reducing costs (Amaro & Duarte, 2015).

Today, companies need to regularly update their apps with new features to stay competitive (Khan et al., 2024). According to Gitnux (2020), the global mobile advertising market is projected to reach $408.58 billion by 2026 and in-app advertising revenue is expected to reach $226 billion by 2025. Consequently, mobile apps offer features that allow users to engage with brands, explore new offers, obtain new information, make purchases and connect with the brand, which can reduce user stress and allow them to get the information they want faster (McLean et al., 2022). Alnawas and Aburub (2016) note that previous researchers attempted to predict or assess the intention to use a mobile application. Previous studies did not focus on determining the impact of mobile applications on consumer purchase behaviour. Therefore, there is a lack of studies that have analysed the influence of antecedents on usage and purchase intention or purchase recommendations via mobile applications. The aim of this paper is to analyse the influence of personal characteristics on purchase intentions via mobile applications and the role of the same characteristics in the intention to recommend purchases via mobile applications. In addition, we investigated the role of the time spent online on purchase and download behaviour.

The paper is organised as follows. The first section is the introduction. The second section provides a theoretical background on mobile apps in consumer purchasing behaviour. The third section describes the methodology, and the section after presents the research findings. Finally, the fifth section summarises the findings and provides implications for business management and directions for future research.

2. Literature review

It is important for any business to understand consumer buying behaviour, and with the increasing use of mobile apps, companies are realising their potential as an effective marketing or communica-

tion tool (Seitz & Aldebasi, 2016). The globalisation of markets and advances in technology have led to an unprecedented rise in digital innovation and competitiveness (Ziakis & Vlachopoulou, 2023). Mobile phones have become essential tools for communication and information consumption, ultimately changing the way businesses interact with their customers (Eze et al., 2021; Tong et al., 2020). Therefore, companies are investing in mobile apps to provide their customers with a unique shopping experience that is also convenient and engaging (Kim & Park, 2023). According to Tong et al. (2020), the ubiquity of mobile devices allows companies to interact more effectively and immediately with users and obtain information that can lead to the design of their marketing strategies and campaigns as a 'next-generation website'. As companies continue to invest in mobile marketing and technology, the role of mobile apps in relation to purchasing will only increase (Emon & Chowdhury, 2024).

Mobile apps need to be understandable, relevant to the product, appropriate and realistic (Zhang et al., 2010). Companies should develop mobile apps to communicate with their customers (Kim et al., 2015). Such communication is useful for the companies because it provides various information about the needs and expectations of their existing customers. Based on this, companies can customise their products, resulting in higher usage intent or purchase intent. Timotius and Octavius (2021) found that some consumers prefer using mobile applications as a shopping platform compared to websites. Similarly, consumers tend to show a stronger purchase intention when interacting with branded applications (Seitz & Aldebasi, 2016). In other words, they are more likely to make a purchase if they have branded apps on their mobile phones (Bellman & Potter, 2011). Therefore, companies are trying to encourage purchase through mobile applications by providing users with quality service and convenient features in the applications (Tiwari & Buse, 2007; Thakur, 2018).

According to Pavlou (2003), online purchase intention can be characterised as a situation in which a consumer is ready to make a purchase, which occurs in three stages: information gathering, information transfer and product purchase. Purchase intention is important for predicting consumer behaviour because the higher the purchase intention, the more likely it is that the consumer will be more inclined to make an actual purchase. Murillo-

Zegarra (2020) explains that purchase intention can be seen as the perceived value and subsequent purchase behaviour of consumers. The consumer's purchase intention can be seen as the aspiration to buy a product or service. The study by Hsu and Lin (2016) also shows that consumers who have a positive attitude towards apps increase both their usage and purchase intentions.

Some studies show that consumers have a positive attitude and intention to use mobile apps because: (i) consumers will not use a mobile app if they are highly interrupted, and (ii) mobile apps need to provide highly targeted experiences that are close to purchase (Bianchi, 2021). The study found that perceived usefulness and perceived ease of use are positively related to behavioural intention to use apps (Gurtner et al., 2014; Zhang & Zhou, 2023; Foroughi et al., 2023; Chanda, 2023). The results reveal that perceived safety, perceived usefulness, perceived compatibility and subjective norms have a significant influence on the intention to use (Ramos de Luna et al., 2023). However, there are not many studies that have investigated the influence of antecedents on mobile app downloads and intention to use. User ratings and recommendations of mobile apps also play an important role in app downloads and usage intention. Studies show that the perceived credibility of the information source as well as the shared relationships between the information source and the recipient of the information have a major influence on the intention to use mobile applications (Dramani, 2019). In addition, the evaluation of mobile application reviews is part of the decision-making process. It is important for companies to know the purchase intention of their customers in order to make mobile apps more convenient for them.

The low retention rate of mobile app users is a cause of concern for many companies, likely due to the diversity of mobile apps available. Users are increasingly switching from one app to another and abandoning the app after just one use. Companies need to invest in positive word-of-mouth (WOM), which helps to increase low retention rates (San-Martin et al., 2015; Calvo-Porral et al., 2017). Mobile app user retention rates are very low and organisations can benefit from positive word-of-mouth to attract more users. Therefore, it is important for organisations to influence user dwell time in mobile apps to increase retention rates. There are limited studies that have analysed the impact of dwell time in mobile apps. Consequently, it would be necessary to investigate its influence on usage intention, pur-

chase intention and giving a recommendation or rating for mobile app purchase.

Technological innovations and the growing trend towards recommendations for online purchases are making them increasingly important for the decision-making process. For example, purchase recommendations can influence consumer purchasing behaviour. Personalised recommendations and offers are perceived as credible and valuable information that can influence the consumer's evaluation and decision-making process (Zhang et al., 2012, Mahapatra, 2017). Reviews in the digital environment refer to consumer-generated content or product reviews published by previous consumers (Chen, 2016). Reviews created in the digital environment regularly contain personal experiences and evaluations of the products, which provide valuable information and recommendations for potential consumers (Park & Kim, 2008). Therefore, potential consumers consider the content of reviews in the digital environment as a high-quality source of information that helps them make decisions. As a result, mobile app users are likely to perceive reviews and recommendations as more reliable and helpful than marketer-generated content. Some previous studies have suggested that high-quality reviews can influence user attitudes and purchase intentions to increase company sales (Park & Kim, 2008; Duan et al., 2008; Waheed, 2021; Teixeira & Nunes, 2024; Macheka et al., 2024). Consequently, high quality reviews can have a positive influence on consumer usage and purchase intention for mobile applications.

The study shows that there are differences between men and women in terms of technology-related behaviour (Faqih & Jaradat, 2015) and that there are gender differences in the use of mobile devices (Zhitomirsky-Geffet & Blau, 2016; Dai et al., 2019; Correia et al., 2024). Therefore, gender can play an important role in the adoption of technological innovations (Faqih, 2016). In general, studies show that mobile app characteristics can influence mobile app usage among all genders, such as the aesthetic view of the mobile environment (Anbumathi et al., 2023), the classic aesthetics of the mobile environment (Oyibo et al., 2019), and confidence in using mobile apps (Chawla & Joshi, 2020; Mumu et al., 2022). Noei and Lyons (2022) investigated the difference between men and women in giving ratings. They show that women rate apps more positively than men, but leave fewer reviews. However,

the results show that women's reviews receive a higher rating than men.

Numerous studies have been conducted over the years that have also considered the variable of age in relation to usage and purchase intention. Shahina and Sachitra (2021) found that mobile marketing provides users, especially the younger generation, with constant access to information and communication anywhere, anytime. However, the study by Girija (2016) examined the impact of mobile usage on young people's way of life and found that youngest users know little about mobile marketing activities. However, most users of a similar age are likely to have similar consumption patterns, attitudes and purchase intentions (Bilgihan, 2016). Therefore, users of the same generation tend to exhibit similar behavioural patterns when using their mobile apps.

Younger people are more inclined to adopt new technologies into their daily lives (Lissitsa & Kol, 2016) as they find them easy to use (Agárdi & Alt, 2022). Younger people are more likely to use new technological tools to obtain important and valuable information and recommendations (Agárdi & Alt, 2022). Older users, on the other hand, have a negative attitude towards technological innovations because they find them difficult to understand and complicated to use (Blut & Wang, 2020). The study by Natarajan et al. (2018) found a correlation between the type of mobile device and the age of users regarding their intention to use mobile shopping applications. Despite the numerous age-appropriate functions integrated into mobile apps, approval of mobile apps is still low (Wildenbos et al., 2018). However, Chua et al. (2023) point out that adding senior-friendly usability features can increase the intention to use mobile apps for older users, as older people are less capable due to their lower cognitive learning ability. It can be concluded that younger users recognise the benefits of new technologies and are more open to adopting innovative technologies compared to older people.

Gong et al. (2020) found significant differences between education levels and trust in mobile app use, with users having higher education levels tending to show greater trust in mobile apps than users with lower income. However, some studies have shown that there are no significant differences between education levels and mobile app usage or user trust in mobile app advertising (Leong et al., 2020).

The study by Laukkanen (2007) argues that a high level of education, a high income, experience with

the use of internet banking and the frequency of use are some of the reasons that influence mobile banking acceptance. For example, the use of mobile banking is much more common among higher income users (Sulaiman et al., 2007; Alafeef et al., 2011; Olaleye et al., 2022). Dakduk et al. (2020) also found that expectations, performance expectations, social influence and perceived security significantly influence the usage intention of low-income users. Mobile app users tend to be younger and have above average income and education levels. Consequently, companies need to improve the ability to reach consumers by enabling personalisation of the content and context of the message in order to achieve a higher propensity to use, purchase and give a rating for purchase via mobile apps.

3. Data description and methodology

An online survey was conducted, yielding 230 questionnaires completed by mobile application users. The selection of respondents was based on a purposive sample of respondents between the ages of 18 and 48. In this study, all analysis was done based on primary data collected from May to September 2023. The questions were created based on previous literature, although little is known about the factors that influence consumer intention to use and purchase through mobile apps, or even about the recommendations to purchase via mobile apps. The questionnaire was divided into two sections. The first section included socio-demographic characteristics of the respondents such as gender, age, education level, income level and time spent on mobile apps. The second section contained the constructs of intention to use, intention to purchase and recommendation to purchase mobile apps.

The aim of this paper is to investigate the influence of gender, age, education level, income and time spent online on three variables (Table 1):

- the probability of downloading a mobile application
- the likelihood of purchasing via mobile applications
- the likelihood of recommending a purchase via a mobile application

Table 1 Variables in the model

download	Yes	64%
	No	36%
purchase	Yes	67%
	No	33%
recommendation	Yes	66%
	No	34%
gender	Females – ref. category	67%
	Males	33%
age	18-26 – ref. category	61.30%
	27-37	14.30%
	38-48	24.30%
education	High school diploma or less – ref. category	49%
	University degree or higher	51%
earnings	Less than 1000 euros – ref. category	58.7%
	More than 1000 euros	31.7%
	Do not want to say	9.6%
time spent on the internet	Less than 2 hours – ref. category	36%
	More than 2 hours	64%

Source: Authors' calculations

Variable *download* summarises the responses to the statement "I am willing to download mob apps", where 64% of respondents agreed with the statement. The dependent variable *purchase* results from the reactions to the following statement in the questionnaire: "I will very likely shop via mobile applications in the future." It can be seen that a very large proportion of the sample (67%) intends to use mobile applications for shopping in the future. The *recommendation* variable is the result of the statement "I would recommend shopping via mobile applications", where two thirds of respondents would recommend this shopping channel.

The table above shows that two thirds of respondents are women and a younger population aged 18 to 26, which is in line with expectations in terms of online purchases. In terms of education level, the sample is evenly divided between respondents with a high school diploma or less and those with a university degree or higher. Almost 60% of respondents receive a salary that is below the national average, i.e. less than a thousand euros, while 9.6% did not want to provide information on the amount of their monthly income. When asked about the amount of time they spend online, most respondents (64%) answered that they spend more than two hours a day on the internet. Generally, the model could be written as follows:

Download/Purchase/Recommendation = f (gender, age, education, earnings, time spent on the internet)

Since dependent variables take on two values, binary logistic regression was chosen as the appropriate method.

$$P(X{=}1 \mid X{=}0) = F(\beta_1 + \beta_i X_i),$$

where $P(X{=}1 \mid X{=}0)$ represents the probability that an event occurs. In this study, the first regression analyses the probability that a person is willing to download a mobile app. The second and the third regression analyse the probability of purchasing and the probability of recommending the purchase via a mobile app, respectively. All three regressions investigate how the mentioned variables depend on gender, age, education level, income and daily time spent on the internet. Based on the previous explanation, the following hypotheses are proposed:

H1: Personal characteristics in combination with time spent online influence the intention to download shopping mobile apps.

Mobile apps can be a powerful sales channel that offers unique opportunity to improve user loyalty. The first step to increase sales through this channel is to get consumers to download apps, and therefore it is important to identify the factors that influence mobile shopping app download intent. By focusing on these factors, organisations can better understand user motivation and develop strategies to encourage downloads of their mobile shopping apps (Natarajan et al., 2018; Blut & Wang, 2020; Noei & Lyons, 2022).

H2: Personal characteristics influence the intention to recommend a purchase via a mobile app.

Shopping via mobile apps is becoming increasingly popular due to their convenience and user-friendliness. When planning and developing apps, customising mobile apps to specific target groups can increase the company's reach through a higher recommendation rate. By understanding the aforementioned role of personal characteristics in users' recommendation intention, businesses can focus on increasing user satisfaction and loyalty, which ultimately leads to a higher recommendation rate for their mobile shopping app and higher sales (San-Martin et al., 2015; Calvo-Porral et al. 2017; Bilgihan 2016; Agárdi & Alt, 2022; Chua et al., 2023).

4. Results and discussion of the findings

Binary logistic regression results used to test the hypothesis are given in Table 1. Diagnostics of the binary logistic regressions support the validity of the models, with high sensitivity and specificity and a statistically insignificant Hosmer and Lemeshaw test.

Table 2 Binary logistic regression results

	Regression 1		Regression 2		Regression 3	
Dependent variable	download		purchase		recommendation	
	Coefficient	Odds Ratio	Coefficient	Odds Ratio	Coefficient	Odds Ratio
Gender – ref. cat. Females						
Males	.357 (0.341)	1.429	-0.545* (0.335)	0.580	-0.070 (0.329)	.932
Age – ref. cat. 18-26						
27-37	-0.371 (0.474)	.690	-0.744 (0.475)	0.475	-0.430 (0.472)	.650
38-48	-1.480*** (0.384)	.228	-1.508*** (0.394)	0.221	-1.031*** (0.383)	.357
Education – ref. cat. high school diploma or less						
Graduates	0.504 (0.319)	1.656	0.124 (0.317)	1.132	1.025*** (0.311)	2.786
Earnings – less than 1000 EUR						
More than 1000 EUR	0.160 (0.397)	1.173	.909** (0.398)	2.481	0.324 (0.384)	1.382
Do not tell	-0.226 (0.521)	.798	1.230** (0.606)	3.423	-0.380 (0.497)	.684
Time – ref. cat. less than 2 hours						
More than 2 hours	0.688** (0.335)	1.989	.646* (0.340)	1.908	0.417 (0.333)	1.517
Constant	-0.129 (0.567)	.879	1.126* (0.576)	3.083	0.183* (0.554)	1.201

Note: *,**, *** - significant at 10%, 5% and 1%, respectively

Source: Authors' calculations

Time spent on the internet will influence the probability of downloading apps and purchase intention. More time spent online increases exposure to various mobile apps through advertisements, social media, and online communities. This exposure leads to greater awareness and exploration of new apps. However, this probability decreases with age since the 38-48 group has a negative coefficient and a low odds ratio. This partially confirms hypothesis H1 and raises the question for companies as to how they can encourage certain age groups to download more. One way is to tailor features to consumer values and interests, creating a compelling reason for them to download and engage with their mobile shopping app.

In the second regression, gender turned out to be statistically significant, with a negative coefficient sign and an odds ratio lower than one. This indicates that men are less likely than women to make purchases via mobile apps, which aligns with expectations. Age is statistically significant for the group of people in the 38–48 age range. A negative coefficient and the odds ratio mean that the probability of future purchases via mobile apps, recommendation and the downloading probability decrease with age. Older consumers tend to be less inclined to make purchases via mobile apps due to their lower familiarity with digital environments.

In the third regression, education turned out to be statistically significant, implying that graduates are more likely to recommend purchases via mob apps; there is even a three times higher probability that individuals with higher education levels will recommend making purchases via mobile applica-

tions. These individuals generally exhibit greater digital literacy and tech-savviness. They are more comfortable navigating mobile apps, understanding their features, and trusting online payment systems, which can translate into greater trust in mobile apps and online transactions. Educated consumers are more likely to recognise secure websites and trusted payment methods, reducing apprehension about fraud and data breaches. Results therefore partially confirm H2, indicating that the level of education, as a personal characteristic, influences the intention to buy via mobile applications and the intention to recommend this purchasing method to others.

Downloads and especially recommendations of mobile apps can help companies to reach new customers via personal networks such as social media or word-of-mouth, leading to an increase in sales and brand awareness. When developing mobile apps, companies should ensure that they encourage customers to download and recommend them, and the question arises as to how this can be achieved. This requires companies to adopt a strategic approach that focuses on utility, convenience and engagement features. Some examples of these types of incentives include exclusive information, discounts, offers or rewards for first-time users who download the app and for those who recommend it to others. This also emphasises the role of developers, who bear the burden of creating a user-friendly interface that simplifies the purchase and referral process.

5. Conclusion

The influence of personal characteristics on purchasing behaviour via mobile apps is a multifaceted area of study that integrates the elements of consumer psychology, technology adoption, and marketing. Personal characteristics that impact mobile app purchases typically include demographic factors, psychographic factors, and individual differences in technology use and attitudes. The aim of the paper was to investigate several relationships. Firstly, we analysed the influence of personal characteristics on purchase intentions via mobile apps. Secondly, we analysed the role these same characteristics play in our behaviour in terms of recommending purchases via mobile apps. We also analysed whether time spent online has an impact on purchase, recommendation and download of mobile apps. The binary logistic regression results

confirmed the importance of gender, age and the level of education, as well as the importance of time spent online on our purchase and recommendation intentions. Spending more time online allows users to conduct thorough research on products, read reviews, compare prices, and watch product demonstrations, leading to informed purchasing decisions via mobile apps.

Although this study provides valuable implications for mobile apps usage, it has some limitations. The first limitation of the study is the sample size that may affect the generalisation of the findings. The second limitation refers to the number of variables included. Future research could include variables such as the continuity of mobile app usage, types of mob apps (free or paid apps), the reliability and security of mobile apps and the interface design of mobile applications.

This research opens up a broad field for further research. Although we found that women are more likely to shop via mobile apps, gender differences can influence the types of products purchased via mobile apps. For instance, it could be interesting to investigate in future research whether women are more likely to buy fashion and beauty products, while men are more likely to buy electronics and gadgets. Future research could also include more detailed analysis of the role of education and income in mobile apps usage and download.

The rise of mobile applications (apps) has significantly changed how users interact with companies and make purchasing decisions. Understanding the factors influencing purchase intentions via mobile app is crucial for companies to develop effective mobile apps. The struggle that companies face is the provision of generated information in mobile applications, which reduces the credibility and relevance of the data or content provided. App developers should develop applications that provide individualised and tailored content to their users in order to gain a clear advantage over other digital communication tools. In addition, mobile applications have to allow users to access the most current and up-to-date information, which can increase user satisfaction. The growing satisfaction of mobile application users will also positively influence their likelihood to recommend the app to others.

In the context of research findings, app developers and companies should consider personal characteristics of users when developing mobile applica-

tions and focus on creating features that encourage recommendation to those who are not inclined to use mobile apps in the context of shopping, such as men or older people. Understanding the role of researched personal characteristics in mobile apps usage, recommendation and download can help businesses and app developers to adapt their mobile app marketing strategies, design user-friendly interfaces and create personalised shopping experiences to increase customer satisfaction and sales.

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ENRICHING KNOWLEDGE FOR RAISING AWARENESS OF SUSTAINABLE TOURISM: A GEN Z PERSPECTIVE

Abstract

Purpose: This study aims to identify students' understanding and awareness of sustainable tourism depending on sustainability knowledge integration into the study program and examine its influence on students' awareness of sustainable tourism.

Methodology: The research was conducted using a survey method on a convenience sample of undergraduate students enrolled in Management of Sustainable Development (MSD) and Business Economics in Tourism and Hospitality (BETH) study programs at the Croatian Faculty of Tourism and Hospitality Management. Exploratory factor analysis (EFA) was implemented on the Stakeholder Understanding of Sustainable Tourism Development Index (SUSTDI) to investigate students' understanding of sustainable tourism. An independent samples t-test highlights the significance of differences in the understanding and awareness of sustainable tourism among students in different undergraduate study programs.

Results: The results reveal the three-factor structure of the SUSTDI as a highly reliable tool for determining the overall level of sustainable tourism understanding and knowledge by Generation Z as a stakeholder. It enables the identification of areas in which knowledge about sustainable tourism should be improved. Significant differences in students' understanding and awareness were identified among different study programs, with higher levels observed in the MSD study program, which incorporates various aspects of sustainability topics through courses.

Conclusion: The research results indicate a greater level of knowledge and understanding of students in a study program that integrated sustainability issues into the study program curricula and a significant positive impact of understanding on students' awareness of sustainable tourism.

Keywords: Knowledge, awareness, sustainable tourism, Stakeholder Understanding of Sustainable Tourism Development Index (SUSTDI), Generation Z

1. Introduction

Knowledge and awareness are fundamental to providing adequate support for sustainable tour-

ism initiatives. Insufficient knowledge among all stakeholders is a major barrier to implementing sustainability in tourism (Tang et al., 2022; Ahmed

& Dwyer, 2010). Since adopting the UN Sustainable Development Goals, higher education institutions worldwide have been systematically striving to integrate sustainability into their curricula. As future agents of change, students play a crucial role in fostering knowledge, awareness, and attitudes toward sustainability challenges. They have the potential to bridge the gap between communities and higher education institutions, thereby strengthening partnerships and accelerating the transition toward sustainability (Filho et al., 2024).

The foundation of any sustainability-related initiative lies in awareness and education, as knowledge is also essential for fostering students' long-term engagement. A fundamental understanding encompassing core concepts, demonstrating relevance, and providing a global perspective ensures students' openness to participation and responsibility in sustainability efforts (Uzorka et al., 2024). Programs, curriculum design, and teaching approaches should incorporate new learning methods, promote interdisciplinarity, and balance theory and practical knowledge, encouraging students to reflect critically on suitability issues and ensure that students have the necessary competencies to implement sustainable development effectively (Iddawala et al., 2024; Slocum et al., 2019).

The research gap is related to the tool for measuring students' or Generation Z's level of acquired knowledge and understanding of sustainable tourism development, areas in which their knowledge should be enriched, and influences of understanding sustainable tourism on awareness. The Stakeholder Understanding of Sustainable Tourism Development Index (SUSTDI) needs continuous validation "as a precursor to developing education and training programs to increase understanding and knowledge of sustainable tourism development" (Cárdenas et al., 2015, p. 254). Thus, SUSTDI is validated for measuring students' knowledge and understanding of sustainable tourism as Generation Z representatives. It is necessary to evaluate all stakeholders' existing knowledge levels to provide an adequate education focused on sustainable tourism, aiming at more active participation and a more active role in sustainable tourism development (Cárdenas et al., 2015). Furthermore, the authors call for integrating sustainable development goals into educational curricula (Zamora-Polo et al., 2019) and raising awareness of sustainable tourism offerings (Grapentin & Ayikoru, 2019). By gaining advanced insights into Generation Z's understanding and awareness of sustainable tourism, further educational needs are identified, strengthening

Generation Z's participation in sustainability-oriented actions.

The paper is organized into five main parts. After the introduction, there follows a conceptual research framework that includes an overview of the theoretical background on knowledge and awareness of sustainable tourism, along with a section on hypothesis development. The third part explains the methodology and it is followed by the research results and discussion. The paper concludes with remarks and recommendations for future research.

2. Conceptual framework

2.1 Knowledge as a prerequisite for sustainable tourism development

A high level of knowledge and understanding of sustainable policies and practices among a wide range of stakeholders ensures that the goals of sustainable tourism development are achieved. Stakeholders who achieve a higher level of knowledge about sustainability develop positive attitudes and are more likely to adopt behaviors that support sustainable practices (Tang et al., 2022). One of the major barriers to implementing policies and practices in the tourism industry is the lack of sufficient knowledge and key competencies necessary to engage in sustainable practices (Ahmed & Dwyer, 2010).

Generation Z is strongly represented in communities and the labor market and represents a stakeholder group for sustainable tourism, taking on different roles (tourists, professionals, decision-makers, etc.). They can easily access information, have extensive digital connections, and are often passionate about causes, including sustainability (Çalışkan, 2021). However, research on Generation Z and their involvement in sustainability initiatives in tourism has found that, while Generation Z is aware of the concept of sustainability and understands the principles and policies, they are not proactively involved in leading sustainability initiatives (Görpe & Öksüz, 2022). To ensure greater participation of Generation Z in sustainability-oriented initiatives, emphasis must be placed on formal and informal education to ensure the acquisition of key competencies.

Considering that the acquisition of knowledge and skills is crucial for sustainable tourism development, education is seen as an essential tool to ensure this knowledge and awareness of the concept among younger generations. Educational institutions have the opportunity to integrate topics related to sustainable development into their programs, subjects, and other student activities. It should

have a positive impact on students' understanding of sustainable tourism. Studies have shown that study programs that expose students to sustainability concepts and practices develop a deeper understanding of the environmental, economic and social impacts of tourism, resulting in more responsible business and personal decisions for the future (Deale, 2019; Fernández-Villarán et al., 2024).

Developing students' action competence though the implementation of education for sustainable development in formal education requires time. Embedding sustainability into educational programs and curricula to improve students' understanding of the challenges and benefits of sustainability, specifically in the tourism industry, will significantly promote the paradigm when they are faced with decision-making in their careers. Whether they are industry professionals, students or other community members, learning about sustainable tourism development during their education will broaden their knowledge and prepare them to apply it in practice (Kubíková & Rudý, 2024). Educational institutions are expected to produce graduates with a comprehensive understanding of sustainability and equipped with tools and awareness necessary for sustainable tourism development (Görpe & Öksüz, 2022). This view is in line with the Education for Sustainable Development movement, which advocates that the education of the next generation is the basis for future sustainable action (Krstinić Nižić & Butković, 2023).

Educational institutions emphasize that the education for sustainable development is the basis for mobilizing Generation Z and other young people toward sustainable action. The research emphasized that integrating sustainability into management curricula positively impacts students' understanding of sustainability issues (Gough & Scott, 2003). Suppose these students and young people graduate with broader knowledge and individual values related to sustainable tourism, they are likely to become stakeholders in the future who demand, support and actively participate in more sustainable tourism development.

Therefore, the following hypothesis is proposed:

H1: There is a significant difference in the students' understanding of sustainable tourism development depending on the inclusion of sustainability topics in the study program.

2.2 Awareness of sustainable tourism

In recent years, many scientific studies have focused on researching awareness of sustainable tourism.

Awareness can be defined as "the ability to perceive, feel, or understand events, objects, or sensory patterns" (Gafoor, 2012). The author also emphasizes that all individuals who possess knowledge must also have awareness, but awareness does not necessarily imply the presence of knowledge. Dourish and Bellotti (1992) define awareness as "an understanding of the activities of others, which provides a context for one's activity." The core of awareness should be collaboration, which entails coordination, assistance, and communication (Gutwin & Greenberg, 1999).

Awareness of the local population regarding sustainable tourism development means that all community members and specific groups within the community "know, understand, utilize, and develop attitudes and approaches following the fundamental principles of sustainable development" (Fokıalı et al., 2006). Furthermore, authorities, institutions, and all local community members must be adequately aware of sustainable tourism development to have a positive impact on a given area. These authors also highlight that community awareness has been identified as essential for the successful implementation of sustainable development policies. Moreover, Sekhokoane et al. (2017) highlight that sustainable tourism development is facilitated when there is a high level of ecological awareness.

Gordon (2007) highlights the impact of early environmental conservation efforts on shaping perceptions, attitudes, and practices, thereby fostering the development of informed students who contribute to the future growth of the field. Furthermore, *Jepchirchir Rop & Kwoba Olubulyera* (2015) emphasize the importance of early tourism education in shaping future professionals. They argue that tourism education should not be introduced only at the university level but should begin as early as high school to enhance public awareness of tourism's impacts. Universities are undeniably key stakeholders in achieving sustainable development goals as they integrate these goals into the educational process (SDSN, 2021). Findings from a study conducted on undergraduate and graduate students by Goh et al. (2017) indicate that sustainability content should be a mandatory part of the curriculum in all hospitality-related educational institutions. The authors also highlight the benefits of integrating sustainability into academic study programs, including strengthening ties between educational institutions and industry partners and aligning curricula with labor market needs. Kasim & Wickens (2020) explore young people's awareness, intentions, and opinions regarding environmentally friendly travel and em-

phasize the potential of young travelers in creating demand for sustainable tourism options. In their study, Wang et al. (2023) state that students, based on their education, can significantly contribute to the promotion of environmental sustainability. Additionally, research conducted on university students by Cachero et al. (2023) examined variations in perceptions and understanding of sustainable development goals. However, students specializing in social and legal sciences demonstrate a higher level of knowledge on the topic, which the authors attribute to specialized curricula and programs integrating sustainable development.

Based on the findings and to gain a deeper understanding of the topic, the second hypothesis is proposed:

H2: There is a significant difference in student's awareness of sustainable tourism depending on the inclusion of sustainability topics in the study program.

Building awareness in the community and achieving general consent on the principles and strategies of sustainable development are crucial for long-term commitment to this cause. Recent studies show that greater awareness leads to a stronger commitment to sustainability. When locals recognize the environmental and socio-cultural benefits beyond the purely economic benefits of green tourism, their commitment to sustainable practices increases significantly (Thang & Thanh, 2023). Building knowledge about sustainable tourism development and involving local people in decision-making processes that lead to tangible results and benefits for all stakeholders contribute to long-term active engagement in sustainable tourism initiatives. Educating tourism professionals, travelers, and locals about the principles of sustainable tourism can lead to more conscious choices and behaviors consistent with the goal of sustainability.

In their study, Zamora-Polo et al. (2019) highlight a general lack of awareness and limited knowledge of sustainable development goals among students from various disciplines, calling for integrating these goals into educational curricula. A similar study by Smaniotto et al. (2020) on students at Italian universities found that most students demonstrate limited knowledge and understanding of sustainable development goals. However, the authors note that students who attended specialized extracurricular courses related to sustainable development exhibited greater knowledge. As future agents of change, university students should have a higher level of awareness and understanding about sustainable development to contribute to its imple-

mentation actively. Research findings indicate that 62.5% of students possess knowledge of sustainable development goals, while 89.5% are aware of their existence (Jati et al., 2019).

Based on the previously mentioned studies and to enhance the understanding of the topic, the third hypothesis of the study is proposed:

H3: Student's knowledge and understanding of sustainable tourism development positively and significantly influence their awareness of sustainable tourism.

3. Methodology

The research used a quantitative approach, following the set hypotheses and the defined research goal. The survey method was applied based on the structured questionnaire, which consisted of two groups of questions. The first part included three close-ended questions about a student's gender, study year, and program. The second part of the questionnaire included two questions. One question was related to sustainable tourism development and included 31 items, taken from previous research by Cárdenas et al. (2015), using the Stakeholder SUSTDI tool presented in Appendix Table A.1. The SUSTDI includes six dimensions: resource preservation (8 items), environmental education (6 items), stakeholder inclusion (6 items), economic planning (6 items), cultural awareness (2 items), and community resource identification (3 items). The next question included four items related to awareness of sustainable tourism, taken from Thang and Thanh (2023) and listed in Appendix Table A.2. Using a five-point Likert scale (from 1 – strongly disagree to 5 – strongly agree), respondents were asked to indicate to which extent they agree or disagree with each statement. The questionnaire was translated into Croatian for empirical research and re-translated into English for analysis.

Approval from the Ethics Committee at the Faculty of Tourism and Hospitality Management was requested to conduct the research with students. The Ethics Committee provided a written positive opinion on the ethical aspects of the proposed scientific research on sustainable development. Furthermore, each course instructor whose students were included in the study was informed about the goals, purpose, and research concept. Written consent was obtained from each course instructor to conduct the research with students in their courses. Prior to their participation in the study, students were informed about the goals and purpose of the

research and subsequently provided their consent to participate. The questionnaire was prepared in Google Forms for the online survey and made accessible to students in the hall via a QR code. The survey was conducted from February 3 to 7, 2025, based on a convenience sample of students at the Faculty of Tourism and Hospitality Management in Opatija, Croatia. A total of 313 questionnaires were collected from the first to fourth-year students of undergraduate studies and included in the analysis. The sample size can be considered adequate since the observations per variable are above the recommended minimum of at least five observations per variable (Hair et al., 2014).

Data analysis was carried out using the SPSS statistical software, version 23. Furthermore, a combination of statistical methods was implemented in

the data analysis. Exploratory factor analysis (EFA) and Principal Component Analysis (PCA) were used to extract factors and identify the number of components and factors. Descriptive statistics were implemented to calculate frequency, percentage, mean, and standard deviation. For inferential statistics, an independent samples t-test was used to compare differences among student groups, and simple and multiple linear regression analyses were implemented to identify the impact of the factors on students' awareness of sustainable tourism.

4. Research results and discussion

4.1 Sample characteristics

The characteristics of the respondents are presented in Table 1.

Table 1 Characteristics of the sample structure (N=313)

	Gender	Frequency (N)	Relative share (%)
1	**Female**	**237**	**75.7**
2	Male	76	24.3
	Year of Study		
1	First	90	28.8
2	Second	77	24.6
3	Third	78	24.9
4	Fourth	68	21.7
	Undergraduate Study Program		
1	Business Economics in Tourism and Hospitality (BETH)	237	75.7
2	Management of Sustainable Development (MSD)	76	24.3

Source: Authors' calculations

Most respondents in the study are females (75.7%). An equal number of students by year of study participated in the research (ranging between 21.7% and 28.8%). Most respondents are undergraduate university students at BETH (75.7%), and one-quarter of the respondents are MSD students (24.3%).

4.2 EFA and reliability analysis

The original scale of the Stakeholder SUSTDI has a six-factor solution, and it was used to investigate students' understanding of sustainable tourism development. Exploratory factor analysis (EFA) was conducted, followed by Principal Component Analysis (PCA). The Kaiser-Meyer-Olkin (KMO) test of sampling adequacy and Bartlett's sphericity test were used to identify the suitability of the data for conducting EFA analysis. Based on the calculated KMO coefficient and Bartlett's test of sphericity, the

data were found to be highly suitable for conducting EFA analysis: a) KMO=0.966; KMO>0.7, and b) Bartlett's test of sphericity ($\chi2=8684.292$, $p<0.001$), according to Hair et al. (2014).

Upon confirming suitability for EFA, Principal Component Analysis (PCA) with Varimax rotation (7 iterations) was implemented to determine whether a six-factor solution and loading values for students or Gen Z matched those of the original SUSTDI scale used in the research. Following Hair et al. (2014), factors are acceptable, providing an eigenvalue greater than 1, total variance explained above 60%, and factor loading was above 0.5. Two items, one in Factor 2 (EE3 with factor loadings 0.498) and one in Factor 3 (EP6 with factor loading 0.475), had factor loading a little below 0.5. Stevens (2002, cited in Cheung et al., 2024) suggested that the value of a factor loading should be greater than 0.4 for interpretation purpos-

es. Thus, the authors retained these items to avoid losing useful information about Gen Z's understanding of sustainable tourism development.

The EFA results produced a three-factor structure with eigenvalues above 1 for the SUSTDI as a tool for understanding sustainable tourism development applied to students or Gen Z (Table 2), compared to the six-factor structure in the original SUSTDI scale (Appendix Table A.1).

Table 2 EFA analysis results for students' understanding of sustainable tourism development

Dimension/Items	Factor loading	Total variance explained (%)
Students' understanding of sustainable tourism development		
Factor 1 – Resource preservation		**58.378**
RP7	.806	
RP2	.804	
RP1	.789	
RP6	.778	
RP8	.712	
RP3	.674	
RP5	.626	
EE6	.585	
EE5	.555	
Factor 2 – Environmental education, participation and resource identification		**5.101**
SI5	.792	
SI4	.735	
SI1	.708	
SI6	.687	
SI2	.669	
EE4	.618	
SI3	.595	
CRI2	.592	
CRI1	.563	
CRI3	.554	
EE1	.543	
EE2	.519	
EE3	.498	
Factor 3 – Economic planning and cultural awareness		**3.288**
EP2	.825	
EP3	.670	
EP1	.656	
EP5	.591	
EP4	.568	
CA1	.563	
CA2	.557	
EP6	.475	
Cumulative total variance explained (%)		66.766

Source: Authors' calculations

EFA analysis indicates a different factor structure of the SUSTDI for Gen Z, identifying three factors: Factor 1 - *Resource preservation,* Factor 2 - *Environmental education, participation and resource identification*, and Factor 3 – *Economic planning and cultural awareness.* From this factor structure, item RP4 - Tourism development should be discouraged when it harms the environment, was excluded as an insignificant variable, with a factor loading below 0.4. The total variance explained by these three factors accounted for 66.766 %.

Furthermore, reliability analysis was performed for the identified factors, and Cronbach's alpha coefficients were calculated (Table 3).

Table 3 Dimension reliability

No.	Dimensions and attributes	Cronbach's alpha (α)
1.	Understanding of sustainable tourism development	0.910
1.1	Resource preservation	0.946
1.2	Environmental education, participation and resource identification	0.956
1.3	Economic planning and cultural awareness	0.914
2.	Awareness of sustainable tourism	0.813

Source: Authors' calculations

As recommended by Hair et al. (2014), the validity of the instruments and the internal consistency of the scale for each variable were confirmed by Cronbach's alpha coefficient (>0.70). The calculated Cronbach's alpha coefficients for the composite variable *Understanding of sustainable tourism development* and its three factors, as well as for *Awareness of sustainable tourism,* exceed the minimal Cronbach's alpha value stated above. Indeed, all values are above 0.9 and above 0.8 for *Understanding sustainable tourism* and *Awareness of sustainable tourism*, respectively. This indicates a high internal consistency of the determined SUSTDI instrument composed of a three-factor structure used to measure Gen Z's understanding of sustainable tourism development.

The three-factor structure of the SUSTDI tool captures Gen Z's specific understanding of sustainable development. Compared to the original SUSTDI framework, the updated version emphasizes a more comprehensive approach to sustainability and combines factors on broader topics: resource conservation, environmental education and participation, resource identification, and economic planning with cultural awareness. The findings support previous research showing that Gen Z views sustainability as an interconnected system that encompasses the environment, society and the economy, rather than an isolated issue (Görpe & Öksüz, 2022; Çalışkan, 2021). For Gen Z, environmental conservation, engagement within the community, and cultural and economic responsibility are closely linked to their perception of sustainability (Kubíková &

Rudý, 2024). This perspective fits well with current trends in student sustainability education, where students are increasingly drawn to interdisciplinary, systematic learning and focused on applying what they learn (Deale, 2019; Fernández-Villarán et al., 2024). These findings reinforce the value of the revised SUSTDI tool and highlight the need for educational programs to adopt a more integrated and interdisciplinary approach to sustainable tourism development.

The three-solution factor of the SUSTDI also identifies areas where knowledge should be enriched, enhancing students' awareness as members of Gen Z and as stakeholders who play a significant role in advancing sustainable development (Murray, 2018). An identified level of knowledge and education needs is evident for their active participation in tourism planning (Cárdenas et al., 2015).

4.3 Descriptive statistics and independent samples t-test

Different levels of sustainability knowledge acquired through study programs (BETH and MSD) enabled research on whether there are various levels of understanding of sustainable tourism development among students enrolled in these studies and how their knowledge and understanding affect their awareness of sustainable tourism development. The importance of such studies integrating various sustainability topics into their curricula stems from previous research, such as Arrobas et al. (2020), which indicated a need to create a specif-

ic "Tourism and Sustainable Development" course for tourism undergraduate students. In order to provide further education for students or Gen Z as stakeholders necessary for ensuring sustainable tourism development, there must be an assess-ment of awareness, knowledge, and understanding (Cárdenas et al., 2015).

A comparison of understanding sustainable tourism between the BETH and MSD study programs was made based on the calculated factor's mean values shown in Table 4.

Table 4 Mean values – student's understanding of sustainable tourism development by study program

No.	Dimensions / Items	BETH (N=237)		MSD (N=76)	
		Mean (M)	Std. Dev. (STD)	Mean (M)	Std. Dev. (STD)
	Factor 1 – Resource preservation				
	RP7	4.49	.795	4.71	.629
	RP2	4.41	.800	4.58	.698
	RP1	4.48	.842	4.74	.640
	RP6	4.51	.857	4.58	.771
1.	RP8	4.42	.858	4.59	.851
	RP3	4.29	.866	4.46	.807
	RP5	4.38	.892	4.55	.737
	EE6	4.34	.851	4.55	.755
	EE5	4.35	.864	4.61	.732
	Overall F1	4.41	.847	4.60	.736
	Factor 2 – Environmental education, participation and resource identification				
	SI5	4.32	.921	4.38	.909
	SI4	4.35	.897	4.46	.930
	SI1	4.32	.900	4.45	.755
	SI6	4.41	.847	4.50	.775
	SI2	4.35	.873	4.53	.683
	EE4	4.33	.893	4.58	.698
2.	SI3	4.32	.883	4.57	.772
	CRI2	4.30	.919	4.36	.890
	CRI1	4.31	.918	4.63	.629
	CRI3	4.43	.824	4.50	.792
	EE1	4.25	.880	4.38	.909
	EE2	4.18	.959	4.38	.879
	EE3	4.36	.945	4.34	.987
	Overall F2	4.33	.897	4.47	.816
	Factor 3 – Economic planning and cultural awareness				
	EP2	4.28	.848	4.39	.801
	EP3	4.11	.984	4.17	.870
	EP1	4.12	.885	4.12	.938
	EP5	4.35	.877	4.55	.681
3.	EP4	4.33	.860	4.53	.683
	CA1	4.30	.848	4.38	.832
	CA2	4.29	.851	4.51	.774
	EP6	4.34	.851	4.59	.657
	Overall F3	4.27	.876	4.41	.780
	Overall	**4.34**	**.873**	**4.49**	**.777**

Source: Authors' calculations

Analyzing the overall mean values of the factors, both study programs exhibit high mean values above 4.0 for all factors, indicating a high level of students' understanding of sustainable tourism. It also confirms previous findings of Borges (2019), who reported that university students possessed favorable knowledge and attitudes toward sustainable development.

BETH students demonstrate a strong understanding of sustainable tourism development. In this study program, knowledge should be improved primarily related to Factor 3 (M=4.27). MSD students demonstrate a strong understanding of Factor 3 (M=4.41) and show an excellent association with the other two factors. Thus, economic planning and cultural awareness (Factor 3) are the main segments in both study programs that need to enrich students' knowledge to better understand sustainable tourism development.

Furthermore, the mean values of all factors were higher in the MSD study program. Furthermore, the overall understanding of sustainable tourism development was greater among MSD students (M=4.34) compared to BETH students (M=4.49).

In addition, an independent samples t-test was conducted to determine whether there is a significant difference in students' understanding of sustainable tourism development between these two study programs. The results are presented in Table 5.

Table 5 Independent samples t-test (overall students' understanding of sustainable tourism by study program)

	Study program	N	Mean	Std. Dev.	Std. Error Mean
1.	BETH	237	130.01	20.643	1.341
2.	MSD	76	134.67	16.317	1.872

	Levene's test		t-test for equality of means		
	F	Sig.	t	df	Sig. (2-tailed)
Equal variances assumed	5.369	.021	1.797	311	.073
Equal variances not assumed			2.025	158.476	.045

Note: p<0.05

Source: Authors' calculations

Independent samples t-test factors are formed as the sums of corresponding items. The calculated significance value from Levene's test (p<0.05) indicates significant differences (p=0.045) in students' understanding of sustainable tourism development between MSD and BETH study programs. Based on these results, the first hypothesis H1 is confirmed. These findings correspond to Goh et al. (2017), indicating that sustainability content should be a mandatory part of the curriculum in all hospitality-related educational institutions. Gough & Scott (2003) examined whether integrating sustainability tourism modules into management curricula positively impacts students' understanding of sustainability issues. According to Shafieieh et al. (2024), understanding and knowledge are prerequisites for developing students' critical thinking skills related to sustainable tourism development. On the other hand, Cole (2006) identified that a lack of knowledge can be a barrier to Gen Z's participation in decision-making related to sustainable tourism development.

Following the identified level of students' understanding and the observed differences among study programs, the research focus shifted to students' awareness of sustainable tourism. The calculated mean values for this factor are shown in Table 6.

Table 6 Mean values – students' awareness of sustainable tourism by study program

Dimensions / Items	BETH (N=237)		MSD (N=76)	
	Mean (M)	Std. Dev. (STD)	Mean (M)	Std. Dev. (STD)
A1	**4.23**	**.929**	4.53	.791
A2	4.24	.873	4.50	.739
A3	3.75	1.050	3.96	1.160
A4	3.73	1.125	3.91	1.022
Overall	3.99	.994	4.23	.928

Source: Authors' calculations

In general, students demonstrate a high level of awareness regarding sustainable tourism. Still, MSD students (M=4.23) demonstrated greater awareness of sustainable tourism development than BETH students (M=3.99). These findings align with Görpe and Őksüz (2022), who identified students' sustainability awareness in Turkey and the United Arab Emirates. Thus, as emphasized by Krstinić Nižić and Butković (2023, p. 243), "Generation Z, as the new workforce of today, is ready to imple-

ment the principles of sustainable development in tourism and understands the meaning and importance of sustainable development in the early stages of their career."

Additionally, an independent samples t-test was conducted to determine whether significant differences exist in awareness of sustainable tourism development between students in the two study programs (Table 7).

Table 7 Independent samples t-test (overall students' awareness of sustainable tourism by study program)

	Study program	N	Mean	Std. Dev.	Std. Error Mean
1.	BETH	237	15.95	3.237	.210
2.	MSD	76	16.89	2.855	.327

	Levene's test		t-test for equality of means		
	F	Sig.	t	df	Sig. (2-tailed)
Equal variances assumed	.294	.588	2.267	311	.024
Equal variances not assumed			2.419	141.924	.017

Note: p<0.05

Source: Authors' calculations

Factors are formed as the sums of corresponding items when conducting the independent samples t-test. Levene's test significance value (p<0.05) indicates the existence of significant differences in awareness of sustainable tourism between students in the two study programs, with MSD students (M=4.23) demonstrating greater awareness. These findings confirm hypothesis H2. This aligns with Shafieieh et al.'s (2024) findings, which emphasizes

that knowledge provides the understanding, awareness, and insights necessary for making informed choices. Additionally, a high level of knowledge contributes to a positive attitude toward sustainable behavior and strengthens stakeholders' motivation to engage in sustainable practice (Tang et al., 2022). Brody and Ryu (2006) suggested that graduate-level education can significantly enhance the extent to which students behave sustainably.

4.4 Regression analysis

Regression analysis was carried out to assess the impact of understanding sustainable tourism development on awareness of sustainable tourism. Both simple and multiple linear regression analyses were employed for that purpose. The results are shown in Table 8.

Table 8 Simple and multiple linear regression analyses (overall students' awareness and understanding of sustainable tourism development)

Students' awareness of sustainable tourism	B	SE	BETA	t	Sig.
Constant	2.198	.901		2.438	.015
Understanding of sustainable tourism development	.107	.007	.665	15.689	.000
R²	.442				
Adjusted R²	.440				
Standard error	2.372				
F-ratio	246.150				
Significance	.000				
Students' awareness of sustainable tourism	B	SE	BETA	t	Sig.
Constant	2.232	.919		2.429	.016
Resource preservation	.030	.043	.059	.709	.479
Environmental education, participation and resource identification	.111	.035	.323	3.134	.002
Economic planning and cultural awareness	.188	.048	.321	3.916	.000
R²	.451				
Adjusted R²	.446				
Standard error	2.359				
F-ratio	84.715				
Significance	.000				

Source: Authors' calculations

Factors are formed as the sums of corresponding items. In a simple regression analysis, understanding of sustainable tourism development was taken as an independent variable, while students' awareness of sustainable tourism was a dependent variable. Regression analysis indicates a statistically significant (p=0.000, p<0.05), positive and strong influence (β=0.665) of understanding sustainable tourism development on its awareness. Furthermore, understanding sustainable tourism development is an important predictor variable of sustainable tourism awareness (Adjusted R²=0.440) and explains 44% of the variance in students' awareness of sustainable tourism.

Furthermore, multiple regression analysis was implemented to identify understanding of sustainable tourism factors and their significance in influencing students' awareness of sustainable tourism. Three factors of understanding sustainable tourism development were taken as independent variables, and awareness of sustainable tourism represented a dependent variable for multiple linear regression calculations. Among the observed factors of understanding sustainable tourism development, *Resource preservation* has an insignificant influence (p=0.479) on students' awareness of sustainable tourism. The remaining two factors have a significant (p=0.002 and p=0.000, p<0.05) and approximately equal (β=0.323, β=0.321) positive influence on students' awareness of sustainable tourism. These significantly influencing factors enable more targeted actions to increase student awareness of sustainable tourism. Following these results, hypothesis H3 is confirmed. These results are

supported by previous findings of Hay and Eagle (2019), which point out that the inclusion of specific sustainability-related content has successfully raised awareness and achieved behavior change. Gafoor (2012) emphasizes that all individuals who possess any form of knowledge must also have awareness. Additionally, the availability of education and training also significantly influences positive perceptions of tourism (Lawelai et al., 2024).

5. Concluding remarks

To develop students' awareness and encourage their future involvement in implementing sustainable tourism solutions, all forms of education must play a key role. The study showed that students' understanding of sustainability differs significantly depending on whether sustainability issues are integrated into the curricula of their study programs. Students who had the opportunity to learn about sustainability as part of their curricula showed a higher level of awareness and competencies related to sustainability, especially sustainable tourism. This result underlines the importance of curriculum design in tourism education for future professionals.

The results show that sustainability values should be integrated as a core theme across all university study programs, rather than treated as isolated topics, to ensure an informed and active generation committed to sustainable tourism development. This study identified specific areas where Gen Z students' knowledge needs to be expanded, particularly in terms of economic planning and cultural awareness, which provided a more focused direction of education. More comprehensive knowledge among students and a better understanding of sustainable tourism development will contribute to their greater interest in this concept and its implementation in decision-making processes related to tourism development. Higher education institutions should emphasize interdisciplinary curriculum design that comprehensively addresses the environmental, social and economic aspects of sustainability. This study offers both theoretical and empirical contributions. The theoretical con-

tribution of this study fills a gap in the literature by examining Gen Z's knowledge and understanding of sustainable tourism development. It proposes a revised and highly reliable three-factor SUSTDI tool that captures Generation Z's perception of sustainable tourism development as a more integrated and holistic concept. The empirical contribution of the study lies in the proposed SUSTDI tool's ability to guide educational institutions in identifying particular areas of knowledge where study programs and curricula need strengthening. The findings offer practical insights for policymakers and destination planners, emphasizing the central role Generation Z could play in advancing sustainable tourism practices.

The study has some limitations that should be mentioned. The research was based on a single-institution convenience sample that limits the generalizability of the findings to a broad population. The sample may reflect institution-specific characteristics that are not representative of Generation Z globally. Thus, future research should extend to a broader range of university study programs to assess more comprehensively the inclusion of sustainability in study programs and students' understanding and awareness of sustainable tourism development. Additionally, the research was conducted in one academic year. Such evaluation must be carried out continuously to empower Generation Z through the knowledge required for more active participation in sustainability-oriented actions, where higher education institutions play a critical role. Longitudinal studies could provide valuable insights by tracking the acquisition of sustainability knowledge and awareness throughout different phases of students' career development.

Several directions for future research are proposed. Comparative studies could examine variations in sustainable tourism awareness across generational groups, such as Millennials and Generation Z. Furthermore, cross-institutional and cross-national comparisons could provide helpful insights into the roles of formal and non-formal learning channels in shaping students' understanding of sustainable development and applying more sustainability-focused decision-making in the future.

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Appendix

Table A.1 Stakeholder Understanding of Sustainable Tourism Development Index (SUSTDI)

Item number	Item
Factor 1 – Resource preservation	
RP1	Tourism development should include the protection of the natural environment.
RP2	Environmental impact studies should be conducted for both existing and proposed tourism development.
RP3	Tourism activities should be integrated with regional conservation programs.
RP4	Tourism development should be discouraged when it harms the environment.
RP5	Tourism should improve the environment for future generations.
RP6	Tourism should not be allowed to damage the cultural resources.
RP7	The natural environment must be protected for use by future generations.
RP8	The community should be actively involved in the conservation of the region's environment.
Factor 2 – Environmental education	
EE1	Opportunities are needed to learn more about the environment.
EE2	Environmental education programs lead to the improvement of natural resources.
EE3	Plants and animals have the same rights as humans to natural resources in the community.
EE4	Education of local residents about proper land use practices is important to successful tourism development.
EE5	Education of local business owners about proper land use practices is important to successful tourism development.
EE6	Education of visitors about proper land use practices is important to successful tourism development.
Factor 3 – Stakeholder inclusion	
SI1	Tourism leaders must monitor business satisfaction with tourism in order for tourism to be successful.
SI2	Tourism leaders must monitor citizen satisfaction with tourism in order for tourism to be successful.
SI3	Community involvement increases support for tourism.
SI4	Tourism leaders must monitor tourist satisfaction with tourism in order for tourism to be successful.
SI5	Visitor participation in tourism development is essential to successful tourism development.
SI6	Community participation in tourism development is essential to successful tourism development.
Factor 4 – Economic planning	
EP1	Tourism diversifies the local economy.
EP2	Tourism is good for a community's economy.
EP3	Economic development funds should be used to promote tourism.
EP4	A long-term goal is needed when planning tourism development.
EP5	I believe tourism development needs well-coordinated planning.
EP6	Education of local governmental officials about proper land use practices is important to successful tourism development.
Factor 5 – Cultural awareness	
CA1	Opportunities are needed to learn more about the local history.
CA2	Opportunities are needed to learn more about the local culture.

Item number	Item
	Factor 6 – Community resource identification
CRI1	The culture of the community is a tourist attraction.
CRI2	Restoration of historical sites would promote tourism.
CRI3	The natural environment is a tourism attraction.

Source: Cárdenas, D. A. et al. (2015)

Table A.2 Awareness of sustainable tourism

Item number	Item
A1	I am aware of the concept of sustainable tourism.
A2	I understand the benefits of sustainable tourism for the community.
A3	I know how to engage in sustainable tourism practices.
A4	I actively seek out eco-friendly tourism options.

Source: Thang, N. D. & Thanh, N. N. (2023)

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ANALYZING USER-GENERATED REVIEWS TO IDENTIFY EXPERIENCE DIMENSIONS AND THEIR IMPACT ON SATISFACTION WITH MOBILE BANKING APPLICATIONS

Abstract

Purpose: This study aims to identify key experience dimensions derived from user-generated reviews and examine their influence on satisfaction with mobile banking applications. By analyzing unsolicited user feedback, the study aims to provide a data-driven understanding of what drives satisfaction and dissatisfaction in m-banking services across Southeast Europe.

Methodology: A total of 56,074 reviews of mobile banking apps from Bosnia and Herzegovina, Croatia, and Serbia were analyzed. The study employed BERT-based sentiment analysis and BERTopic modeling to extract thematic experience dimensions from reviews categorized by sentiment polarity. Multiple linear regression was used to assess the predictive power of these dimensions and sentiment polarity on user-assigned satisfaction ratings.

Results: Eleven distinct experience dimensions were identified and confirmed as significant predictors of satisfaction. These dimensions, derived through topic modeling and sentiment analysis, were quantitatively modeled and qualitatively interpreted based on review content, offering rich contextual insights into user perceptions. The regression model explained 58% of the variance in rating behavior. Additionally, sentiment polarity emerged as a strong predictor, further enhancing the model's explanatory power and underscoring the emotional weight embedded in user reviews.

Conclusion: This study shows that user satisfaction in mobile banking is shaped by a combination of functional and emotional factors, which can be effectively identified through text mining. Including sentiment polarity alongside experience dimensions offers a more robust framework for evaluating digital service quality. These insights can support academic model development and practical efforts to optimize m-banking app design and communication.

Keywords: Customer satisfaction, mobile banking, user-generated reviews, sentiment analysis, topic modeling, user experience

1. Introduction

The widespread adoption of smartphones and the growing demand for digital financial services have positioned mobile banking (m-banking) as an important channel for customer interaction in the banking sector (Shaikh & Karjaluoto, 2015). This shift has transformed how banks deliver services and redefined user expectations and experiences (Iswani, 2023). In increasingly competitive digital markets, user experience (UX) has emerged as a key determinant of mobile app success, influencing customer satisfaction, trust, and long-term loyalty (Hassenzahl & Tractinsky, 2006). Despite the critical importance of UX in mobile banking, prior research has primarily relied on structured instruments, surveys, interviews, and expert-driven models to assess satisfaction and perceived quality (Sharma & Malviya, 2011; Orehovački et al., 2023). However, such approaches often fail to capture spontaneous and user-driven expressions of satisfaction and dissatisfaction, particularly as reflected in user-generated content such as app store reviews (Amirkhalili & Wong, 2025). These textual reviews offer rich insight into how users interpret, evaluate, and emotionally respond to their banking app experiences, an insight that often eludes traditional models.

The research problem in this study addresses the limited understanding of which experiential dimensions users emphasize in unsolicited mobile banking app reviews and how these dimensions relate to their satisfaction levels, as measured by app ratings. While previous models have proposed theoretical constructs of mobile service quality, they often lack empirical grounding in authentic, user-expressed feedback. Analyzing app reviews offers academic and practical value: for researchers, it reveals emergent and experience-based dimensions of app quality that legacy frameworks may not capture, while for practitioners, it informs UX and product design by pinpointing what truly matters to users. Moreover, identifying the latent structure of user experience as expressed in natural language helps bridge the gap between quantitative app ratings and the qualitative drivers behind them. Beyond its descriptive value, identifying these UX dimensions contributes to developing more precise and context-specific measurement tools, including validated scales for assessing satisfaction with mobile banking applications. By empirically grounding such instruments in real-world user narratives, this research supports the construction of psychometrically robust tools for academic inquiry and industry benchmarking.

The objectives of this paper are twofold:

RO1: To identify the thematic dimensions that users spontaneously express in mobile banking app reviews.

RO2: To examine how these identified dimensions relate to users' satisfaction, as proxied by their app rating scores.

These objectives are addressed through a mixed-methods approach combining transformer-based sentiment analysis with BERTopic modeling to analyze over 50,000 user reviews of mobile banking applications in Bosnia and Herzegovina, Croatia, and Serbia.

The remainder of the paper is structured as follows. Section 2 reviews the literature on mobile banking, application quality, user experience, and the use of sentiment and topic modeling in UX research. Section 3 details the research methodology, including sampling, data collection, and analysis procedures. Section 4 presents the empirical findings, focusing on the most prominent experiential dimensions and their influence on app ratings. Section 5 discusses theoretical and practical implications. Finally, Section 6 offers a comprehensive conclusion by synthesizing the main findings, highlighting the study's academic and practical contributions, and discussing its limitations and directions for future research.

2. Theoretical background

This section synthesizes links between mobile-banking app quality, UX, and customer satisfaction, justifies using reviews, and outlines modeling to derive dimensions and hypothesized effects.

2.1 The role and evolution of mobile banking in the digital era

Mobile banking (m-banking), a rapidly evolving segment of electronic banking (e-banking), refers to the use of mobile devices such as smartphones and tablets to access a range of financial and non-financial services anytime and anywhere. These include functionalities such as checking account balances, transferring funds, paying bills, reviewing transaction history, and managing payment cards, typically via proprietary applications developed by

financial institutions (Ayala Gavilanes et al., 2023; Iswani, 2023). As a component of e-banking, mobile banking coexists with other digital channels, such as internet banking portals and automated teller machines (ATMs), jointly reshaping how customers interact with financial services (Adhikari & Gyawali, 2023; Mwakisoba & Meela, 2024). The growing demand for mobile banking is primarily driven by customers' rising expectations for immediacy, convenience, and constant accessibility, coupled with banks' objectives to reduce operational costs and enhance service efficiency (Shaikh & Karjaluoto, 2015). Mobile banking has become the dominant digital touchpoint in many markets due to the widespread adoption of smartphones, improved mobile internet infrastructure, and the increasing availability of intuitive and feature-rich mobile apps (Ayala Gavilanes et al., 2023). Notably, mobile banking is no longer limited to transactional services but has expanded to include real-time alerts, savings tools, investment tracking, and financial planning features, transforming it into a comprehensive digital experience. From a strategic perspective, mobile banking represents more than a technological advancement. It signifies a paradigm shift in the way financial institutions engage with customers. User experience (UX) has become a pivotal criterion for app success in this new context.

2.2 Linking application quality, user experience, and satisfaction in mobile banking

In mobile banking, application quality, user experience (UX), and satisfaction are interrelated but distinct constructs. Application quality refers to an app's technical and experiential attributes, including usability, reliability, security, and performance (Grady, 1992; ISO/IEC, 2011). Early models such as SERVQUAL (Parasuraman et al., 1988) and E-S-QUAL (Parasuraman et al., 2005) conceptualized quality as the discrepancy between expectations and perceived performance, later extended to digital interfaces. Hoehle and Venkatesh (2015) and Garcia and Casas (2020) emphasized usability and visual design as core to mobile app quality, aligning with the notion of Quality of Experience (QoE).

UX, defined by ISO 9241-210 (2010), includes perceptions and emotional responses before, during, and after interaction with an app. While quality contributes to UX, the experience integrates affective and contextual dimensions (Hassenzahl & Tractinsky, 2006). For instance, efficient functionality may yield poor UX if emotional engagement is lacking (Iswani, 2023). Studies show that UX in mobile banking is shaped by digital touchpoints, e.g., responsiveness, personalization, and perceived security, which influence satisfaction (Oh & Kim, 2022; Adhikari & Gyawali, 2023; Sugiono et al., 2025). UX also varies by user characteristics, i.e., younger users value speed and design, while older users emphasize trust and security (Iswani, 2023; Sharma et al., 2024).

Satisfaction is the evaluative judgment after usage (Oliver, 1997), shaped by quality and UX. Definitions stress affective, functional, and contextual factors (Hammouri et al., 2020; Alkhafaji, 2016; Ranjitha & Agarwal, 2024; Finley et al., 2018). In mobile banking, many users lack prior expectations shaped by experience. Instead, expectations are formed via brand messaging (Jiang et al., 2017), peer influence (Oyekunle et al., 2023; Sällberg et al., 2022), analogical reasoning (Al-Shamaileh & Sutcliffe, 2023), and dominant digital norms (Alam et al., 2024; Zimmermann et al., 2022; Squillaro, 2021). Self-efficacy further informs expectations and adoption intentions, especially among inexperienced users (Compeau & Higgins, 1995). Empirical studies confirm its role in app usage and satisfaction (Liu et al., 2022; Keith et al., 2011).

Sentiment analysis of 90,000 reviews (Oh & Kim, 2022) identified ease of use, convenience, security, and support as key drivers of satisfaction, reflecting both functional and emotional elements. These findings align with the technology acceptance model (Davis, 1989) and the role of trust as a key emotional mediator (Gentile et al., 2007; Sugiono et al., 2025).

In summary, application quality is a key antecedent of UX, which serves as a mediator toward satisfaction. The three constructs are conceptually distinct but form a causal chain shaping user perceptions, emotions, and engagement with mobile banking apps.

2.3 Online reviews as a source of customer insight

Online customer reviews have become a powerful lens on user satisfaction, expectations, and service experiences in the digital economy. Unlike surveys or interviews constrained by researcher-defined questions, reviews capture spontaneous, user-driven narratives in the consumer's language (Oh & Kim, 2022; Garcia & Casas, 2020). Traditional

surveys, grounded in predetermined quality dimensions (Zeithaml et al., 1993; Parasuraman et al., 1988; 2005), secure statistical comparability but can overlook emergent issues. For instance, a mobile banking user who assigns a 4/5 rating provides no clue whether the missing point reflects login delays, confusing navigation, or absent real-time alerts. These nuances surface only in free-form reviews. These narratives, therefore, complement numeric scores by isolating the features that drive delight or frustration, especially in contexts where rapid transactions coexist with poor support. Empirical work across hospitality, e-commerce, and banking confirms this diagnostic value: ostensibly high-scoring services still attract complaints about cleanliness, responsiveness, trust, or disruptive updates (Kim & Kim, 2022; Kubrusly et al., 2022; Amirkhalili & Wong, 2025). Large-scale analyses of mobile banking apps further show that usability, security, and transaction reliability dominate review discourse, underscoring functional and affective dimensions of satisfaction (Khabour et al., 2023; Islam et al., 2023). Text-mining of reviews can therefore serve as a scalable, near-real-time diagnostic for identifying critical experience dimensions (Vargas-Calderón et al., 2021), so long as researchers mitigate selection bias, compensate for sparse demographic data, and detect or filter potential review manipulation through rigorous validation and triangulation procedures (Askalidis & Malthouse, 2016; Zhu et al., 2022; Fatima & Khan, 2024; Gandhi et al., 2025; Zhang et al., 2023).

2.4 Sentiment analysis and topic modeling in UX research

Digital feedback requires tools that reveal what users talk about and how they feel. Sentiment analysis classifies emotion and polarity, evolving from the lexicon and classic ML (e.g., SentiWordNet; Naïve Bayes, SVM) to deep-learning and transformer models such as BERT and its multilingual version, which excel across languages (Liu, 2012; Devlin et al., 2019; Wu & Dredze, 2019).

Topic modeling uncovers latent themes. LDA laid the groundwork (Blei et al., 2003) but falters on short, noisy texts. BERTopic overcomes this by pairing BERT embeddings with class-based TF-IDF, yielding clearer, interactive topics (Grootendorst, 2022).

Together, BERT-based sentiment and BERTopic provide a scalable, context-sensitive lens on UX.

Recent applications range from tracking mental-health discourse on Reddit (Cai et al., 2023) to monitoring post-COVID e-commerce moods (Öztürk Birim, 2024) and diagnosing fintech app issues (Sangaraju et al., 2022). This combined approach helps researchers surface emerging problems, gauge trust, and refine user-centered design.

2.5 Models of mobile banking app evaluation and dimensions of quality and satisfaction

Early studies assessed m-banking largely with SERVQUAL and E-S-QUAL, prioritizing reliability and responsiveness (Parasuraman et al., 1988; 2005). Although still relevant (Aghdaie & Faghani, 2012; Sharma & Malviya, 2011), these instruments overlooked mobile-specific needs such as usability and interface design. Subsequent work broadened the lens. Ahmed et al. (2020) added trust and perceived value to E-S-QUAL, showing technical features affect satisfaction indirectly, while Adhikari & Gyawali (2023) blended TAM with service-quality items to demonstrate that functional ease and emotional assurance jointly shape acceptance in emerging markets. Inductive, user-centered analyses deepened this shift. Jun and Palacios (2016) and Shankar et al. (2020) mined reviews to surface dimensions like mobile convenience, privacy, and interactivity, structural models later confirmed the salience of interface design and system reliability (Zhou et al., 2021; Nisha, 2016). Arcand et al. (2017) bridged utilitarian and hedonic views, finding that while functionality builds trust, enjoyment and sociality more strongly drive satisfaction. Hussain et al. (2014) refined usability into learnability, error prevention, and task efficiency, stressing cognitive simplicity. Recent sentiment-aware mining (Halvadia et al., 2022; Amirkhalili & Wong, 2025) corroborates these findings at scale, highlighting usability, security, and support, factors often absent from surveys. Collectively, the literature has moved from generic checklists to multidimensional, context-sensitive frameworks that integrate functional performance (reliability, efficiency, security) with experiential qualities such as trust, aesthetics, enjoyment, social interaction, and perceived control (Jun & Palacios, 2016; Arcand et al., 2017; Oh & Kim, 2022). The result is a more nuanced understanding of service quality as the interplay between technical adequacy and user-centric design.

3. Methodology

This section succinctly summarizes a mixed-methods design deriving dimensions from app-store reviews and estimating association with satisfaction via regression.

3.1 Research design

This study employs a mixed-method approach combining natural language processing techniques and quantitative modeling to explore how user experience dimensions extracted from online reviews relate to satisfaction with mobile banking applications. The goal was to move beyond predefined survey instruments by leveraging unsolicited user feedback on app stores, providing spontaneous and context-rich insights.

3.2 Sample definition and app identification

All banks operating in Bosnia and Herzegovina, Croatia, and Serbia that offer mobile banking services were identified based on official national banking registries. The corresponding mobile banking application on the Google Play platform was located and verified for each bank. The inclusion criterion required that the app be actively maintained and have received user reviews on the Google Play store as of April 2025.

3.3 Data collection

The data were collected in the Python programming environment during April 2025 using the `google_play_scraper` package. The scraper was customized to extract all available user reviews for the identified mobile banking applications, applying language and country filters to ensure contextual relevance. A total of 56,074 reviews were collected across all three countries.

3.4 Data preprocessing

All collected reviews were processed to standardize language and encoding. Reviews written in Cyrillic script were converted to Latin script to ensure consistency during text analysis. Basic cleaning procedures included lowercasing, removing punctuation, and eliminating duplicate or empty entries. No reviews were excluded based on sentiment or rating content.

3.5 Sentiment analysis and topic modeling

Each review was subjected to sentiment analysis using the transformer-based model `nlptown/bert-base-multilingual-uncased-sentiment` via the Hugging Face `pipeline` function. The model classified each review as expressing either "positive," "neutral," or "negative" sentiment. Topic modeling was then conducted using "BERTopic" and applied separately to each sentiment group. This allowed the extraction of distinct semantic themes relevant to different emotional tones. Topics were interpreted through a two-step process: (1) analysis of keywords, and (2) qualitative coding of 50 randomly sampled reviews per topic. Semantically similar topics were grouped into higher-order "user experience dimensions" through this process.

3.6 Dimensional assignment procedure

The BERTopic model generated a probability distribution across identified topics for each review. The topics with the highest, second-highest, and third-highest probabilities were retained and designated as the *primary*, *secondary*, and *tertiary* topics, respectively, for subsequent analysis. Each dimension was operationalized as a separate column in the dataset, with the relevant topic probability recorded as the degree of association. This probabilistic assignment enabled each review to contribute proportionally to the dimensional structure of the dataset.

3.7 Statistical analysis

Descriptive analysis was first conducted on the total dataset to summarize the sample's structure and examine the sentiment distribution across reviews. This step allowed for identifying dimensions that most frequently appeared in positively and negatively classified reviews, providing insights into the key experiential drivers of satisfaction and dissatisfaction.

A linear regression model was then estimated in R to assess the impact of individual user experience dimensions on perceived satisfaction. The app rating score (on a 1–5 scale) served as the dependent variable. In contrast, the independent variables included both the identified experience dimensions, operationalized through topic probabilities, and the sentiment classification of each review (positive, neutral, or negative).

4. Results

This section reports the corpus profile, eleven dimensions, and regressions linking dimensions/sentiment to ratings, highlighting key predictors and sentiment's added explanatory power.

4.1 Sample profile

The analytical process in this study relied on user-generated content collected from the Google Play platform. The dataset consisted of 56,074 reviews submitted by users of 49 mobile banking applications offered by banks in Bosnia and Herzegovina, Croatia, and Serbia. These reviews were used for topic modeling and the inductive identification of user experience dimensions. The most significant portion of reviews originates from Croatia (53.4%), followed by Serbia (38.2%) and Bosnia and Herzegovina (8.4%). In terms of sentiment distribution, the reviews are almost evenly split between positive (43.6%) and negative (46.6%) sentiment, with neutral reviews representing a smaller share (9.8%). Serbia recorded the highest proportion of negative sentiment (53.8%), while Bosnia and Herzegovina had the highest share of neutral reviews (12.5%). Croatia showed the most balanced sentiment distribution, with nearly equal proportions of positive (47.5%) and negative (42.6%) feedback. These figures highlight important regional differences in user experience perceptions and serve as a basis for further analysis of market satisfaction drivers.

Table 1 Distribution of reviews per country and per sentiment category – Initial dataset

Country	Banks	Reviews (% of total)	Positive sentiment num. (% of row)	Negative sentiment num. (% of row)	Neutral sentiment num. (% of row)
Bosnia and Herzegovina	19	4,716 (8.4%)	2,266 (48%)	1,862 (39.5%)	588 (12.5%)
Croatia	17	29,960 (53.4%)	14,225 (47.5%)	12,764 (42.6%)	2,971 (9.9%)
Serbia	13	21,398 (38.2%)	7,963 (37.2%)	11,514 (53.8%)	1,921 (9%)
Total	49	56,074	24,454 (43.6%)	26,140 (46.6%)	5,480 (9.8%)

Source: Author

Each review in the dataset is accompanied by an app rating ranging from 1 (lowest satisfaction) to 5 (highest satisfaction). A descriptive analysis of rating scores in the initial dataset revealed the following distribution, which is presented in Table 2.

Table 2 Distribution of rating scores by country

Country	Rating score						
	Mean	SD	5	4	3	2	1
Bosnia and Herzegovina	3.48	1.69	47.4%	11.3%	8.5%	7.6%	25.2%
Croatia	3.33	1.79	47.5%	8.4%	5.7%	6.5%	31.9%
Serbia	2.87	1.84	37.5%	6.6%	5.2%	6.5%	44.1%
Total*	3.17	1.82	43.7%	8.0%	5.7%	6.6%	36.0%

Note: * The sums of percentage ratings by country may deviate from 100% due to rounding to one decimal place.
Source: Author

The analysis of rating score distribution reveals notable differences across countries. On average, users in Bosnia and Herzegovina gave the highest ratings (M = 3.48, SD = 1.69), with nearly 47.4% of reviews awarding the maximum score of 5 and a relatively lower proportion of negative ratings (25.2%). In Croatia, the average score was slightly lower (M = 3.33, SD = 1.79), with a similar share of 5-star ratings (47.5%) but a higher proportion of 1-star ratings (31.9%), indicating a more polarized distribution. Serbia had the lowest average rating (M = 2.87, SD = 1.84), with less than 38% of reviews

awarding five stars and a notably high share (44.1%) of 1-star ratings, suggesting greater user dissatisfaction. Overall, the total average rating across all reviews was 3.17, with the most frequent ratings being either five stars (43.7%) or 1 star (36.0%), indicating a bimodal pattern and emphasizing the presence of strong polar opinions in user feedback.

4.2 Identified user experience dimensions

Following sentiment analysis using a BERT-based model and subsequent topic modeling with BER-

Topic, 135 topics related to positive reviews, 39 topics related to neutral reviews, and 63 topics related to negative reviews were identified. For each topic, keyword analysis and content review of 50 randomly selected reviews were conducted to determine the thematic orientation. Based on this process, each topic was assigned to one of the relevant user experience dimensions. In total, 11 distinct dimensions were identified and are presented in Table 3.

Table 3 Dimensions of user experience with m-banking apps – Distribution per sentiment

Dimension	Description	Negative	Neutral	Positive
D1 - Ease of Use	This dimension includes the app's simplicity, clarity, and ease of interaction. It encompasses intuitive design, clear navigation, transparent layout, and straightforward task execution. It reflects a user-friendly interface that supports smooth and efficient application use.	2,865 (5.1%)	2,580 (4.6%)	24,454 (43.6%)
D2 - Performance Speed	This dimension includes the application's speed, responsiveness, and efficiency. It covers fast command execution, low latency, quick loading times, and immediate system feedback. It applies to navigation within the app and the timely processing of user requests.	23 (0.04%)	353 (0.63%)	24,454 (43.6%)
D3 - Operational Reliability and Stability	This dimension includes the consistency and stability of the application's functioning. It covers error-free operation, predictable performance, and system reliability. It encompasses app crashes, freezing, software bugs, installation errors, and failures that prevent access to the app. It also includes disruptions caused by unstable performance or malfunctioning features.	25,841 (46.1%)	578 (1%)	10,034 (17.9%)
D4 - Functional Utility	This dimension includes the availability and usefulness of features that support everyday banking needs, such as account management, payments, and self-service options. It reflects how functionally complete the app is and how much it replaces in-branch services while simplifying users' daily routines.	1,045 (1.9%)	0	2,451 (4.4%)
D5 - Payment Functionality	This dimension includes all aspects of initiating and processing payments through the app. It covers features such as QR code payments, photo bill scanning, NFC-based payments, and integration with third-party services like Google Pay. It reflects the availability, reliability, and practicality of in-app payment options.	1,521 (2.7%)	550 (1%)	185 (0.3%)
D6 - Security	This dimension includes data protection, secure authentication, and user privacy. It covers security mechanisms such as PINs, biometric login, token-based access, and the app's permission requirements. It reflects concerns about unauthorized access, protection of sensitive information, and the overall trust in the app's security protocols.	2,336 (4.2%)	127 (0.2%)	266 (0.5%)
D7 - Version Experience	This dimension includes user feedback related explicitly to experiences with different app versions. It encompasses reactions to updates, including improvements or problems introduced in newer versions. It covers functionality loss, interface changes, delayed notifications, and differences in performance after updates.	25,503 (45.5%)	286 (0.5%)	5,814 (10.4%)

Dimension	Description	Negative	Neutral	Positive
D8 - Service Access	This dimension includes accessing core services within the app. It covers issues such as unavailable features, geographic or language restrictions, lack of integration with tools like Google Pay, and the inability to open or process certain documents. It reflects how technical, regional, or functional restrictions impact the application's usability.	1,902 (3.4%)	326 (0.6%)	471 (0.8%)
D9 - Customer Support Experience	This dimension includes user feedback related to their interactions with customer support. It encompasses perceived professionalism, helpfulness, friendliness, and responsiveness of support staff. It reflects how effectively customer inquiries, issues, or requests are handled through the app or associated service channels.	0 (0%)	40 (0.07%)	532 (0.95%)
D10 - Emotional Expression	This dimension includes emotionally charged statements that reflect strong user sentiments such as frustration, delight, excitement, or disappointment. It covers expressions like "worst bank ever" or "finally!" that communicate emotion without specifying reasons or referencing specific app features. It reflects the affective tone rather than the functional content of the feedback.	11,501 (20.5)	5,163 (9.2%)	16,866 (30.1%)
D11 - General satisfaction	This dimension includes general expressions of satisfaction or dissatisfaction with the app. It reflects an overall impression without reference to specific features or issues. It encompasses statements that describe the app as "excellent," "very satisfied," "everything works fine," or "completely dissatisfied," focusing on the global user experience.	0 (0%)	21 (0.04%)	9,201 (16.4%)

Source: Author

4.3 Impact of experience dimensions and sentiment on rating scores

Multiple linear regression analysis was conducted using R to examine how user experience dimensions and sentiment polarity influence rating behavior. The dependent variable was the user-assigned rating score (ranging from 1 to 5), while the independent variables comprised probabilistic indicators of eleven predefined user experience dimensions derived from topic modeling. Each review was associated with up to three topics with the highest associated probabilities, as identified by the BERTopic model. A review was assigned to a particular user experience dimension if any associated topics (with sufficient probability) matched the set of topics defining that dimension for the corresponding sentiment category. Each dimension was represented as a separate variable in the dataset, and the topic probabilities were aggregated per dimension. This probabilistic aggregation allowed for a weighted contribution of each review to the multidimensional representation of user experience.

In the baseline specification (Model 1), only the eleven user experience dimensions were included as predictors. This model accounted for approximately 28.1% of the variance in user-assigned rating scores (*Adjusted R^2 = 0.281*), indicating a moderate explanatory capacity based solely on experiential content derived from topic modeling. All eleven dimensions exhibited statistically significant effects on rating behavior. Among the most potent positive predictors were Performance Speed (β = 2.55, $p < 0.001$), Functional Utility (β = 2.49, $p < 0.001$), Emotional Expression (β = 2.22, $p < 0.001$), General Satisfaction (β = 3.35, $p < 0.001$), and Customer Support Experience (β = 2.03, $p < 0.001$), suggesting that these dimensions are closely aligned with users' perceptions of high-quality service. Additionally, Ease of Use (β = 1.12), Security (β = 0.64), and Service Access (β = 0.90) were positively associated with higher ratings. Conversely, Operational Reliability and Stability (β = -0.72), Version Experience (β = -0.73), and Payment Functionality (β = -0.42) demonstrated significant negative associations with rating scores.

To further enhance explanatory power, sentiment polarity (positive, negative, neutral [reference]) was added in Model 2. This extension significantly im-

proved the model, raising Adjusted R² to 0.581, thus accounting for more than half of the variance in rating behavior. Both sentiment predictors emerged as highly significant: reviews labeled as *negative* were associated with a 1.71 point reduction in rating scores (β = -1.711, p < 0.001), while *positive* sentiment led to a 0.94 point increase (β = 0.941, p < 0.001). These findings emphasize the critical role of emotional tone in shaping rating behavior, reinforcing the notion that sentiment not only complements but also amplifies the explanatory power of topic-based dimensions.

To assess multicollinearity among predictors in Model 2, Variance Inflation Factors (VIFs) were computed. The vast majority of variables demon-

strated low VIF values (GVIF^(1/(2*Df)) < 1.2), indicating negligible multicollinearity. The highest observed VIFs were for *Ease of Use* (2.43) and *Performance Speed* (2.48), suggesting moderate collinearity, likely due to the conceptual overlap in how users perceive usability and responsiveness. Nonetheless, these values remain well below the standard thresholds of concern (VIF > 5), affirming the model's robustness (Hair et al., 2019). Overall, the results indicate that the content (i.e., what users discuss) and the affective tone (i.e., how users feel) are vital in predicting satisfaction outcomes. The joint modeling of topic-derived dimensions and sentiment polarity provides a comprehensive understanding of the drivers behind rating behavior.

Table 4 Regression estimates for Model 2

Term	Estimate	Std. Error	t-value	Sig.
(Intercept)	3.45	0.02	195.30	***
Ease of Use	0.13	0.06	2.33	*
Performance Speed	0.56	0.06	9.69	***
Functional Reliability & Stability	0.13	0.04	3.26	**
Functional Utility	0.88	0.06	13.72	***
Payment Functionality	0.18	0.08	2.24	*
Security	-0.20	0.10	-2.07	*
Version Experience	-0.43	0.05	-8.0	***
Service Access	0.29	0.08	3.52	***
Customer Support Experience	0.78	0.13	6.04	***
Emotional Expression	0.37	0.03	11.81	***
General Satisfaction	0.45	0.06	7.00	***
Sentiment - Negative	-1.71	0.02	-95.79	***
Sentiment - Positive	0.94	0.02	50.164	***

Note: Significance codes: p < 0.001 "***", p < 0.05 "*".
Residual standard error: 0.9506 on 8,791 degrees of freedom
Multiple R-squared: 0.5283, Adjusted R-squared: 0.5276
F-statistic: 757.5 on 13 and 8,791 DF, p-value: < 2.2e-16
Source: Author

5. Discussion

This study combines BERTopic-based topic modeling with sentiment-augmented regression to clarify how content cues and emotional tone shape satisfaction with mobile banking apps. Analysis of 56,074 unsolicited reviews from three Southeast

European markets uncovered eleven experience dimensions that extend traditional service-quality constructs.

Regarding functional and affective drivers, dimensions tied to core system performance, Performance Speed (β = 0.56, p < .001) and Functional Utility (β

= 0.88, p < .001), proved the most potent positive predictors, confirming that fast, comprehensive functionality remains central to perceived value. Ease of Use (β = 0.13) and Operational Reliability (β = 0.13) acted more as hygiene factors: their absence provokes complaints, yet their presence yields only incremental gains. More minor but significant effects emerged for Payment Functionality (β = 0.19) and Service Access (β = 0.29). The former shows that smooth payment features incrementally boost satisfaction. The latter indicates that users reward apps that offer broad geographic or language coverage and all the services and functions they expect.

Sources of dissatisfaction cluster around Security (β = −0.20) and Version Experience (β = −0.43). Intrusive authentication or unstable updates erode trust and violate expectations set by earlier app versions, echoing expectancy-disconfirmation logic. Customer Support (β = 0.78) offsets these risks; although mentioned in only 1% of reviews, responsive assistance markedly lifts ratings, underscoring the enduring value of human help in digital finance.

Emotional resonance also matters. Affect-laden themes, Emotional Expression (β = 0.37) and General Satisfaction (β = 0.45), show that users often judge the app through their broader relationship with the bank. Adding sentiment polarity improved explanatory power substantially (Adj. R^2 = 0.58); strong positive (β = 0.96) and negative (β = −1.70) coefficients confirm that affective language is an efficient proxy for satisfaction.

These results refine classic frameworks. Reliability, responsiveness, and security remain pertinent, yet their influence is eclipsed by digital-specific factors such as speed and functional breadth, dimensions rarely addressed in earlier models. This supports earlier critiques by Jun and Palacios (2016) and Shankar et al. (2020), who emphasized the inadequacy of conventional models for capturing the dynamic and interactive nature of mobile banking. Compared to TAM-based models (Davis, 1989; Venkatesh & Davis, 2000), which highlight perceived ease of use and usefulness, our findings nuance these constructs. While ease of use is frequently mentioned, it exhibits only a modest effect on satisfaction, functioning as a hygiene factor rather than a satisfier, echoing the expectancy-disconfirmation theory (Oliver, 1980). *Ease of Use* behaves as a threshold attribute, while *Functional*

Utility broadens "perceived usefulness" to encompass transactional completeness.

The strong influence of customer support experience validates claims by Amirkhalili and Wong (2025) and Arcand et al. (2017) that human interaction retains value in digital contexts. This dimension rarely features in classical models but proves crucial for digital adoption, especially among low-literacy users, a fact highlighted in developing market studies (Adhikari & Gyawali, 2023). The dimension version experience, emerging as a strong negative predictor, has been rarely treated in prior service quality models. Its significance underscores the unique challenges of platform volatility and update inconsistency in app-based services, a theme Hussain et al. (2014) raised in usability research but not fully integrated into most frameworks. The prominence of update stability and customer support lends weight to recent calls for context-sensitive, multidimensional models. Finally, quantifying sentiment's additive value demonstrates that affective cues enhance prediction beyond behavioral variables, offering a replicable template for future UX analytics. Overall, satisfaction with mobile banking arises from the interplay of speed, functional richness, version stability, supportive service, and emotional tone. Models that ignore these digitally specific and affective elements risk misdiagnosing what truly matters to users.

6. Conclusion

This study contributes to the digital service analytics literature by demonstrating how user-generated textual feedback can be transformed into actionable experience dimensions using sentiment-aware topic modeling. The empirical identification and validation of eleven experience dimensions, confirmed as significant predictors through regression analysis, provide a robust foundation for refining satisfaction measurement frameworks and developing more context-sensitive instruments. In addition to these content-derived insights, incorporating sentiment polarity into the regression model marks a notable methodological advancement. The significant coefficients for both positive and negative sentiment support the argument that affective language can be a surrogate measure of satisfaction, enhancing explanatory power beyond what traditional behavioral predictors offer. This is further

validated by the model's improved performance (Adjusted $R^2 = 0.58$), confirming that sentiment polarity is not merely an auxiliary variable but a quantifiable and impactful predictor of user satisfaction.

From a practical standpoint, key drivers of satisfaction such as Performance Speed, Functional Utility, and Customer Support Experience offer clear priorities for mobile banking app developers. At the same time, negative feedback clustered around Version Experience and Security points to the need for rigorous testing, transparent update processes, and more reliable authentication mechanisms. The predictive power of sentiment polarity further highlights the need for institutions to monitor emotional cues in user feedback as early signals of satisfaction or discontent. Overall, the study bridges the gap between unstructured feedback and structured evaluation models, offering valuable insights for researchers and practitioners seeking to improve digital banking service quality.

Like all empirical studies, this research has limitations. First, while the dataset is large and diverse, it focuses exclusively on user reviews from three Southeast European countries, which may limit the generalizability of findings to other regions or cultural contexts. Second, the reliance on algorithmically derived dimensions, though grounded in real user language, may overlook subtleties that a mixed-methods approach could capture. Lastly, the sentiment model, while effective, interprets affective tone at the review level, not at the sentence or feature-specific level.

Future research should explore cross-country comparisons to validate the stability of identified dimensions across cultural and regulatory environments. Integrating qualitative interviews or survey-based validations with topic modeling would enhance construct validity. Additionally, fine-grained sentiment analysis and temporal tracking of user feedback could offer deeper insights into how satisfaction evolves over time and in response to feature updates or policy changes.

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THE ROLE OF PERCEIVED CELEBRITY FAME ORIGIN IN SHAPING PURCHASE INTENTIONS AMONG YOUNG CONSUMERS

Abstract

Purpose: The study investigates how the perceived origin of a celebrity's fame–classified as ascribed, achieved, or attributed/celetoid (celetoid fame refers to celebrities known primarily for short-term media exposure, scandals, and public appearances)–influences consumer purchasing behaviour, particularly among younger audiences. While celebrity endorsements remain a prevalent marketing strategy, limited research has examined how media representation and the perceived legitimacy of such fame affect consumer purchase intentions.

Methodology: The research is grounded in Rojek's (2001) classification of celebrity fame and employs a survey conducted on a convenience sample of 902 respondents in Croatia. ANOVA and regression analyses were used to examine whether fame origin and demographic variables predict consumers' likelihood of purchasing endorsed products.

Results: Findings indicate that age (F = 20.633, p < .001) and achieved fame (F = 15.613, p < .001) are statistically significant predictors of purchase intention. Consumers aged 18–25 were more influenced by celebrity endorsements, and those who perceived celebrities as having achieved fame through talent and accomplishment were more likely to respond positively to endorsements. In contrast, ascribed and attributed/celetoid fame had no significant impact on purchasing behaviour, suggesting that the credibility and authenticity conveyed through media narratives play a key role in shaping endorsement effectiveness.

Conclusion: The results highlight that merit-based fame enhances the effectiveness of celebrity endorsements, particularly among younger audiences. These insights suggest that brands should strategically align with celebrities perceived as accomplished, not only from a marketing standpoint but also considering how these figures are communicated and perceived in the public sphere.

Keywords: Achieved fame, consumers purchase behaviour, Rojek's typology of celebrities' fame origin, celebrity endorsement, young consumers, media-centric production of fame

1. Introduction

In contemporary industry of marketing and media, celebrities are used for endorsements of products, services or brands—the greater the number of endorsement deals, the better. To secure more endorsement deals, celebrities need to possess various characteristics and influence consumer behaviour, i.e., encourage consumers to take action (to purchase a product, subscribe to a media platform, etc.). Research has shown that a celebrity's characteristics, such as credibility and expertise, can strengthen emotional attachment to a brand, influence consumer behaviour, and enhance brand image (Gofur & Shafariah, 2025; Aprianto et al., 2024). Additionally, social status plays an important role in shaping consumer preferences and loyalty (He et al., 2019). Although much has been written about celebrity characteristics, social status, and their role in branding (Turner, 2004; Marshall, 2016), the connection between the social origin of fame and consumer behaviour has been less thoroughly explored. Investigating how the social origin of a celebrity's fame interacts with celebrity endorsement strategies can shed light on how communication mechanisms shape consumer perceptions. The social status and media construction of a celebrity's fame are key factors in determining how effectively they can engage with audiences and influence consumer behaviour. Therefore, a deeper understanding of the origins of fame, as articulated by Chris Rojek (2001), can provide valuable insights into the effectiveness of celebrity endorsements on consumer behaviour, specifically in relation to purchasing decisions. the study is focused particularly on younger audiences, that mostly correspond to Generations Y and Z, who actively engage with celebrity culture to identify how the perceived origin of a celebrity's fame influences the likelihood of consumers purchasing a product they endorse.

This paper has a few sections. It starts with the introduction, which outlines the research problem and significance. The next section presents the theoretical background, focusing on Rojek's (2001) classification of celebrity fame and prior studies on celebrity endorsements and consumer behaviour. It is followed by the methodology section, which describes the research design, sampling method, data collection instruments, and criteria for celebrity selection. The results section then presents the statistical analysis results, examining the impact of fame origin and demographic variables on consumer purchase intentions. The discussion section interprets these findings in light of existing literature, hypotheses and theoretical frameworks. Finally, the conclusion summarises the main insights, addresses the study's limitations, and suggests directions for future research.

2. Theoretical background

2.1 Rojek's fame classification and the role of media representation of fame

A central theoretical framework for understanding contemporary celebrity culture is Rojek's (2001) tripartite classification of fame, which distinguishes between **ascribed**, **achieved**, and **attributed** forms of celebrity status. These categories provide critical insight into how fame originates and how it is perceived by the public, particularly in relation to authenticity, merit, and media influence. **Ascribed** fame is inherited, typically through familial connections, granting individuals such as royalty or aristocrats automatic social status (e.g., Prince William and Prince Harry). **Achieved** fame is earned through talent and accomplishments in fields like sports, music, and the arts (e.g., Pablo Picasso, Venus Williams). This type of fame carries strong connotations of merit and authenticity, often increasing public trust and admiration. **Attributed** fame, on the other hand, is often constructed by media and industry mediators (such as publicists, journalists and producers), with individuals like reality TV stars or viral figures gaining temporary fame through media representation rather than personal merit. An important notion for this study was Rojek's acknowledgement of the model's limitations, which led to the recognition of other forms of celebrities derived from attributed fame, such as **celetoids**–figures who experience brief yet intense media-driven fame, including reality TV contestants, streakers, or whistle-blowers, and **celeactors**–fictional characters who momentarily dominate public attention (e.g., Borat) (Rojek, 2001). This model was selected for the present research because it is the most frequently cited, along with its extended version. Rojek's model has proven useful for understanding the varying origins of fame and their implications for celebrity endorsements, particularly in distinguishing between those whose fame is inherited or earned versus those whose fame is manufactured by the media. Thus, understanding the origin of a celebrity's fame–whether ascribed, achieved, or attributed–can provide criti-

cal insights into how different types of celebrity influence consumer decision-making.

While Rojek's classification offers a foundational typology, contemporary scholars have emphasised the **central role of media representation** in shaping not only celebrity status but also public perceptions of legitimacy and value. As Turner (2004) and Marshall (2010) argue, celebrity is not simply a personal trait or social outcome, it is a **media product**, constructed through storytelling, repetition, and image framing. The **celebrification process** (Turner, 2006) transforms ordinary individuals into public figures by embedding them in media cycles that emphasise visibility over substance. This media-centric production of fame is particularly evident in the rise of digital influencers, who accumulate what Driessens (2013) describes as *celebrity capital*, a form of symbolic value built through sustained visibility rather than traditional credentials. These figures, often lacking institutionalised expertise, become powerful brand ambassadors due to their perceived relatability and frequent presence in the everyday media consumption of audiences (Abidin, 2018; Hearn & Schoenhoff, 2015). In the era of social media, such *attributed celebrities* have become increasingly prominent in endorsement research (Shao et al., 2024; Calvo-Porral et al., 2021). Typically emerging from platforms like Instagram or TikTok, they are viewed as accessible and authentic, which enhances their persuasive capacity in shaping consumer attitudes and behaviours.

Numerous studies have emphasised that characteristics such as attractiveness, expertise, credibility, and social status are critical for consumers to perceive a celebrity endorser as trustworthy (Cansu & Sezen, 2025; Gaikwad & Muley, 2024). These attributes align with Rojek's fame typology: "achieved" celebrities often embody skill and merit, "ascribed" celebrities inherit recognition through familial or social status, while "attributed" celebrities may blend elements of both–depending on how they are framed by media narratives. However, the legitimacy of attributed fame remains contested. As Stewart and Giles (2019) argue, media discourse plays a powerful role in assigning moral and cultural value to different fame types. Attributed and *celetoid* celebrities are frequently portrayed as superficial or undeserving, reinforcing hierarchies of fame in which achieved celebrities are perceived as more credible and aspirational. This moral cod-

ing becomes particularly significant in commercial contexts, where perceived authenticity and legitimacy can determine the effectiveness of celebrity endorsements. Thus, while attributed celebrities may enjoy high visibility, their endorsement power is often shaped–and limited–by how they are constructed and evaluated within public and media discourse.

2.2 Celebrity brand endorsement influence on consumer purchase decisions

There are many factors that influence consumer purchasing behaviour, not only innovative marketing approaches (Pucelj et al., 2024), but also, increasingly, the involvement of celebrities in shaping consumer decisions. Here, we review previous research on celebrity brand endorsement and its influence on consumer purchase decisions.

Starting with the authors who claimed that celebrity brand endorsement had an influence on the purchase decisions, Lestari and Wahyono (2021), who used the quantitative method, i.e., a survey of 115 participants, came to a conclusion that celebrity endorsers, online promotion and brand image had a positive impact on consumer purchase decisions. In their research, they claim that the predictors influencing consumer purchase are celebrity credibility, attractiveness and visibility. Annissa and Paramita (2021) conducted a survey with 216 participants from Generations Y and Z to examine whether celebrity endorsement of the Maybelline brand influenced consumer purchase decisions. Their findings confirmed a positive effect. The same predictors were crucial for purchase decisions, such as celebrity attractiveness, as well as skill in endorsing and product-related knowledge (i.e., expertise) (Annissa & Paramita, 2021). A subsequent study by Syalsabila and Hermina (2023) employed a questionnaire-based survey on a sample of 185 respondents, predominantly male (63%) and aged between 35 and 45, within the culinary industry. The authors concluded that the effective use of celebrity endorsements significantly increases customer engagement, which in turn has a positive impact on purchasing decisions. Specifically, the study found that higher consumer engagement correlates with a greater likelihood of making a purchase. In addition, in this study, the predictor that influenced positive consumer purchase decisions was attachment to the celebrity figure. In contrast, using a descriptive research technique in the cosmetics in-

dustry, Dey et al.'s (2024) research on 150 females belonging to Generation Z showed that females were positively influenced by celebrities to buy the product, and they also perceived the product more credible when it is endorsed by the celebrity. The study also found that celebrity personality was the most significant predictor of the consumer–celebrity relationship influencing purchase decisions. Further research on the influence of celebrity endorsement in the cosmetics industry was conducted by Rafiah and Rahmawita (2025) via an online survey involving 102 respondents. The study demonstrated that celebrity endorsements significantly impact purchasing decisions, accounting for 67.1% of the variance. Key predictors influencing consumer behaviour included the celebrity's credibility, physical attractiveness, alignment with the brand, and the ability to gain trust from product users.

Focusing on the tea processing industry, Ananda et al. (2024) conducted a survey-based study involving 225 participants, most of whom were female (60%) and aged between 22 and 25, representing Generation Z. The results were consistent with those of Dey et al. (2024), emphasising that celebrity personality serves as a significant predictor of consumer purchasing behaviour. Specifically, the study found that consumers are more likely to make positive purchase decisions when the endorsing celebrity is someone they admire or idolise. Ananda et al. (2024, p. 361) further stated that "celebrity product adoption can increase consumer purchase intentions, which directly influences their decision to purchase the iced tea product." This conclusion is supported by similar findings from Aprilia and Hidayati (2020) and Park and Lin (2020).

Extending the focus to younger generations, prior studies have consistently shown that Generations Y (Millennials) and Z are particularly susceptible to the influence of celebrity culture, as they are the most active followers of celebrity-related media content (Mendick et al., 2018) and influencer culture (Jin et al., 2019; Centeno & Wang, 2017). In line with this, Macheka et al. (2024) conducted a questionnaire-based study targeting Generation Y, specifically exploring purchase intentions related to beauty products among female respondents (N = 203), most of whom (29.06%) were aged 36 and above. The results revealed that Estée Lauder was the most favoured beauty brand (35%), followed by Maybelline (26%) and L'Oréal (16%). The authors concluded that celebrities perceived as credible,

knowledgeable, and possessing domain-specific expertise have a positive influence on the purchase intentions of female consumers from Generation Y.

Building on previous findings that emphasise the role of celebrity credibility and expertise, further research has explored additional dimensions of influence within specific cultural contexts. Priyambodo et al. (2025) investigated the impact of celebrity endorsement within the K-pop fanbase and found that both celebrity credibility and physical attractiveness had a significant impact on purchasing decisions related to an electronic payment card, resulting in a reported sales increase of 73.7%. The study was conducted via an online survey with 95 respondents. Similarly, using a qualitative approach through semi-structured interviews with five Generation Z participants, Maharani et al. (2025) demonstrated the importance of celebrity attractiveness in triggering impulse purchases. An additional noteworthy predictor identified in their study was the celebrity's public speaking ability, which played a persuasive role in encouraging consumers to engage in purchasing behaviour.

Contrary to the majority of studies emphasising the positive effects of celebrity endorsements, several recent findings suggest a more limited or even negligible influence in certain contexts. Nuryanti et al.'s (2023) study among 636 students (the sample size was determined by the Slovin formula) showed that there is no positive influence between celebrity endorsers and purchasing decisions, highlighting that for a celebrity endorsement to be successful, the celebrity should not be overexposed. According to a questionnaire-based study, Pratama and Sudarmiatin (2024) concluded that celebrity endorsements do not have a significant impact on consumer purchase decisions within the TikTok Shop platform. Their results indicate that the presence or absence of a celebrity endorser does not meaningfully affect consumers' purchasing behaviour. Expanding on this perspective, Yanti and Zamrudi (2025) conducted research on Generation Z consumers (N = 100) in the cosmetics sector and found that while celebrity endorsements had an insignificant impact, brand image and brand awareness played a more decisive role in influencing purchase intentions. Supporting this trend, Goldin and Rodiah (2025) investigated consumer behaviour in the fashion industry–specifically in relation to Adidas footwear–and reached similar conclusions: celebrity endorsements exerted only a marginal influence, whereas

brand image had a considerably stronger effect on purchasing decisions.

This literature review provides a comprehensive overview of the varying degrees to which celebrity brand endorsements influence consumer purchase decisions. It can be seen that most of the research was conducted using surveys. A substantial body of empirical evidence indicates that celebrity endorsements can exert a positive and statistically significant impact on consumer behaviour, particularly among younger generations (Generations Y and Z) and within industries such as cosmetics, fashion, food and beverage, and digital services. Key factors identified as influential in shaping purchasing decisions include celebrity credibility, attractiveness, expertise, brand alignment, and the emotional attachment or idolisation of the celebrity by the consumer. Studies showed that well-executed celebrity endorsements, especially when tailored to the appropriate demographic and product category, enhance consumer trust, brand perception, and ultimately drive purchase intentions.

However, some studies show a limited or no influence of celebrity endorsement due to factors such as overexposure (Nuryanti et al., 2023), poor brand-celebrity fit (Yanti & Zamrudi, 2025), platform-specific dynamics such as on TikTok (Pratama & Sudarmiatin, 2024), and increasing consumer skepticism—especially among younger, media-savvy audiences.

In conclusion, while celebrity endorsements can be a powerful marketing tool and a tool for impacting purchasing decisions, their effectiveness is highly context-dependent.

3. Methodology

Building on the theoretical concept and drawing from Rojek's (2001) model, this study explores how the perceived origin of fame—mediated through public discourse—influences consumer evaluations of celebrity-endorsed products. By linking fame typology to media representation, the research aims to uncover how consumers distinguish between different celebrity figures and how these distinctions shape their purchasing behaviour.

To strengthen the empirical grounding of the research model, the following hypotheses are informed by prior studies on celebrity endorsement and generational consumer behaviour. Existing

literature consistently identifies celebrity credibility, expertise, and authenticity as key predictors of endorsement effectiveness (Lestari & Wahyono, 2021; Rafiah & Rahmawita, 2025; Dey et al., 2024), with age and emotional attachment to celebrities shown to influence consumer response (Ananda et al., 2024; Macheka et al., 2024). Furthermore, media-saturation effects and trust in social media influencers are also relevant to understanding differences in consumer response by generation (Güneş et al., 2022).

H1: Consumer age and the perception that a celebrity has achieved fame through talent and accomplishments are statistically significant predictors of consumers' likelihood to purchase celebrity-endorsed products.

This is supported by prior findings showing that celebrity expertise and perceived effort (achieved fame) increase trust and purchase intention (Macheka et al., 2024; Rafiah & Rahmawita, 2025; Dey et al., 2024).

H2: The perception that a celebrity's fame is ascribed (inherited) or attributed/celetoid (media-constructed or short-lived) does not significantly influence consumer purchase intentions.

Several studies have shown a limited or no effect of celebrity endorsements when the endorser is perceived as overexposed or lacking authenticity (Nuryanti et al., 2023; Pratama & Sudarmiatin, 2024; Yanti & Zamrudi, 2025).

H3: Younger consumers (aged 18–25) are more likely to be influenced by celebrity endorsements than older consumers (aged 36 and above).

Empirical studies indicate that Generations Y and Z are more actively engaged with influencer content and more responsive to celebrity marketing (Centeno & Wang, 2017; Jin et al., 2019; Güneş et al., 2022).

H4: Younger consumers (aged 18–25) are more responsive to celebrities whose fame is perceived as media-constructed (attributed/celetoid) compared to consumers aged 36 and above.

Younger consumers show higher trust in social media influencers (Güneş et al., 2022) and are more likely to follow and emulate celebrities whose fame is driven by digital visibility (Annissa & Paramita, 2021; Ananda et al., 2024).

3.1 Data collection and instrument validity

The research data were collected from August to September 2024 using a convenience sample of 902 respondents from Croatia. The survey was distributed via Google Forms to ensure broad accessibility and ease of participation. Based on previous research on branding, consumer behaviour, and purchasing decisions that commonly employed Likert scales as measurement tools (Che et al., 2025; Montecchi et al., 2024; 't Hart and Phau, 2022; Philip et al., 2023; Dey et al., 2024; Lestari & Wahyono, 2021; Nuryanti et al., 2023), this study also utilised a Likert-type scale to measure consumer responses.

A five-point Likert scale (from 1 = strongly disagree to 5 = strongly agree) was used to assess respondents' attitudes toward each celebrity and their likelihood of purchasing the products endorsed by those celebrities. This approach allows for structured, reliable measurement of attitudinal and behavioural variables relevant to celebrity endorsement effects.

3.2 Sampling process and celebrity selection criteria

To reach a demographically relevant and media-savvy audience, the study employed the snowball sampling method (Milas, 2005; Pavić, 2021) appropriate for populations without a formal sampling frame, particularly within digital and social media communities (Noy, 2008). Although the study relied on a non-probability convenience sample, the use of a snowball strategy via a prominent social media figure ensured access to a target demographic that is highly relevant for this type of research.

The well-known Croatian Instagram influencer Ana Pulić was selected as an entry point. With over 113,000 followers and active collaborations with global beauty brands such as L'Oreal, she served as a strategically effective channel to reach Millennials and Generation Z–cohorts known for their high engagement with celebrity culture and strong susceptibility to celebrity endorsements (Centeno & Wang, 2017; Mendick et al., 2018; Singh & Banerjee, 2019; Sarwar et al., 2025; Rafael et al., 2023; Sabita & Mardalis, 2023; Yanti & Zamrudi, 2025; Veybitha et al., 2023; Azhar et al., 2024).

While the use of a convenience sample limits generalisability to the broader population, it is well-aligned with the study's objectives and suitable for exploratory research focused on media and marketing behaviours among highly digital, media-oriented users.

For the purpose of testing the influence of the social origin of celebrity fame as a predictor of purchase intention, five celebrities were selected to represent the categories outlined in Rojek's (2001) fame typology. The selected celebrities included Ella Dvornik, Kim Kardashian, Kendall Jenner, Luka Modrić, and the fictional character James Bond. These individuals were chosen for their clear alignment with different fame types—ranging from inherited and achieved to media-constructed and fictional—thus ensuring a comprehensive representation of social fame origins relevant to the study context.

4. Results

This section presents the findings of the statistical analysis conducted to determine which factors significantly predict the probability of consumers purchasing a product endorsed by a celebrity. The analysis focused on four key predictors: age group, perception of ascribed fame, perception of achieved fame, and perception of attributed/celetoid fame. Due to methodological constraints, gender was excluded from the predictive analysis, as the sample included an insufficient number of male respondents (n = 48, 5.4%). However, a cross-tabulation of gender and age confirmed that the sample was predominantly female, with this distribution being statistically significant ($\chi^2 = 54.93$, p < .001), which is relevant when contextualising the findings. Additionally, employment status was also omitted, as it did not show predictive significance in preliminary testing.

In order to examine whether the origin of celebrity fame serves as a predictor of purchase likelihood, particularly due to specific response patterns for Kendall Jenner and Kim Kardashian–the category of celetoid fame was included under the broader classification of attributed fame in the statistical analysis. Celetoid fame refers to celebrities known primarily for short-term media exposure, scandals, and public appearances, which Rojek (2001) conceptualises as a subcategory of attributed fame. Accordingly, respondents who assigned the status

of "celetoid" to specific celebrities were statistically coded under the attributed fame category.

Table 1 provides a descriptive summary of the demographic and conceptual variables used as predictors in the subsequent analyses. These factors were considered relevant for exploring the relationship between the perceived origin of celebrity fame and its potential influence on purchase probability.

Table 1 Descriptive overview of predictive factors

Variable	Category	Frequency (N)	Percent (%)
Age group (years)	18–25	567	62.9
Age group (years)	26–35	239	26.5
Age group (years)	36 and above	73	8.1
Employment status	Unemployed	98	10.9
Employment status	Employed	426	47.2
Employment status	High school student	112	12.4
Employment status	College student	243	26.9
Ascribed fame indicators	None selected	203	22.5
Ascribed fame indicators	1 selected	454	50.3
Ascribed fame indicators	2 or more selected	222	24.6
Achieved fame indicators	At most 1 selected	554	61.4
Achieved fame indicators	2 selected	242	26.8
Achieved fame indicators	3 or more selected	83	9.2
Attributed/celetoid indicators	None selected	113	12.5
Attributed/celetoid indicators	1 selected	214	23.7
Attributed/celetoid indicators	2 selected	399	44.2
Attributed/celetoid indicators	3 or more selected	153	17.0

Source: Authors

Of the total sample of 902 respondents, 879 provided complete responses to the items used in the statistical analysis of perceived celebrity fame origin and its influence on purchase intentions. All analyses related to this index were therefore conducted on this subsample. The sample (N = 879) consisted predominantly of participants aged 18–25 (62.9%), followed by those aged 26–35 (26.5%), and 36+ (8.1%). Employment status showed that nearly half of the respondents were employed (47.2%), with students (both high school and college) making up a considerable portion of the sample (12.4% and 26.9%, respectively).

Regarding the perceived origin of celebrity fame indicators, participants could indicate whether they believed certain celebrities (selected celebrities for the research purposes elaborated earlier) became famous due to ascribed, achieved, or attributed (including celetoid) factors. Each indicator category reflects how many celebrities were assigned to that fame origin by the respondents. This approach allows for evaluating general perceptions of fame origin across different celebrity endorsements.

Table 2 presents the results of the general linear model analysis, identifying which predictors significantly influence the probability of purchasing a celebrity-endorsed product. For each predictor, the table reports the Type III sum of squares, degrees of freedom (df), mean square, F-value, significance level (p-value), and partial eta-squared as a measure of effect size. These values help determine the statistical significance and the relative contribution of each predictor to the model, based on the corrected total variance.

Table 2 Predictors of purchase probability

Predictor	Type III Sum of Squares	df	Mean Square	F	Sig. (p)	Partial Eta-Squared
Age group (years)	1117.138	2	558.569	20.633	0.000	0.045
Ascribed fame indicators	97.109	2	48.555	1.794	0.167	0.004
Achieved fame indicators	845.357	2	422.678	15.613	0.000	0.034
Attributed/celetoid indicators	9.634	3	3.211	0.119	0.949	0.000
Error	23768.997	878	27.072			
Total	138300.000	888				
Corrected Total	26137.387	887				

Source: Authors

The results indicate that two predictors–age group and perception of achieved fame–showed a statistically significant effect on purchase probability. Specifically, age group yielded a highly significant result ($F = 20.633$, $p < .001$) with a partial eta-squared value of .045, indicating a small to moderate effect size. Likewise, perception of achieved fame was also statistically significant ($F = 15.613$, $p < .001$) with a partial eta-squared value of .034, suggesting it is a meaningful predictor of consumer behaviour. In contrast, ascribed fame did not demonstrate a significant effect ($p = .167$), and attributed/celetoid fame was found to have no statistical significance ($p = .949$). These findings suggest that while perceived merit-based fame (achieved) and demographic factors (age) influence purchasing intentions, inherited or media-constructed fame plays a minimal role in shaping consumer decisions within this sample.

These findings align with Rojek's (2001) typology, which emphasises that achieved fame, grounded in talent and accomplishment, carries greater symbolic and moral capital—traits that enhance credibility in endorsement contexts. This is further supported by empirical studies such as those by Ananda et al. (2024) and Rafiah and Rahmawita (2025), which showed that consumers respond more positively to endorsements from celebrities perceived as credible, accomplished, and authentic. The significant effect of age and achieved fame confirms the first hypothesis (H1), which proposed these variables as statistically significant predictors of consumer purchase intention.

Conversely, the lack of significance for ascribed and attributed/celetoid fame supports the second hypothesis (H2), suggesting that inherited or media-constructed fame lacks the perceived authenticity required to influence consumer behaviour. Respondents showed lower levels of purchasing intentions when celebrities were associated with these fame origins, indicating a diminished level of consumer trust in endorsements perceived as unearned or media-constructed. The importance of age also aligns with previous literature, which highlights younger consumers as more receptive to celebrity culture (Mendick et al., 2018; Centeno & Wang, 2017) and celebrity endorsement influence (Syalsabila & Hermina, 2023; Dey et al., 2024).

In the next step of the analysis, we examined how the previously identified predictors specifically influence purchase intentions. Table 3 presents the results of parameter estimates, offering a more detailed understanding of the direction and strength of each predictor's effect on the likelihood of purchasing a celebrity-endorsed product.

Table 3 Parameter estimates – effects of predictors on purchase probability

Parameter	B	Std. Error	t	Sig. (p)
Age group: 18–25	3.065	0.638	4.804	0.000
Age group: 26–35	0.984	0.683	1.441	0.150
Age group: 36+ (ref)	0.000			
Ascribed: 0 selected	0.349	0.715	0.488	0.626
Ascribed: 1 selected	-0.566	0.579	-0.978	0.328
Ascribed: 2+ selected (ref)	0.000			
Achieved: ≤1 selected	-4.319	0.774	-5.583	0.000
Achieved: 2 selected	-3.460	0.752	-4.603	0.000
Achieved: 3+ selected (ref)	0.000			
Attributed: 0 selected	-0.403	0.889	-0.453	0.650
Attributed: 1 selected	-0.442	0.749	-0.590	0.556
Attributed: 2 selected	-0.188	0.572	-0.328	0.743
Attributed: 3+ selected (ref)	0.000			

Source: Authors

The results show that respondents aged 18–25 are significantly more likely to be influenced by celebrity endorsements compared to the reference group (36+), with a positive and statistically significant coefficient (B = 3.065, p < .001). This finding confirms the third hypothesis (H3), which stated that younger consumers are more receptive to celebrity influence in their purchasing decisions.

Regarding fame origin, the results indicate that participants who identified fewer celebrities as having achieved fame were significantly less likely to report high purchase intention, with negative coefficients for both "≤1 selected" (B = -4.319, p < .001) and "2 selected" (B = -3.460, p < .001) compared to the reference category "3+ selected". Specifically, participants who perceived a greater number of celebrities as having achieved fame (i.e., earned through talent, skill, or professional accomplishment) demonstrated a higher probability of purchasing endorsed products. This suggests that perceived credibility and authenticity associated with merit-based fame play a key role in influencing consumer decisions.

This further reinforces earlier findings and supports the argument—grounded in Rojek's (2001) typology—that perceived achievement-based fame is a strong driver of consumer trust and endorsement effectiveness (Dey et al., 2024; Lestari & Wahyono, 2021; Annissa & Paramita, 2021; Rafiah & Rahmawita, 2025).

In contrast, ascribed and attributed/celetoid fame again failed to reach statistical significance, indicating a minimal effect on purchase intention. These outcomes are consistent with the earlier analysis and theoretical expectations that authenticity, effort, and merit play a key role in shaping how consumers respond to celebrity endorsements, especially among younger, media-savvy audiences. Although attributed fame was not statistically significant, an interaction effect between age group and attributed fame status was tested to determine whether the impact of media-constructed fame on purchase likelihood varied across age cohorts. However, the analysis showed no statistically significant interaction, suggesting that the influence of attributed fame on consumer behaviour is consistent across age groups.

This finding contradicts the initial hypothesis H4, which proposed that younger consumers (aged 18–25), due to greater media exposure, would be more influenced by attributed fame than older participants. While it was assumed that younger cohorts, more immersed in social media and digital celebrity culture, might show greater susceptibility to celetoid fame, the data did not support this, suggesting that media-based fame does not have an age-differentiated effect.

This outcome may be partially explained by increasing media saturation and desensitisation among

younger users (Marwick, 2015; Abidin, 2018), as well as shifting attitudes toward influencer culture, where perceived inauthenticity or over-commercialisation can reduce persuasive impact (Djafarova & Trofimenko, 2019).

5. Discussion

The results of this study offer empirical support for the theoretical framework grounded in Rojek's (2001) classification of fame and further reinforce the relevance of media representation in shaping consumer responses to celebrity endorsements. Specifically, the findings confirm that achieved fame, defined as celebrity status earned through talent, skill, and personal accomplishment, is significantly associated with increased purchase intentions. This outcome is consistent with prior research highlighting the importance of celebrity credibility, expertise, skill and authenticity as critical predictors of endorsement effectiveness (Lestari & Wahyono, 2021; Annissa & Paramita, 2021; Rafiah & Rahmawita, 2025). These characteristics not only contribute to a more favourable brand image but also foster greater emotional attachment and trust among consumers–factors shown to directly influence purchasing decisions (Dey et al., 2024; Macheka et al., 2024).

Interestingly, ascribed fame (fame due to family background) and attributed/celetoid fame were found to be statistically insignificant in influencing purchase behaviour. This aligns with the critiques raised by Stewart and Giles (2019), who argue that attributed fame is often perceived as superficial, undermining consumer trust. Despite attributed celebrities often enjoying high visibility, the data reinforce the notion that visibility alone does not equate to influence, particularly when it lacks the grounding of perceived legitimacy or merit (Turner, 2004; Hearn & Schoenhoff, 2015).

Moreover, the significant role of age as a predictor, particularly the increased receptivity among respondents aged 18–25, aligns with the broader literature emphasising Generations Y and Z as the most actively engaged demographics in celebrity culture and social media (Mendick et al., 2018; Centeno & Wang, 2017). These findings confirm H3, which posited that younger consumers, specifically aged 18–25, are more likely to be influenced by celebrity endorsements compared to older age groups. Previous studies consistently report similar patterns; for example, Annissa and Paramita (2021) and Ananda et al. (2024) demonstrated that younger audiences are not only more exposed to celebrity-driven marketing but are also more susceptible to endorsement effects when the celebrity is perceived as relatable, aspirational, or trustworthy. Furthermore, Syalsabila and Hermina (2023) and Dey et al. (2024) found that attachment to a celebrity figure, especially one admired or idolised by younger consumers, can significantly increase emotional engagement and, consequently, purchasing behaviour. This is particularly true when the endorser embodies credibility and expertise, as these traits resonate with the values of younger, media-savvy consumers who are increasingly selective and critical of overtly commercial or inauthentic content (Dey et al., 2024). The present study extends these insights by empirically confirming that age, combined with perceptions of achieved fame, forms a strong basis for predicting endorsement effectiveness among younger audiences.

Although attributed fame was not found to be a significant predictor of purchase intention, an additional analysis tested for an interaction between age group and attributed fame to determine whether its influence varied across generations. Contrary to Hypothesis 4, the interaction was not statistically significant, indicating that media-constructed fame does not differentially impact younger versus older consumers.

This finding suggests that, despite greater exposure to digital celebrity culture, younger consumers are not necessarily more susceptible to attributed or celetoid fame. Instead, their purchasing decisions–like those of older cohorts–appear to rely more on perceived credibility and authenticity than mere visibility. These results reinforce the notion that media presence alone is insufficient to drive endorsement effectiveness without a foundation of perceived legitimacy.

Taken together, these findings contribute to a more nuanced understanding of how the origin of fame, filtered through media narratives and audience interpretation, affects consumer behaviour. While many prior studies confirm the general positive impact of celebrity endorsement on purchase intentions (e.g., Lestari & Wahyono, 2021; Syalsabila & Hermina, 2023), the present research clarifies that the type of fame matters, and that consumer evaluations are conditioned by both demographic factors and perceptions of legitimacy.

These insights not only validate Rojek's theoretical model in a marketing context but also reaffirm that celebrity endorsement is most effective when strategically aligned with public expectations of merit and credibility.

6. Conclusion

This study contributes to a more nuanced understanding of how the origin of celebrity fame, shaped through media narratives and audience interpretation, influences consumer behaviour. While celebrity endorsements are generally shown to have a positive impact, the findings highlight that the perceived legitimacy of fame—particularly when achieved through merit—plays a decisive role in shaping consumer trust and purchase intentions. The analysis confirmed that achieved fame is a statistically significant predictor of purchase intention (F = 15.613, p < .001), while ascribed and attributed/celetoid fame showed no significant effect. Additionally, younger consumers (aged 18–25) were more responsive to celebrity endorsements overall (F = 20.633, p < .001), reaffirming the relevance of this demographic for endorsement strategies. These results validate Rojek's model in a contemporary marketing context and reaffirm that effective endorsements depend not just on visibility, but on alignment with public expectations of credibility, authenticity, and expertise.

From a practical standpoint, brands should be strategic in selecting celebrity endorsers, prioritising those whose fame stems from perceived talent, skill, or professional achievement. Authenticity and a clear alignment between the celebrity's image and the brand's values can significantly enhance consumer trust and engagement. Marketers should also remain attuned to evolving audience perceptions, especially in the digital age where fame can be rapidly constructed and deconstructed.

Despite its contributions, the study has limitations, including a sample predominantly composed of young female respondents, which may affect generalisability. Additionally, the dynamic and evolving nature of digital fame may not always fit neatly into existing theoretical categories, highlighting the need for further refinement. Future research should adopt longitudinal and cross-cultural designs, incorporate micro-influencers, and explore platform-specific dynamics. Combining quantitative and qualitative approaches would offer a more comprehensive view of how fame is constructed, communicated, and interpreted across different audiences and media environments.

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DETERMINANTS OF DIGITAL EURO ACCEPTANCE AMONG STUDENTS: THE ROLE OF PRIVACY CONCERNS AND THE LIMITATIONS OF SECURITY MEASURES

Abstract

Purpose: The research examines the factors influencing university students' intention to use the digital euro, problematising the role of privacy concerns and the effectiveness of security measures

Methodology: The research is based on survey data from 150 students at the Faculty of Economics, Business and Tourism, University of Split, Croatia. Binary logistic regression, ROC curve analysis and chi-square independence tests were used.

Results: The results show that privacy concerns compared to other payment methods, preference for cash payments, belief in lower transaction cost, and familiarity with the digital euro significantly influence students' intention to adopt this digital currency. In particular, it was found that a high concern about privacy and a strong preference for cash had a negative impact on the intention to adopt the digital euro. On the other hand, a higher level of belief in lower transaction costs and better familiarity with the digital euro had a positive effect on their willingness to adopt. Additionally, the analysis showed that technical security measures, such as a digital signature, biometrics, encryption and pseudonymisation, did not significantly mitigate students' privacy concerns.

Conclusion: The research highlights the need to tackle privacy issues and strengthen trust in institutions and the legal framework, indicating that technical solutions alone are not enough to encourage adoption of the digital euro. Implementation of the digital euro as a means of payment requires broad strategies that pair technological progress with strong institutional protection, thereby reducing privacy risks and increasing trust of the digital euro as a payment instrument.

Keywords: Digital euro, adoption intention, privacy concerns, security measures, fintech, institutional trust

1. Introduction

The development of fintech has enabled the conceptual development and introduction of central bank digital currencies (CBDCs). Recent research has focused in particular on the digital euro as a form of digital money and complement to cash in the liabilities of the Eurosystem. Extensive discussions and comprehensive progress reports (Deutsche Bundesbank, 2024; European Central Bank, 2024; Tronnier et al., 2022) have highlighted numerous benefits but also a number of potential drawbacks, among which privacy and security concerns related to the use of the digital euro are particularly emphasised (Jabbar et al., 2023; Hamm et al., 2023; Mashatan et al., 2022). The importance of protecting privacy and security is fundamental and was already taken into account in the initial development phases as part of the "privacy by design" approach. In addition to technical aspects, security-related and institutional aspects of implementation, which have received less attention in the literature, are also becoming significant. Even in the case of possible technical deficiencies and shortcomings, the development of a suitable institutional security infrastructure ensures security and the repair of damage. It is also a fundamental link in the adoption of the digital euro, as it strengthens trust and accountability.

This article has two main objectives: first, to examine the factors influencing the intention to use the digital euro and to determine the role of privacy concerns; and second, to determine the importance of security measures in mitigating privacy concerns. These objectives were achieved through a survey of students from the Faculty of Economics, Business and Tourism, University of Split. The sample size was appropriate for the methodological framework and methods used. Binary logistic regression, ROC analysis and chi-square independence tests were used in statistical analyses to investigate the factors influencing the intention to use the digital euro, as well as the role of privacy perceptions and security measures. The analysis showed that students recognise the potential benefits of the digital euro but also stress privacy and the continued importance of cash for payments. This finding raises several questions, one of which is how well they understand the concept of the digital euro itself. The analysis also confirms that technical security solutions do little to ease privacy worries, implying the need to study security measures at the institutional level, specifically, how effectively legislation is implemented.

The paper consists of six sections. After the introduction, Section 2, which deals with theoretical and conceptual background, defines the importance of privacy and security in the development of the digital euro. The third section presents the research methodology, while the fourth section analyses the research results. The fifth section develops the discussion, reviews the paper's contribution, and provides directions for further research. Finally, the concluding considerations are presented in Section 6.

2. Theoretical and conceptual background

The discussion about central bank digital currencies (CBDCs) is becoming increasingly important. The digital euro, which was developed by the European Central Bank as a complement to cash to improve the efficiency of the payment system, financial integration and monetary sovereignty of the eurozone, occupies an important place in recent discussions and research. Despite numerous advantages such as speed, convenience and efficiency of transactions, the digital euro brings with it various challenges, with privacy protection being particularly emphasised.

The perception of risk in relation to the introduction of the digital euro, in particular the potential loss of privacy, is a decisive factor in the adoption of new technologies (Deutsche Bundesbank 2024, 2021; De Nederlandsche Bank 2021). This becomes clear when users realise that by paying with the digital euro, they are making their personal financial data (spending habits) accessible within the system. In line with the "privacy by design" approach, privacy protection is a core element of the architecture of the digital euro, which emphasises the anonymity of offline transactions. Nevertheless, the literature highlights challenges posed by centralised infrastructures that are vulnerable to cyber-attacks and regulatory abuse (Kramcsák et al., 2024), which exacerbates users' privacy concerns.

The literature review focuses on two areas: firstly, analysis of previous research on privacy concerns with a focus on the digital euro, and secondly, analysis of the literature on perceptions of the effectiveness of security measures and their influence on technology adoption.

In the fintech industry, privacy refers to the right of users to control access to their personal financial data, while risk refers to the possibility of adverse consequences when using certain technologies or

services (Karwatzki et al., 2022). In addition to traditional financial risks such as loss of money, fintech is increasingly faced with threats related to loss of privacy, security of digital identity and misuse of data (Mashatan et al., 2022). Digital currencies, especially the digital euro as a prime example of a CBDC, can increase the perceived risk and fear for privacy as transaction data is transparent (Borgonovo et al., 2019; Herskind et al., 2020). Hamm et al. (2023) confirm that privacy concerns significantly influence the intention to adopt digital currencies. According to Jabbar et al. (2023), users weigh the benefits against the risks and are willing to sacrifice some privacy if practical benefits such as ease of use justify it. The "digital privacy paradox" is notable as users claim to value privacy but often jeopardise it for relatively small benefits (Athey et al., 2017). Privacy concerns are shaped by the transparency of data use, the risk of data breaches and the demographic, psychological and cultural characteristics of users (Tronnier et al., 2022; Voskobojnikov et al., 2020; Gao et al., 2016).

In addition to privacy risks, the general perception of risk significantly influences users' attitudes towards digital currencies (Chen & Farkas, 2019). In addition to privacy concerns, users evaluate several other risk dimensions, such as financial and operational risks (Abramova & Böhme, 2016; Mashatan et al., 2022). To understand how these perceptions determine users' intentions and behaviour, researchers rely on established theoretical models. Frameworks such as the Technology Acceptance Model (TAM) and the Theory of Planned Behaviour (TPB) are commonly used to explain how perceived risks influence technology adoption (Tronnier et al., 2022; Marriott et al., 2017).

Although privacy concerns and risk perceptions dominate discussions about digital currency adoption, perceptions of security measures significantly influence users' trust in financial technologies. According to Zaghloul et al. (2020) and Krombholz et al. (2016), typical security technologies such as digital signatures, biometrics, encryption and pseudonymisation are generally perceived positively by users, yet they are often accompanied by unrealistic expectations regarding their effectiveness. Even though biometrics and pseudonymisation can mitigate privacy concerns to a certain extent, research shows that their implementation is often not enough to significantly reduce users' fears (Mashatan et al., 2022; Jabbar et al., 2023). There is therefore a noticeable gap between user expectations and the actual technical capabilities of these measures, which means that a high level of perceived risk remains despite advanced security technologies (Herskind et al., 2020).

3. Methodology

3.1 Description of the sample and operationalisation of the key variables

The study was conducted using survey data collected between July and September 2024. The target population consisted of students from the Faculty of Economics, Business and Tourism, University of Split, selected for their relevance as potential future users of the digital euro and assumed to be more familiar with the concept of the digital euro compared to the wider population. A non-random sample was used, targeting accessible and willing participants within this population. Surveys were distributed through personal invitations within faculty channels (student mailing lists). The total sample size was 150 respondents, which was appropriate for the exploratory nature of the study and the statistical methods used (binary logistic regression and chi-square tests). The data were collected using electronic surveys via Google Forms, which ensure anonymity and easy access. While this sampling frame is not representative of the entire Croatian or EU student population, it allowed for targeted insights into a subgroup with greater familiarity with economic concepts, payment systems, and the (digital) euro.

The questionnaire consisted of closed questions to operationalise the variables of interest, primarily on a Likert scale from 1 to 5. However, the main dependent variable, intention to use the digital euro, was measured using a categorical scale with four distinct options to capture nuanced attitudes towards adoption. This scale was chosen to reflect realistic decision-making stages rather than a standard agreement continuum. The independent variables included perceptions and attitudes (*privacy concerns, sense of security, familiarity with the concept, importance of cash*) and socio-demographic characteristics, including gender and year of study (see Table 1). The variables were dichotomised to simplify the analysis and provide clearer insights into the differences between groups of respondents and to ensure consistency of statisti-

cal processing. This approach maintains analytical relevance while promoting interpretative clarity of the results.

Within the sample, 70% of respondents were female (n=105), while 30% were male (n=45). In addition, the distribution of respondents by their year of study was as follows: 12.7% were first-year students (n=19), 7.3% second-year (n=11), 27.3% third-year (n=41), 18.7% fourth-year (n=28), and 34.0% fifth-year students (n=51). This structure indicates that the majority of participants were in the more advanced stages of their studies, which may have influenced their familiarity with economic and financial concepts, and consequently their ability to evaluate the potential introduction of the digital euro.

Table 1 Definition and operationalisation of key variables

Variable status	Variable name	Original measurement scale	Recoding
Dependent variable	Intention to use Dig_EUR	{1, Yes, immediately}; {2, Yes, after some time}; {3, No}; {4, Not sure}	Dichotomous variable - {1,2, Intention to use}; {3,4, No intention to use}
Independent variable	Privacy concerns	{1, Not at all concerned}; {2, Slightly concerned}; {3, Moderately concerned}; {4, Concerned}; {5, Very concerned}	Dichotomous variable - {1,2,3, Low to moderate concern}; {4,5, High concern}
Independent variable	Belief in lower transaction cost	{1, Do not believe at all}; {2, Slightly believe}; {3, Neutral}; {4, Believe}; {5, Strongly believe}	Dichotomous variable - {1,2,3, Low to moderate belief}; {4,5, High belief}
Independent variable	Belief in greater security compared to cryptocurrencies	{1, Do not believe at all}; {2, Slightly believe}; {3, Neutral}; {4, Believe}; {5, Strongly believe}	Dichotomous variable - {1,2,3, Low to moderate belief}; {4,5, High belief}
Independent variable	Belief in complexity of use	{1, Don't believe at all}; {2, Believe a little}; {3, Neutral}; {4, Believe}; {5, Strongly believe}	Dichotomous variable - {1,2,3, Low to moderate belief}; {4,5, High belief}
Independent variable	Familiarity with Dig_EUR	{1, Not at all familiar}; {2, Slightly familiar}; {3, Somewhat familiar}; {4, Well familiar}; {5, Very well familiar}	Dichotomous variable - {1,2,3, Low to moderate familiarity}; {4,5, High familiarity}
Independent variable	Use of financial technology	{1, Never}; {2, Rarely}; {3, Sometimes}; {4, Often}; {5, Almost always}	Dichotomous variable - {1,2,3, Rare or moderate use}; {4,5, Frequent or intensive use}
Independent variable	Importance of cash	{1, Not at all important}; {2, Slightly important}; {3, Moderately important}; {4, Very important}; {5, Extremely important}	Dichotomous variable - {1,2,3, Low to moderate importance}; {4,5, High importance}
Independent variable	Source of information	{1, Faculty}; {2, Media}; {3, Internet}; {4, Social networks}; {5, Personal contact}; {6, Professional publications}; {7, Banks}; {8, Other}	Categorical variable - {1,6, Faculty and professional publications}; {2,3,4,5,7,8, Other}
Independent variable	Gender	{1, Female}; {2, Male}	Categorical variable - {1, Female}; {2, Male}
Independent variable	Year of study	{1, First year}; {2, Second year}; {3, Third year}; {4, Fourth year}; {5, Fifth year}	Dichotomous variable - {1,2,3, Undergraduate level}; {4,5, Graduate level}

Variable status	Variable name	Original measurement scale	Recoding
Independent / **Dependent variable**	Belief in privacy concerns compared to other payment methods	{1, No impact}; {2, Low impact}; {3, Moderate impact}; {4, Significant impact}; {5, Complete threat to privacy}	Dichotomous variable - {1,2,3, Low to moderate perceived threat}; {4,5, High perceived threat}
Independent variable	Measure - Digital signature	{1, Not at all important}; {2, Slightly important}; {3, Moderately important}; {4, Very important}; {5, Extremely important}	Dichotomous variable - {1,2,3, Low to moderate importance}; {4,5, High importance}
Independent variable	Measure - Biometrics	{1, Not at all important}; {2, Slightly important}; {3, Moderately important}; {4, Very important}; {5, Extremely important}	Dichotomous variable - {1,2,3, Low to moderate importance}; {4,5, High importance}
Independent variable	Measure - Authorisation control	{1, Not at all important}; {2, Slightly important}; {3, Moderately important}; {4, Very important}; {5, Extremely important}	Dichotomous variable - {1,2,3, Low to moderate importance}; {4,5, High importance}
Independent variable	Measure - Encryption	{1, Not at all important}; {2, Slightly important}; {3, Moderately important}; {4, Very important}; {5, Extremely important}	Dichotomous variable - {1,2,3, Low to moderate importance}; {4,5, High importance}
Independent variable	Measure - Pseudonymisation	{1, Not at all important}; {2, Slightly important}; {3, Moderately important}; {4, Very important}; {5, Extremely important}	Dichotomous variable - {1,2,3, Low to moderate importance}; {4,5, High importance}

Note: Questionnaire items were adapted for research purposes based on the following sources: Deutsche Bundesbank (2024); Tronnier et al. (2022); Deutsche Bundesbank (2021).

Source: Compiled by the authors

The descriptive statistics of the variables indicate several key characteristics of the respondents. The variables related to the use of financial technology have the highest value (M=4.20, SD=0.867), indicating frequent use by the respondents. Security measures, in particular authorisation control (M=4.17, SD=1.096), encryption (M=4.16, SD=1.106), and biometric authentication (M=4.15, SD=1.110), were rated highly, indicating a high level of sensitivity to the security aspects of the digital euro. The variables describing the perceived complexity of using the digital euro (M=2.27, SD=1.028) and familiarity with the concept of the digital euro (M=2.50, SD=1.008) had the lowest mean scores, indicating a relatively low perceived complexity but also limited familiarity with the concept itself. The analysis of distribution asymmetry shows a pre-dominant negative asymmetry for variables relating to security measures and the use of fintech, indicating that most respondents rate these aspects highly. Conversely, a positive asymmetry was found for the intention to use the digital euro (skewness=0.690), indicating significant reservations about immediate adoption. Most of the variables showed a slightly negative kurtosis, which indicates a slightly larger dispersion compared to the normal distribution.

The descriptive analysis shows an intriguing pattern: respondents express major concerns about privacy protection while at the same time being in favour of technical security measures such as authorisation control, encryption and biometric authentication. In the context of the digital euro, this paradox suggests that technical solutions alone are not enough to gain the trust of users.

Table 2 Descriptive statistics

Variable	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Intention to use Dig_EUR	150	1	4	2.48	.880	.690	.198	-.621	.394
Privacy concern	150	1	5	2.97	1.223	.064	.198	-.863	.394
Belief in lower transaction cost	150	1	5	2.90	1.122	-.176	.198	-.806	.394
Belief in greater security compared to cryptocurrencies	150	1	5	3.29	1.051	-.633	.198	.044	.394
Belief in complexity of use	150	1	5	2.27	1.028	.384	.198	-.512	.394
Familiarity with Dig_EUR	150	1	5	2.50	1.008	.299	.198	-.261	.394
Use of financial technology	150	2	5	4.20	.867	-1.027	.198	.520	.394
Importance of cash	150	1	5	3.33	1.028	-.106	.198	-.393	.394
Year of study	150	1	5	3.54	1.359	-.532	.198	-.831	.394
Belief in privacy concerns compared to other payment methods	150	1	5	2.95	.992	-.240	.198	-.158	.394
Measure - Digital signature	150	1	5	3.98	1.261	-.980	.198	-.151	.394
Measure - Biometrics	150	1	5	4.15	1.110	-1.085	.198	.177	.394
Measure - Authorisation control	150	1	5	4.17	1.096	-1.082	.198	.103	.394
Measure - Encryption	150	1	5	4.16	1.106	-1.107	.198	.243	.394
Measure - Pseudonymisation	150	1	5	3.85	1.167	-.687	.198	-.384	.394

Source: Compiled by the authors

The distribution of responses for the main dependent variables of the study, which provide an insight into the attitudes and perceptions of students of the Faculty of Economics, Business and Tourism, University of Split, with regard to the digital euro. The analysis focuses on two main variables: the intention to use the digital euro and the belief that the use of the digital euro is associated with privacy risks.

According to the survey results, 60% of respondents stated that they would use the digital euro, but only after some time. A smaller proportion, 6%, stated that they would use the digital euro as soon as it is available, indicating a degree of confidence in this new technology and digital currency. Conversely, 14% of respondents indicated that they would not use the digital euro, while 20% remained unclear about its use.

Figure 1 Distribution of responses regarding the intention to use the digital euro
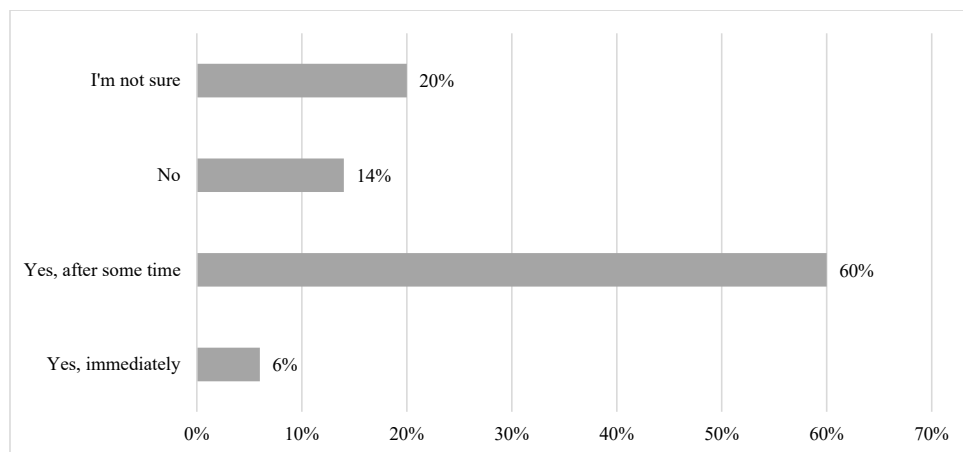
Source: Compiled by the authors

Respondents believe that the digital euro could jeopardise their privacy and see it as a potential risk to the protection of personal data, which could be an obstacle to wider adoption. According to the data collected, 73.4% of respondents believe that the use of the digital euro could moderately, significantly or completely compromise or threaten their privacy. Conversely, only 26.7% believe that this impact would be negligible or non-existent.

Figure 2 Distribution of responses regarding the belief in a threat to privacy from the use of the digital euro compared to other means of payment
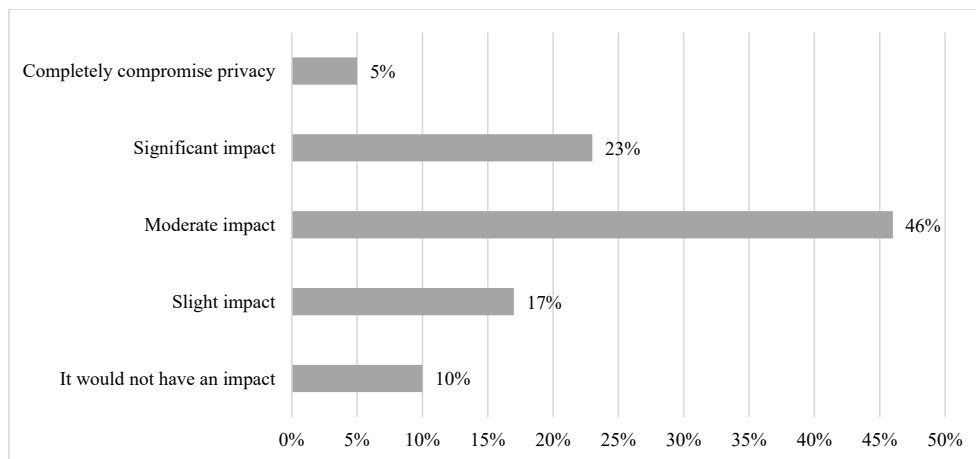
Source: Compiled by the authors

3.2 Methods of data analysis

In this study, several statistical methods were used to analyse the collected data. Binary logistic regression was used to identify the main determinants influencing students' intention to use the digital euro. Logistic regression is particularly well suited for modelling dichotomous (binary) outcomes and allows the assessment of relationships between mul-

between predicted and observed values within the prediction deciles. The classification accuracy of the model is 76%, the specificity is 80.8%, and the sensitivity is 66.7%.

The theoretical logistic regression model is expressed as follows:

$$\text{logit}(p) = -1.448 + 1.627X1 + 1.542X2 - 1.375X3 - 1.643X4.$$

Respondents who perceive a high threat to privacy from the digital euro compared to other means of payment are 5 times more likely not to use it than respondents who perceive a low to medium threat [β=1.627, Exp(β)=5.090, p<0.001]. Respondents for whom cash is very important are 4.7 times more likely not to use the digital euro [β=1.542, Exp(β)=4.674, p<0.001] than respondents who consider cash less important. The model suggests that

the threat to privacy and the importance of cash are the biggest barriers to the adoption of the digital euro. Conversely, belief in the efficiency of transactions and familiarity with the digital euro are facilitating factors. Individuals who believe that the digital euro reduces transaction costs are 74.7% less likely to reject it [β=-1.375, Exp(β)=0.253, p=0.005], and individuals who are better informed about the digital euro are 80.7% less likely to reject it [β=-1.643, Exp(β)=0.193, p=0.029].

Additional confirmation of the model quality was obtained by the ROC analysis. The area under the curve (AUC) was 0.777 ≈ 0.8 (SE = 0.041; p < 0.001; CI95% = [0.696 - 0.857]), indicating a very good discriminatory ability of the model according to Fawcett (2006) and Hosmer et al. (2013), which accurately distinguishes between students who intend to use the digital euro and those who do not.

Figure 3 ROC curve for predicting the intention to use the digital euro
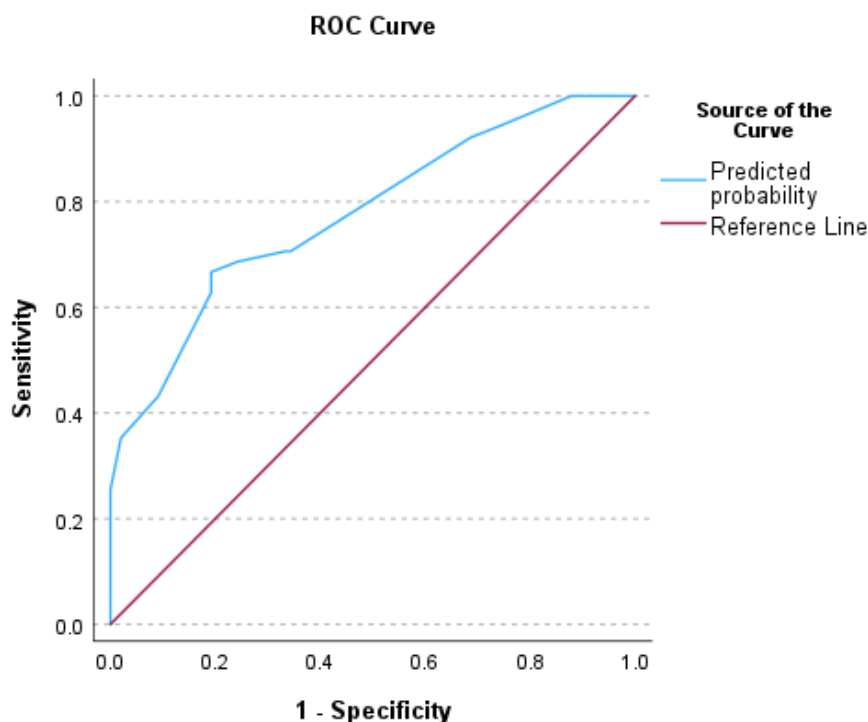
Source: Compiled by the authors

To further examine the robustness of the binary logistic regression results, chi-square tests for independence were performed to examine bivari-

ate relationships between the dependent variable, intention to use the digital euro, and individual predictor variables. In contrast to logistic re-

gression, which simultaneously controls for the effects of multiple predictors, chi-square tests allow the identification of potentially significant relationships at the level of individual variables, independent of others. This provides a more comprehensive insight into the data patterns and confirms the results obtained with the multidimensional model.

Table 5 Chi-square test results for associations with the intention to use the digital euro

Variable	X^2 value	p-value	Confirmed by binary logistic regression
Belief in privacy concerns compared to other payment methods	18.297	< 0.001	Yes
Importance of cash	14.61	< 0.001	Yes
Belief in lower transaction cost	6.551	0.01	Yes
Familiarity with the digital euro	4.229	0.04	Yes
Privacy concerns	14.441	< 0.001	No
Perceived complexity of use	9.638	0.002	No
Opposition to digital money	9.037	0.003	No
Perceived security (digital euro is more secure)	6.805	0.009	No
Belief in security compared to cryptocurrencies	4.015	0.045	No

Source: Compiled by the authors

4.2 Concerns about privacy and the limits of security measures

Having established that privacy concerns are the most important predictor of the intention to adopt a digital euro, in this analysis we investigated whether technical security measures that can provide greater privacy protection can effectively mitigate these concerns. A binary logistic regression using a forward stepwise method (likelihood ratio) examined the effects of security measures on students' concerns about using the digital euro. The measures were the digital signature, biometrics, authorisation control, encryption and pseudonymisation.

The logistic regression results showed that none of the security measures made statistically significant contributions to the model (p > 0.05).

Table 6 First selection results for security variables in logistic regression

Variable	Score	df	p-value
Measure - Digital signature	0.743	1	0.389
Measure - Biometrics	1.112	1	0.292
Measure - Authorisation control	0.135	1	0.713
Measure - Encryption	0.024	1	0.878
Measure - Pseudonymisation	0.944	1	0.331

Source: Compiled by the authors

Chi-square tests confirmed these results and also showed no statistically significant correlations between the technical measures mentioned and privacy concerns.

These results indicate that the perception of privacy is not significantly influenced by the available technical security measures, confirming the paradox identified earlier: Although technical security measures are highly rated, these measures do not adequately address privacy concerns.

This emphasises the need for further research on other potential factors influencing privacy concerns, such as institutional trust and regulatory assurances, which are crucial for overcoming perceived risks among potential users of the digital euro.

Table 7 Chi-square test results for the relationship between security measures and privacy concerns

Variable	χ^2 value	p-value	Confirmed by binary logistic regression
Measure - Digital signature	0.743	0.389	No
Measure - Biometrics	1.112	0.292	No
Measure - Authorisation control	0.135	0.713	No
Measure - Encryption	0.024	0.878	No
Measure - Pseudonymisation	0.944	0.331	No

Source: Compiled by the authors

The results indicate that students' perception of privacy is not significantly influenced by the available technical security measures. These results support the previously identified paradox from the analysis: Although students express a high degree of importance regarding technical security measures, these measures do not explain their privacy concerns.

5. Discussion

The research results confirm the original assumptions. Students recognised the potential benefits of the digital euro, such as faster and cheaper transactions, but at the same time viewed risks to privacy as a major barrier. The logistic regression analysis revealed that perceived privacy threat, importance of cash, confidence in transaction security, and familiarity with the digital euro were significant predictors of adoption. The ROC analysis also confirms the strong discriminatory power of the model (AUC = 0.777), with concern for privacy proving to be the most significant predictor compared to other payment methods. The results of this study are consistent with the Deutsche Bundesbank (2024) and the European Data Protection Board (2023), both of which emphasised data protection as a key factor for the introduction of the digital euro.

The results also indicate that technical security measures such as biometric authentication, digital signatures, encryption and pseudonymisation do not significantly reduce privacy concerns. This

suggests that technical protection measures alone are not sufficient to improve the acceptance of the digital euro (Jabbar et al., 2023; Lee et al., 2021). Concerns about surveillance and misuse of personal data cannot be addressed by technology alone, but point to the need for stronger institutional data control. In this respect, the findings support previous work by the European Data Protection Board (2023) and Panetta (2021), emphasising that institutional safeguards and oversight mechanisms are essential for the public acceptance of central bank digital currencies.

Another important result concerns the role of familiarity. Students reported relatively low levels of knowledge about the digital euro (mean score 2.5 on a five-point scale). Our analysis shows that greater familiarity is associated with a higher likelihood of adoption, highlighting that privacy sensitivity is partly shaped by knowledge gaps. This is consistent with earlier findings, which underline the need for education (Horváth, 2023) and transparent communication of institutional safeguards to build user trust (Bijlsman et al., 2023).

The model analysed also takes into account the characteristics of the sample. While gender is not statistically significant in the regression model, it may still be important to understand the observed strong sensitivity to privacy, as 70% of respondents were female. According to van der Cruijsen and Broekhoff (2024), women tend to be more afraid

of the digital world and have less knowledge about payment fraud. In contrast, men are more inclined to adopt new digital payment instruments. In terms of their year of study, the majority of participants were in their senior year of study (the third to fifth year of study, 80%). Although gender and year of study do not have a statistically significant influence on the intention to use the digital euro, this structure may have influenced perceptions, as students who are more familiar with economic and financial concepts may be better able to assess the impact of the digital euro, especially when weighing up its benefits and risks.

The results support the view that the adoption of the digital euro depends precisely on the confidence that its implementation avoids privacy concerns, and that this cannot be achieved through technical design solutions alone. From a theoretical perspective, acceptance depends on the integration of institutional, legal and social safeguards that address privacy issues, combined with education and communication strategies that support the adoption of the digital euro. The interplay of institutional trust and public understanding therefore proves to be a key prerequisite for the acceptance of central bank digital currencies. From a theoretical perspective, the results support the notion that the implementation of the digital euro must not only provide technical solutions, but also institutional, legal and societal guarantees for the protection of privacy.

5.1 Policy and practical implications

In line with the research results, the implementation of the digital euro must prioritise strengthening user trust. This requires embedding data protection principles into its architecture. Such an approach includes enabling anonymous transactions for smaller amounts, establishing strict limits on data collection and access, and ensuring independent oversight. Beyond technical design, transparent communication with citizens on both the legal and institutional safeguards, as well as the broader benefits of introducing the digital euro, is of critical importance.

Both the European Union and Croatia are already moving in this direction. At the European level, the digital euro project is in its active preparation phase (November 2023 - October 2025) and represents the central framework for national strategies, including Croatia's. This process explicitly emphasises "privacy by design" principles, with ongoing consultation on the appropriate level of transaction anonymity, proportionality of data use, and institutional supervision (European Data Protection Board, 2023). In the Croatian context, alignment with these standards will be crucial, but national authorities must also ensure that European-level guarantees are communicated in an accessible and locally relevant manner.

The findings of this study further suggest that familiarity with the digital euro is important. Therefore, public communication (educational campaigns) coordinated at the EU level should be implemented locally. Such campaigns should clearly explain who has access to transaction data, under which legal basis, and what protections are available. Communication strategies should not only highlight technological safeguards but also underline legal protections and institutional guarantees against the misuse of personal data. In Croatia, the Croatian National Bank (HNB) should take a leading role in carrying out public communication efforts aimed at improving familiarity with the digital euro.

Finally, evidence-based pilot projects and systematic reporting practices are necessary to complement the existing technical and legal infrastructure for the digital euro. Public reporting of pilot outcomes, covering adoption rates, privacy-related incidents, and user comprehension, would build trust through verifiable evidence rather than abstract assurances. Such an integrated approach to policies and measures directly responds to the insights from this study, according to which trust and familiarity with the digital euro emerge as decisive conditions for wider acceptance.

5.2 Limitations of the research and future research directions

Despite its contributions, this study has several limitations that should be acknowledged. First, the research was conducted on a student population of economics majors. While this group is relevant given their potential role as future users of the digital euro and their relatively high level of financial literacy, the results cannot be fully generalised to the wider population. Older citizens or those with lower levels of digital literacy, different payment habits, and less confidence in using new technologies may perceive the risks and benefits of the digital euro differently, and ultimately display different levels of willingness to adopt it. Future research should therefore aim to broaden the sample to include other age, educational, and socio-economic groups, thereby allowing for more meaningful comparisons.

Second, the role of broader socio-psychological factors, such as institutional trust, risk aversion, and overall digital literacy, requires deeper investigation, as these may be closely linked to intentions to adopt the digital euro. The introduction of the digital euro represents not only a technological, but also an institutional and societal change. Future studies should therefore explore how different dimensions of trust, whether in central banks or in technological solutions, shape attitudes towards adoption.

Third, longitudinal and cross-country comparative research would be particularly valuable for tracing how perceptions of privacy and acceptance of the digital euro evolve over time. Such studies could provide insight into the dynamics of public trust and user attitudes under the influence of institutional and regulatory developments.

Finally, further research should also assess the effectiveness of public communication strategies aimed at familiarising citizens with the concept and functions of the digital euro. An open question remains whether such communication can lead to behavioural change and long-term acceptance. Addressing this issue would allow for a more precise evaluation of which combination of regulatory measures, institutional guarantees, and educational approaches most effectively builds trust in the digital euro.

6. Conclusion

This study focused on the analysis of the factors influencing the acceptance of the digital euro among students, with particular attention to privacy concerns and perceptions of security measures. The results of the binary logistic regression model indicate that perceived risk to privacy, importance of cash, confidence in the security of transactions and familiarity with the concept of the digital euro significantly influence attitudes towards its adoption. At the same time, the proposed security technologies showed no significant impact on reducing privacy concerns, indicating a limited understanding of technical security solutions.

Students who reported higher levels of familiarity were substantially more likely to express an intention to adopt the digital euro. Given that the research population consisted of economics students, many of whom were in advanced stages of study, this finding suggests that exposure to financial and economic concepts can enhance understanding and lower perceived barriers to adoption. At the

same time, the results indicate that even within a population expected to possess relatively high financial literacy, average familiarity with the digital euro was only moderate. This signals a gap between general economic knowledge and awareness of specific financial innovations, a gap that may be even wider in the general population.

The second model showed that no single technical solution has a statistically significant effect on privacy concerns related to the intention to use the digital euro. Even more advanced technical measures failed to lessen concerns of privacy. Thus, alongside understanding and overcoming the limits of technical fixes, the institutional-regulatory framework plays an important role in encouraging the adoption of the digital euro by lowering the perceived privacy risk.

The acceptance of the digital euro does not depend solely on addressing privacy concerns through institutional and regulatory frameworks, but also on building knowledge about the currency itself. Among economics students, familiarity with the digital euro emerged as a one of the key factors facilitating adoption. Public communication and the dissemination of information aimed at increasing awareness of its functions and benefits are therefore indispensable components of a successful introduction strategy. For policymakers, this underscores the need for a holistic approach: combining legal and institutional guarantees for privacy with sustained efforts to raise public awareness and understanding of the digital euro as a complement to cash and a reliable means of payment.

Although this study provides valuable insights into the attitudes of economics students towards the adoption of the digital euro, several limitations should be acknowledged. The reliance on a student population limits the generalisability of the findings, as older groups or those with lower levels of digital and financial literacy may perceive risks and benefits differently, and ultimately display varying intentions to adopt the digital euro. Future research should therefore include more diverse demographic and socio-economic samples and track changes in attitudes over time, particularly as the ECB moves closer to potential issuance. In addition, broader factors such as institutional trust, digital literacy, and the effectiveness of educational interventions deserve closer examination in order to understand how they shape the long-term acceptance of the digital euro.

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RELATIONSHIP BETWEEN REGIONAL DISPARITIES AND NATIONAL GROWTH IN CROATIA

Abstract

Purpose: This paper analyzes the applicability of Williamson's inverted U-curve hypothesis to Croatian regional development from 2000 to 2021. According to the theories of Kuznets (1955) and Williamson (1965), regional disparities tend to increase initially and then decline as economic development progresses. This phenomenon, known as the Kuznets-Williamson hypothesis, serves as the foundation for this study, which aims to test its validity in the context of the development of the Croatian counties from 2000 to 2021.

Methodology: This paper employs Pearson's correlation coefficient to examine the relationship between regional disparities, measured by the coefficient of variation, and economic growth, measured by the annual growth rate of national GDP per capita.

Results: The results of the analysis confirm the validity of the Kuznets-Williamson hypothesis in the case of Croatia. During the first phase of economic growth (until 2010), regional disparities increased, while in the second phase (from 2010 onwards), they decreased. Evidence of β-convergence (2015-2021) suggests that poorer regions grew faster, reducing the development gap.

Conclusion: Regional disparities in Croatia from 2000 to 2021 follow the Kuznets-Williamson hypothesis, i.e. disparities increased until 2010 and declined thereafter. Additionally, Zagreb's economic dominance played a key role in regional disparities, particularly between 2000 and 2014. However, after 2014, regional disparities decreased despite a slight increase in Zagreb's dominance, an outcome that is somewhat unexpected. The stronger integration of Croatia into the European Union may have played a crucial role in accelerating the growth of poorer counties and reducing regional disparities.

Keywords: Regional disparities, economic growth, Croatia, counties, Kuznets-Williamson hypothesis

1. Introduction

This paper examines Croatia's economic development over the past twenty years, focusing on the trade-off between national growth and regional inequality. Between 2000 and 2021, Croatia experienced several significant events that influenced both overall economic growth and the evolution of regional disparities. Several major events are high-

lighted: the global financial crisis of 2009, Croatia's accession to the European Union in 2013, the pre-pandemic expansion, and the COVID-19 pandemic in 2020. Each of these events had profound implications for Croatia's economic landscape, contributing to shifts in both national economic performance and the balance of regional disparities.

In line with the Kuznets-Williamson hypothesis, three key observations can be made regarding the evolution of regional disparities in Croatia:

1. Less developed counties grew faster than more developed ones, especially in the post-crisis of 2009-2014, indicating evidence of β-convergence;

2. Over the past 20 years of economic development, regional inequalities initially increased (σ-divergence) and subsequently decreased (σ-convergence);

3. Economic activities in Croatia are highly unevenly distributed, with the City of Zagreb holding a dominant position both in absolute and relative terms.

This paper is structured as follows: The introduction is followed by the theoretical background and a literature review highlighting the most significant works addressing regional disparities and examining the Kuznets-Williamson hypothesis. The third section analyzes regional disparities in Croatia, measured by GDP, GDP per capita, and the shares of individual counties in Croatia's total GDP, with a particular focus on the City of Zagreb. The Kuznets-Williamson hypothesis is also tested, exploring the evolution of the relationship between regional disparities and economic growth, along with assessments of beta and sigma convergence. Finally, Section 5 provides key considerations and recommendations for economic policymakers.

2. Theoretical background and literature review

2.1 Theoretical background

Regional inequalities in income levels and economic development are present in most countries, and their explanation stems from different theoretical approaches. In this paper, the theoretical framework is primarily based on the Kuznets-Williamson hypothesis. The core ideas proposed by Kuznets (1955) and Williamson (1965) suggest that spatial

inequalities tend to increase during the early stages of economic development, reach a peak, and then decline. This phenomenon is often described as an inverted U-shaped relationship between regional (spatial) inequalities and economic development. The underlying mechanism is that, in the initial phases of development, economic gains tend to be concentrated among a limited segment of the population, typically those investing in physical capital. As a result, economic disparities widen. However, as development progresses, a structural transformation occurs, with more individuals transitioning from the agricultural sector to the industrial sector, leading to a reduction in inequalities. In a spatial context, this implies that the benefits of economic development are initially confined not only to a select few but also to specific geographic areas. For instance, during the early stages of industrialization, regions rich in natural resources such as coal and iron often experience more rapid development, exacerbating regional inequalities.

As industrialization advances, labor migration from less developed to more developed regions can create balancing effects. The influx of workers into industrial hubs decreases wages in those regions while increasing wages in poorer areas due to labor shortages, narrowing the income gap across the country. Furthermore, government interventions, including public investments and economic assistance, play a crucial role in mitigating regional disparities. These dynamics collectively produce an inverted U-shaped curve of regional inequality over the course of economic development. Figure 1 displays the basic Kuznets-Williamson hypothesis, also known as Williamson's curve of regional disparities.

Figure 1 Williamson's curve of regional disparities
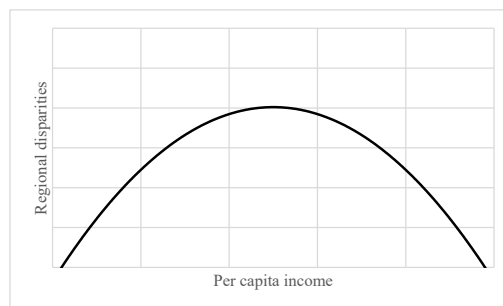
Source: Authors, on the basis of Capello (2016), p. 204

2.2 Literature review

In this section, we review key literature on the Kuznets-Williamson hypothesis and then focus on studies that explore the dynamics of regional inequalities in the context of economic growth in Croatia. As mentioned in the introduction, the theoretical foundation of this paper is based on the works of Kuznets (1955) and Williamson (1965). In his seminal work, Kuznets (1955) examined the nature and causes of personal income inequality in the United States. He proposed that income inequality tends to first increase and then decrease as economic development progresses. He identified the concentration of industrialization in one or a few regions as a key driver of rising inequality, while the subsequent spread of industrial development across the country leads to a reduction in disparities. Building on this hypothesis, Williamson (1965) applied it to regional disparities in both developed and developing countries. By introducing the coefficient of variation as a measure of regional inequality, he concluded that regional disparities also follow an inverted U-shaped pattern during economic development, first increasing, then decreasing. The Kuznets-Williamson hypothesis has been highly influential since its inception, prompting numerous authors to test its validity across different time periods and countries or regions. However, empirical findings remain mixed. The first part of this literature review presents the most significant studies that confirm the existence of the Kuznets-Williamson hypothesis, while the second part focuses on those that fail to confirm it or propose alternative interpretations of the hypothesis.

Kuznets's discovery was soon followed by studies that confirmed the pattern of inequality first increasing and then decreasing with economic growth. For instance, Easterlin (1958) identified the key factors driving the convergence of regional income levels in the United States, providing early empirical support for this relationship. Smolensky (1961) reached a similar conclusion in his analysis of the relationship between national income and per capita income distribution in the United States from 1919 to 1950. He found that income inequality increased during the 1920s and then steadily decreased until the end of World War II. Perin and Semple (1976) confirm that income inequalities in the United States decreased during the period 1953–1972, but at a decreasing rate. Robinson (1976) developed a simple two-sector model demonstrat-

ing that regional inequalities can persist and remain long-lasting if not addressed through appropriate countervailing policies. In more recent years, studies that have empirically confirmed this phenomenon include Kim and Margo (2003), who argued that economic geography is intrinsically tied to the process of economic development. From a historical perspective, regional inequalities in the United States initially increased during the 19th century, as industry dominated the North while agriculture prevailed in the South. By the second half of the 20th century, however, these inequalities diminished due to the widespread industrialization and the shift toward a tertiary-based economy. Ezcurra and Rapún (2006), who analyzed 14 Western European countries during the period 1980-2002, came to the conclusion that regional inequalities are transitory, they increase initially and then decrease during economic development. Barrios and Strobl (2009) use regional data from European countries and conclude that there is an inverted U-shaped relationship between regional inequalities and GDP per capita. Davies and Hallet (2002) only partially confirmed Williamson's hypothesis regarding the evolution of regional inequalities during economic development. Using data from EU-15 countries, they found evidence that regional inequalities increase during the early stages of development but found little support for the notion that these inequalities decrease in the later stages. Petrakos et al. (2003) found that, in the short term, regional inequalities within the EU are pro-cyclical, increasing during periods of economic expansion and decreasing during periods of slower growth. In the long term, however, these inequalities tend to decline. Rusnák et al. (2023) test the Kuznets-Williamson hypothesis on the example of Slovakia. Their analysis confirms that Slovakia has entered the second phase of regional development, characterized by a decline in regional inequalities. However, this comes at the cost of lagging behind the EU's average standard of living. Other studies that have confirmed the existence of an inverted U-shaped relationship between economic development and regional inequalities include Crafts (2005) for the United Kingdom, Combes et al. (2011) for France, Martinez-Galarraga et al. (2015) for Spain, Badia-Miró et al. (2012) for Portugal, and Neszmélyi et al. (2016) for the Visegrad Group.

However, there are also studies that have not found a strong link between inequality and development,

as predicted by the Kuznets-Williamson hypothesis, especially in cases where inequalities increase in the highest stages of development. Therefore, the focus shifted to explaining an N-shaped relationship between development and regional inequalities. Amos (1988) examined the Kuznets-Williamson hypothesis using data from the U.S. states and found that, in the later stages of economic development, regional inequalities tend to increase once again. This finding suggests that the Kuznets curve evolves beyond its traditional inverted U shape, forming a pattern resembling the letter N. This finding is inconsistent with the neoclassical logic underlying the inverted-U hypothesis, which posits that inequalities should not increase once regional convergence is achieved in the later stages of development, as pointed by Fan and Casett (1994), who argue that the inverted-U hypothesis no longer adequately explains the recent rise in regional inequalities. Instead, they suggest that U.S. regional development is now shaped by new factors, such as sectoral shifts and global restructuring, necessitating the adoption of new frameworks and tools to better understand and address regional inequalities. Terrasi (1999) also suggests that regional inequalities tend to increase in the later stages of economic development. Analyzing the period from 1953 to 1993 for Italian regions, the study observes a trend of regional income convergence up until 1975, followed by a period of divergence thereafter. Giannetti (2002) examined the effects of EU integration on both national and regional convergence. Her findings indicate a lack of coexistence between these two processes: while EU countries exhibited convergence at the national level, regions within individual countries did not follow the same pattern. Lessmann (2014) reached a similar conclusion, affirming the relationship between spatial inequalities and economic development using panel data from 56 countries spanning 1980 to 2009. His analysis also revealed that at very high levels of economic development, regional inequalities tend to rise again, further supporting the notion of an N-shaped curve in the development-inequality relationship. Lessmann and Seidel (2017) conducted a similar study using data from 180 countries over the period 1992-2012, employing satellite data on night time illuminance as a proxy for economic activity. Their findings reaffirm the N-shaped relationship between development and regional inequalities. They also emphasize the significant roles played by factors such as trade openness, foreign aid, federalism, and human capital in shaping these dynamics. A similar conclusion is reached by Díez-Minguela et al. (2020), who, based on data on regional and national GDP per capita for France, Italy, Portugal, and Spain covering the period 1860-2010, find that regional inequalities initially increase and then decrease, but have risen again in recent decades.

This section of the literature review highlights key studies that have addressed regional inequalities in Croatia. It is important to note that, to date, no studies in Croatian economic literature have specifically tested the Kuznets-Williamson hypothesis. Therefore, this paper represents a novel contribution to the analysis of regional disparities in Croatia. Nonetheless, several important works have examined regional differences more broadly and are worth mentioning. Sić (2003) analyzes regional disparities through the lens of the center-periphery model, highlighting the dominance of Zagreb and its surrounding areas. He suggests that European economic integration could help bridge the development gap between Croatian regions. Pejnović (2004) explores the increasing polarization of Croatia, emphasizing the strong growth of central Croatia (Zagreb) at the expense of other regions, particularly eastern Croatia. Puljiz and Maleković (2007) assess regional income and unemployment disparities from 2000 to 2005 using various inequality measures. Their findings indicate that while Croatia exhibits moderate income disparities, unemployment inequalities are more pronounced. Bićanić and Pribičević (2013) use the Gini coefficient and the Theil index to demonstrate that inequalities are increasing both within and between regions. Đokić et al. (2016) examine the impact of the economic crisis on regional inequalities from 2008 to 2012. Their analysis indicates that the crisis contributed to increasing regional inequalities and had a negative impact on regional GDP per capita and productivity. However, it also led to a reduction in regional unemployment dispersion. Marošević (2020) focuses on eastern Croatia and provides key recommendations for reducing the development gap between this region and the rest of the country. Marošević (2021, pp. 163-173) also provides an extensive review of empirical studies confirming the persistence of regional inequalities in Croatia. The OECD study (2024) highlights significant regional disparities in Croatia, noting that excessive territorial fragmentation weakens the country's capacity to implement effective regional development policies.

3. Method and data

There are several ways to measure economic growth at the regional level, including GDP per capita, the Human Development Index (HDI), per capita consumption, poverty rate, access to public services, unemployment rate, labor force participation rate, and others (Nijkamp & Abreu, 2009). However, the most important measure for regional development analysis is GDP per capita, which will also be used in this paper. Our paper follows the methodology outlined by Rusnák et al. (2023), which examines Kuznets-Williamson hypothesis in the case of Slovakia. A similar approach has been applied to the analysis of regional disparities in Croatia with the necessary adjustments to fit the scope of this research.

Pearson's correlation coefficient (r) is employed to examine the relationship between regional disparities and economic growth. The standard formula can be written as (Wooldridge, 2002):

$$r = R_{XY} = \frac{\sum_{i=1}^{n}(X_i - \bar{X})(Y_i - \bar{Y})}{(\sum_{i=1}^{n}(X_i - \bar{X})^2)^{1/2}(\sum_{i=1}^{n}(Y_i - \bar{Y})^2)^{1/2}},$$

where:

X_i and Y_i denote the values of two variables for county i,

$\bar{X}$ and $\bar{Y}$ denote the mean of X and Y, and

n is the sample size (the number of counties).

The Pearson correlation coefficient ranges between -1 and 1. A value close to zero indicates a weak relationship, while values closer to -1 or 1 suggest a stronger correlation (negative or positive, respectively). A coefficient of 1 indicates a perfect positive correlation, meaning both variables move in the same direction. Conversely, a coefficient of -1 signifies a perfect negative correlation, indicating that the variables move in opposite directions. A value of 0 suggests no correlation between the variables. According to the Kuznets-Williamson hypothesis, the Pearson correlation coefficient is expected to be positive in the first phase, indicating that regional disparities increase alongside economic growth. In the second phase, the coefficient should be negative, suggesting that further economic growth leads to a decline in regional disparities.

Regional disparities are measured by the coefficient of variation (CV), which is used as a relative measure of dispersion. It is a normalized form of the standard deviation, where N represents the number of regions, g_i is the GDP per capita of region i, and μ is the national average GDP per capita (i.e. the average across all regions). The formula is as follows (Bartolini et al., 2016):

$$CV = \frac{\sqrt{\frac{1}{N}\sum_{i=1}^{N}(g_i - \mu)^2}}{\mu} = \frac{\sigma}{mean}.$$

A higher value of the coefficient of variation indicates a greater level of regional inequality, while a lower value suggests convergence among regions. An important assumption when using the coefficient of variation as a measure of regional disparities is that the distribution has a non-zero mean and that all values are positive. These conditions are satisfied when using regional GDP per capita. The value of the coefficient of variation is interpreted as a percentage relative to the mean. For example, a CV of 0.03 means that the dispersion in regional income is 3% relative to the average. The main advantage of the coefficient of variation is that it is independent of the mean, which allows for straightforward comparisons across regions. For instance, CV values can be compared between regions with different levels of GDP per capita, unlike other inequality measures such as the Gini coefficient or the Theil index, which are sensitive to the scale of the distribution and the units of measurement (Bartolini et al., 2016).

However, there are two limitations to using the CV. First, it is not invariant to the number of regions in a country, as it can take values from 0 up to $\sqrt{N-1}$. Second, it does not account for the population size of each region. Disparities are calculated without considering how many people live in a given region. This issue can be addressed by calculating a population-weighted coefficient of variation. Nevertheless, using Slovakia as an example, Tvrdon and Skokan (2011) demonstrated that weighted and unweighted coefficients of variation generally follow the same trend, although the weighted version tends to show slightly higher values. Therefore, in this paper, we opted for the unweighted variant of the coefficient of variation. Concerning economic growth, we measure it by using annual GDP per capita growth, with the year 2000 set as the reference year (GDP per capita = 1).

Furthermore, β-convergence is analyzed to determine whether poorer regions grow faster than wealthier ones. This test is also conducted using Pearson's correlation coefficient, assessing the sta-

tistical significance of the relationship between the initial GDP per capita level and GDP per capita growth rates. A negative coefficient indicates β-convergence, meaning poorer regions grow faster, while a positive coefficient signals β-divergence, implying that poorer regions grow more slowly than wealthier ones.

Additionally, the relationship between the dominance of the City of Zagreb (measured by its percentage share in the national GDP) and regional disparities is examined using Pearson's correlation coefficient. A positive coefficient suggests a direct relationship, indicating that as Zagreb's dominance increases, regional disparities also rise.

4. Results and discussion

4.1 Recent regional development trends in Croatia

The analysis in this section is based on regional differences at the county level using indicators of GDP, GDP p.c. and the shares of counties in the total GDP of Croatia. The spatial distribution of economic activity in Croatia largely reflects the population distribution across its territory. An analysis of total economic activity, as measured by GDP, reveals the

significant dominance of the City of Zagreb, with a GDP of approximately 20 billion EUR, accounting for about 34.3% of Croatia's GDP in 2021. Including the surrounding Zagreb County, which together with the city forms a functional unit and covers only 6.5% of Croatia's territory, this figure rises to 23.8 billion EUR, or about 40.6% of the national GDP. This highlights a pronounced concentration of economic activity in a very narrow geographic area.

In absolute terms, Croatia's GDP increased by 34.8 billion EUR between 2000 and 2021. Of this growth, the City of Zagreb accounted for the largest share, with its GDP increasing by just over 13 billion EUR. Additionally, the City of Zagreb's contribution to Croatia's total GDP increased from 29.5% in 2000 to 34.3% in 2021 (4.8 pp). This is followed by Zagreb County (0.9 pp) and Zadar County (0.8 pp). The largest decreases in share were recorded by Sisak-Moslavina County (-1.4 pp), Primorje-Gorski Kotar County (-1.3 pp), and Koprivnica-Križevci County (-1.1 pp) (Graph 1). Given the largest growth in the share of the City of Zagreb in Croatia's total GDP, we also analyze the connection between the dominance of the City of Zagreb and regional inequalities in Croatia.

Graph 1 County share (%) in GDP (2000 and 2021) and change in shares (pp)
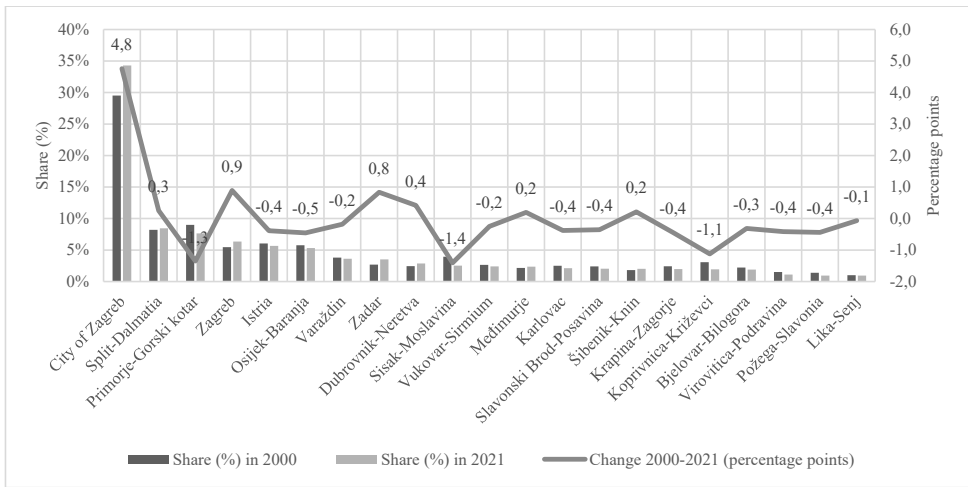
Source: Authors' calculations, made based on the Croatian Bureau of Statistics data (2024)

From 2000 to 2021, Croatia's economy grew at an average annual rate of 4.4%, with GDP increasing approximately 2.5 times over this period. The highest average annual growth rates were observed in Zadar County (5.76%), Dubrovnik-Neretva County

(5.19%), and Zagreb County (5.16%). Conversely, the lowest GDP growth rates during this period were recorded in Koprivnica-Križevci County (2.17%), Sisak-Moslavina County (2.23%), and Požega-Slavonia County (2.54%) (Graph 2).

Graph 2 GDP by county (2000 and 2021) and GDP annual growth rate (%)
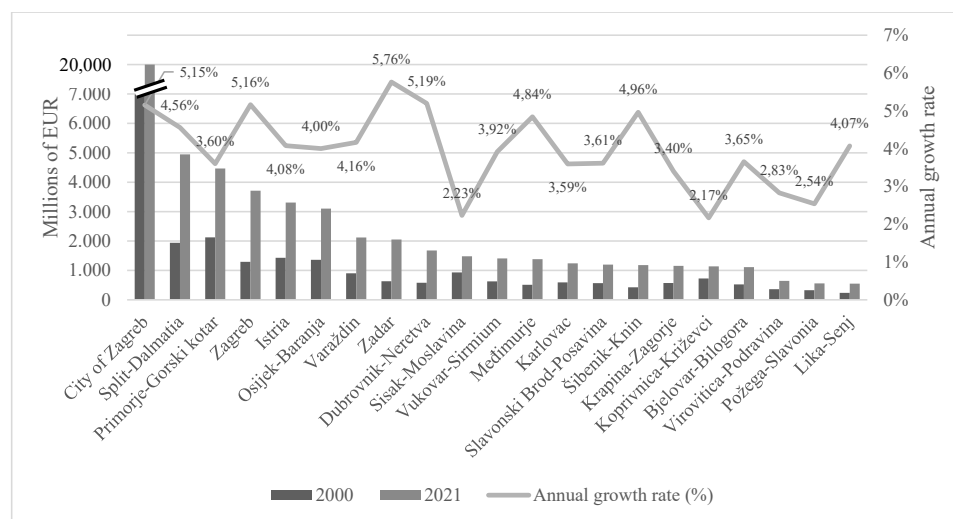
Source: Authors' calculations, made based on the Croatian Bureau of Statistics data (2024)

GDP per capita, used as a measure of living standards, increased in Croatia from EUR 5,342 in 2000 to EUR 14,810 in 2021, or 2.8 times. As with overall GDP growth, the City of Zagreb leads in this regard. Specifically, Zagreb's GDP per capita grew from EUR 8,983 in 2000 to EUR 25,454 in 2021—an increase of EUR 16,471, or 2.8 times. This figure is 1.74 times higher than the national average of EUR 14,810. All other counties recorded an absolute increase in GDP per capita below the national average, with Primorje-Gorski Kotar County and Istria County reaching EUR 9,442 and EUR 9,348, respectively. The smallest absolute increase in GDP per capita was recorded in Požega-Slavonia County, where GDP per capita increased by EUR 4,842 between 2000 and 2021. Meanwhile, the lowest GDP per capita growth rate was recorded in Koprivnica-Križevci County, at 1.9% per year (Graph 3).

Graph 3 GDP per capita by county (2000 and 2021) and GDP per capita annual growth rate (%)
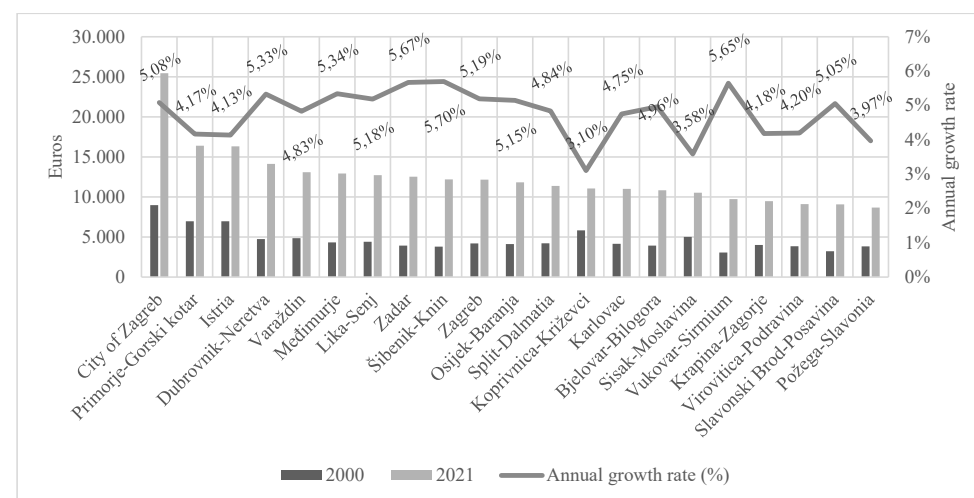
Source: Authors' calculations, made based on the Croatian Bureau of Statistics data (2024)

A brief analysis of three economic indicators (county shares in GDP, total GDP, and GDP per capita) highlights the economic dominance of the City of Zagreb within the Croatian economy. Between 2000 and 2021, Zagreb experienced the largest increase in its share of Croatia's GDP and consistently ranked first in both economic size (measured by GDP) and wealth (measured by GDP per capita). Therefore, we can agree with Čavrak (2011) that the Republic of Croatia has increasingly evolved into a monocentric economy, with the City of Zagreb playing a dominant role. This has intensified the centralization of business activities, leading to a relative decline in economic activity across other Croatian regions and an underutilization of available resources. As opportunity costs rise in less developed areas and excess demand for development resources grows in Zagreb, the overall costs of this development model increase, ultimately reducing the competitiveness of the Croatian economy.

4.2 Regional disparities and economic growth in Croatia

The evolution of regional disparities in Croatia shows two distinct phases: an increase from 2000 to 2010, followed by a decline until 2021. The observed period can also be divided into three phases: post-transition growth (2000-2008), the economic stagnation (2009-2014), and economic integration (2015-2021). Three key phenomena are analyzed for each phase:

1. β-convergence, which tests whether less developed counties in Croatia experienced faster growth compared to more developed counties;

2. σ-convergence, which examines whether regional disparities in Croatia have decreased over the past 20 years of economic progress;

3. The dominance of the City of Zagreb, reflecting the highly uneven distribution of economic activities across Croatia, with a significant concentration in Zagreb.

β-convergence examines whether poorer regions grow faster than wealthier ones, as indicated by a negative relationship between the initial income level and the growth rate. A positive relationship would indicate β-divergence, meaning poorer regions grow more slowly, widening the development gap. During the post-transition growth period (2000-2008), the Pearson correlation coefficient was not statistically significant, either for individual years or the entire period, indicating no evidence of beta β-convergence or divergence (see columns a) and b) in Table 1, respectively). During the phase of economic stagnation (2009-2014), there was similarly no statistically significant relationship between initial income levels and growth rates, except in 2010/2009, when the Pearson correlation coefficient was 0.49, indicating β-divergence. This suggests that poorer regions grew more slowly than richer ones, widening the development gap during the crisis. During the period of economic integration (2015-2021), the Pearson correlation coefficient was statistically significant at -0.65, pointing to β-convergence. This means that during Croatia's deeper integration into the European Union, poorer counties recorded higher growth rates than wealthier ones, narrowing the development gap. On a yearly basis, β-convergence was observed for the periods 2015/2014, 2018/2017, 2019/2018, and 2020/2019 (column a) in Table 1.

Table 1 Pearson correlation results for β-convergence analysis

a)			b)		
Year to year growth	**Pearson correlation coefficient**	**p-value**	**Period**	**Pearson correlation coefficient**	**p-value**
2001/2000	-0.21	0.355	2000-2008	-0.12	0.621
2002/2001	-0.19	0.401			
2003/2002	0.12	0.593			
2004/2003	0.06	0.790			
2005/2004	-0.04	0.865			
2006/2005	-0.18	0.424			
2007/2006	0.01	0.955			
2008/2007	-0.19	0.404			
2009/2008	0.18	0.422	2009-2014	0.31	0.171
2010/2009	0.49	0.024			
2011/2010	-0.32	0.162			
2012/2011	0.13	0.569			
2013/2012	-0.26	0.252			
2014/2013	0.19	0.406			
2015/2014	-0.48	0.029	2015-2021	-0.65	0.002
2016/2015	-0.33	0.142			
2017/2016	-0.06	0.783			
2018/2017	-0.38	0.089			
2019/2018	-0.47	0.031			
2020/2019	-0.45	0.041			
2021/2020	0.11	0.639			

Source: Authors' calculations, made based on the Croatian Bureau of Statistics data (2024)

The second phenomenon is related to σ-convergence, which investigates whether regional disparities diminish over time. When economic growth is included in the analysis, the Kuznets-Williamson hypothesis is tested. This hypothesis suggests that regional inequalities initially increase and later decrease as economic growth progresses. A positive Pearson correlation coefficient between regional disparities (measured by the coefficient of variation) and economic growth (measured by GDP per capita) indicates σ-divergence. Conversely, a negative Pearson correlation coefficient signifies σ-convergence.

Regional inequalities in Croatia exhibit a pattern of both increase and decrease over time. However, their evolution does not follow the smooth transformation during economic growth predicted by the Kuznets-Williamson hypothesis. Graph 4 illustrates the relationship between regional disparities, measured by the coefficient of variation, and economic growth, measured by the growth of GDP per capita. As shown in Graph 4, regional disparities underwent significant oscillations during the observed period from 2000 to 2021.

Graph 4 Regional disparities vs national growth 2000-2021
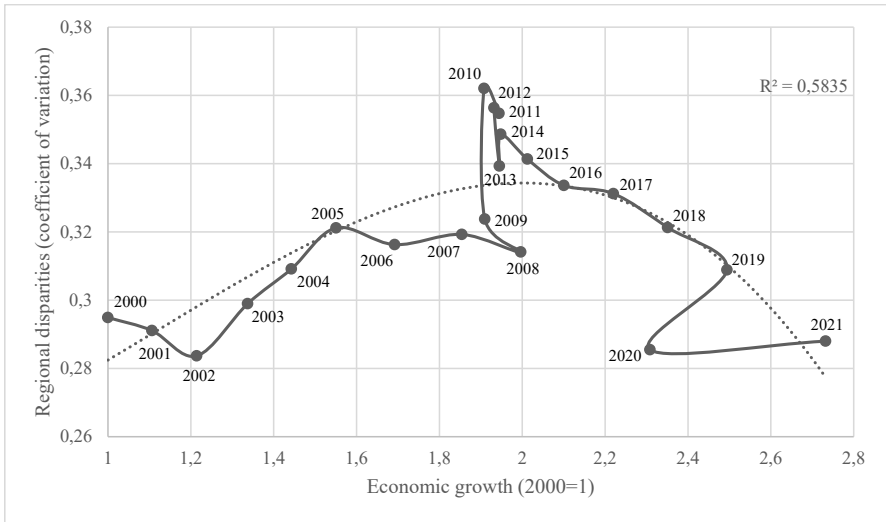
Source: Authors' calculations, made based on the Croatian Bureau of Statistics data (2024)

In the midst of democratic changes from 2000 to 2002, the coefficient of variation decreased, reaching its lowest point in 2002. This was followed by an increase in regional disparities until 2005. Between 2005 and 2008, the coefficient of variation declined slightly, reaching a new low in 2008. However, the global economic crisis caused Croatia to experience six years (2009-2015) of economic decline and stagnation, during which the coefficient of variation peaked at its highest value in 2010 (0.362). Following this period, the coefficient of variation began to decline, albeit with oscillations. Since 2015, when Croatia resumed positive economic growth, the coefficient of variation has generally been on a downward trend. The exception is 2020, when the economic contraction caused by the COVID-19 pandemic led to an increase in regional disparities, as reflected in the rise of the coefficient of variation in 2021 (Graph 4).

In the case of Croatia, both phases of the Kuznets-Williamson hypothesis are observed. From 2000 to 2010, regional disparities increased, as indicated by the statistically significant positive correlation. This suggests σ-divergence, with the coefficient of variation peaking at 0.36 in 2010. From 2010 to 2021, regional inequalities began to decrease, as demonstrated by the statistically significant negative correlation, pointing to σ-convergence (Table 2).

Table 2 Pearson correlation results for σ-convergence analysis

a)			b)		
Period	**Pearson correlation coefficient**	**p-value**	**Period**	**Pearson correlation coefficient**	**p-value**
2000-2010	0.77	0.006	2000-2008	0.82	0.007
			2009-2014	0.14	0.793
2011-2021	-0.88	0.000	2015-2021	-0.78	0.037

Source: Authors' calculations, made based on the Croatian Bureau of Statistics data (2024)

Within the framework of σ-convergence analysis, the overall observed period 2000-2021 can be divided into three phases (column b) in Table 2): during the post-transition growth (2000-2008), the relationship between regional inequality and economic growth is statistically significant and posi-

tive, indicating σ-divergence. During the phase of economic stagnation (2009-2014), no statistically significant relationship exists between regional inequality and economic growth. During the economic integration (2015-2021), the Pearson correlation coefficient is statistically significant and negative (-0.78), confirming σ-convergence. This analysis highlights that regional disparities in Croatia followed the two-phase pattern predicted by the Kuznets-Williamson hypothesis.

The third phenomenon focuses on the relationship between the dominance of the City of Zagreb (measured by its percentage share in the national GDP) and regional disparities (measured by the coefficient of variation). In all three observed periods (economic growth 2000-2008, economic stagnation 2009-2014, and economic integration 2015-2021), the Pearson correlation coefficient is statistically significant, with a positive sign in the first two periods, while in the period 2015-2021, it has a negative sign (-0.79). This trend is similar to that observed in the case of σ-convergence, as regional disparities diminished during the period of economic growth (2015-2021). Even though the City of Zagreb's dominance increased, its effect on regional disparities seemed to decrease, indicating a more balanced growth distribution across Croatia (Table 3).

Table 3 Relationship between the City of Zagreb's economic dominance and regional disparities

Period	Pearson correlation coefficient	p-value
2000-2008	0.90	0.001
2009-2014	0.97	0.001
2015-2021	-0.79	0.035

Source: Authors' calculations, made based on the Croatian Bureau of Statistics data (2024)

This result reveals an unexpected negative relationship between the dominance of the City of Zagreb and regional disparities during the period 2015-2021. In contrast, the relationship was positive in the previous periods (2000-2008 and 2009-2014), which is in line with expectations. A plausible explanation for this unexpected finding lies in the previously tested and confirmed β-convergence during 2015-2021, when poorer regions experienced faster growth than wealthier ones. This period coincided with the deepening of economic integration into the European Union, particularly during the 2014-2020 EU budget cycle, when Croatia had access to 12.19 billion EUR from the European Structural and Investment Programmes (ESIF), rising to 14.2 billion EUR with national contributions (European Commission, 2025).

4.3 Discussion

This study analyzed regional disparities in Croatia from 2000 to 2021, confirming the two-phase pattern predicted by the Kuznets-Williamson hypothesis. From 2000 to 2010, regional disparities increased as economic growth was concentrated in more developed regions, particularly in the City of Zagreb, and from 2010 onwards, disparities began to decline, suggesting a convergence trend. These findings align with earlier studies on regional inequalities in post-transition economies. For example, Rusnák et al. (2023) observed a similar trend in Slovakia, where regional disparities declined, albeit at the cost of slower overall growth and lagging behind the EU average. Similarly, Sić (2003) predicted that European integration would help reduce disparities, which is partially supported by our results, especially after 2014.

Our research has significant implications for economic theory, as the results confirm the existence of the Kuznets-Williamson hypothesis, particularly after 2014. This underscores the importance of European economic integration for a post-transition country like Croatia. Following the end of economic stagnation and the acceleration of economic integration, Croatia experienced high economic growth rates, which coincided with several key findings of our analysis. First, regional disparities declined, confirming the second phase of the Kuznets-Williamson hypothesis. Second, development convergence occurred among Croatian counties reducing the overall development gap. And third, despite the increasing dominance of the City of Zagreb, regional disparities have decreased, which can be explained with the EU funding programs after Croatia's accession to the EU in 2013.

This finding aligns with the central dilemma in regional economics: the trade-off between equality and efficiency. Should the focus be on promoting balanced development across all regions to reduce regional inequalities, or should priority be given to the unhindered growth of the most developed regions to sustain overall national growth? This decision presents a significant challenge for both policy makers and regional economists.

For policymakers, our findings highlight the importance of maintaining deep integration processes within the European Union and developing strategies for further decentralization, infrastructure investment, and targeted development policies that foster balanced spatial development. From a regional policy perspective, if economic development consistently leads to regional disparities, then effective regional policies must be an integral part of national government strategies to ensure balanced and inclusive growth.

While this paper provides valuable insights, it is important to acknowledge its limitations and suggest directions for future research. First, measuring inequality and development primarily through GDP per capita has its constraints. Although widely used, alternative indicators such as productivity, quality of life, and employment levels should be incorporated to provide a more comprehensive perspective. Second, a more detailed spatial analysis is needed. While this study focuses on inter-regional inequalities, future research could also examine intra-regional disparities to offer deeper insights at the micro level. Third, a comparative analysis of post-transition countries such as Slovakia, Hungary, and Poland would provide a broader perspective and enhance our understanding of regional development trends in countries similar to Croatia.

5. Conclusion

This paper examines the evolution of regional disparities in Croatia between 2000 and 2021, focusing on testing the Kuznets-Williamson hypothesis, which states that regional disparities increase in the initial phase of economic growth and decrease in the later phase. Specifically, from 2000 to 2010, regional disparities in Croatia widened alongside economic growth. However, from 2010 to 2021, during a period of strong economic expansion, regional inequalities declined, confirming both phases of the Kuznets-Williamson hypothesis.

Furthermore, the paper provides evidence of β-convergence in Croatia between 2015 and 2021. During this period, strong economic growth and deeper European integration led poorer Croatian counties to experience faster growth than wealthier ones, thereby reducing the interregional development gap and confirming the presence of σ-convergence.

Finally, the results indicate that the dominance of the City of Zagreb (measured by its share of Croatia's GDP) plays a significant role in shaping regional disparities. This effect is evident in all three examined periods. From 2000 to 2008, the City of Zagreb experienced strong economic growth, which led to an increase in dominance and a rise in regional disparities, creating a core-periphery effect. During the 2009-2014, economic stagnation the City of Zagreb, as an economic center, proved to be more resilient compared to the rest of Croatia and increased its share in national GDP. In the post-crisis period, i.e. 2015-2021, regional disparities declined despite the increase in Zagreb's economic dominance, which can be attributed to deeper economic integration into the European Union and greater utilization of EU funds. These findings highlight the importance of designing cohesive and place-sensitive regional development policies that leverage the opportunities provided by EU integration, with the aim of promoting balanced growth across counties while protecting national economic competitiveness.

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GOVERNANCE MODELS AND PANDEMIC OUTCOMES: ANALYSING THE IMPACT OF STRINGENCY, ECONOMIC STRENGTH AND HEALTH SYSTEM CAPACITY ON EXCESS MORTALITY

Abstract

Purpose: This paper explores the anti-epidemic policies of Italy, Germany, and Sweden in response to the COVID-19 pandemic in the period 2020–2022. The degree of decentralization, the stringency index, and the universal health coverage (UHC), expressed as the percentage of the gross domestic product (GDP), present distinguishing characteristics of the three crisis management models, making them essential for exploring their correlation with excess mortality.

Methodology: The mixed-method approach is used in this research. The study uses a qualitative cross-case design, incorporating countries with various combinations of key factors, allowing for the analysis of the causes of outcome variation. Given the temporal heterogeneity of independent variables, the quantitative analysis relies on the Mixed Data Sampling (MIDAS) regression model.

Results: The MIDAS regression analysis of excess mortality shows a statistically significant positive correlation with both average population age and healthcare expenditure, where the latter is contrary to expectations. GDP per capita and the proportion of women in total population are negatively correlated with excess mortality. In this sample, UHC and daily stringency indices are not statistically significant, indicating no detected association with excess mortality.

Conclusion: The presented analysis of Italy, Germany, and Sweden affirms that the demographics and the economic capacity, as opposed to the stringency index, shape excess mortality. The null effect for UHC and the surprising direction of the health-spending estimate suggest that the governance and productivity of resources matter more for pandemic performance than the magnitude of the budget.

Keywords: COVID-19, excess mortality, GDP, governance, mixed-methods

1. Introduction

The concept of crisis has become conventional, and the recurring emergence of economic, educational, and social crises has led some scholars to label the present era as the "century of crises" (Zamili, 2014). The COVID-19 pandemic is a health crisis, since the spread of SARS-CoV-2 produced cascading disruptions in public health, economic, and political contexts and affected the entire population. It caused a tragic loss of human life and a level of global economic insecurity not seen since the 2008 financial crisis (Song and Zhou, 2020; Brada et al., 2021). It reshaped nearly all spheres of life and posed an ultimate challenge for political leadership (Sahu, 2021). To prevent spread, countries introduced unprecedented measures, including quarantines to minimise social interactions, limits on travel, and school closures. Yet the literature indicates no consensus on an optimal strategy for managing such emergencies. Scholarship has shifted from discrete policy elements or isolated decisions toward complex processes and interactions among policy actors within institutional structures (Weible et al., 2020). Berman et al. (2023) highlight recent evidence that states' conduct during COVID-19 was conditioned by contextual factors that steered policy development. Given pronounced differences in approaches, implementation, and health outcomes, these authors argue that future analyses should focus on key causal drivers, including institutional rules, governance mechanisms, political context, and the structure of health systems, with emphasis on public health and crisis decision-making. In line with these considerations, Vampa (2021) notes that the pandemic sparked far reaching debates on the design of public policies capable of delivering coordinated and effective responses while recognizing territorial dynamics. However, the mechanisms linking territorial configurations to policy performance remain undertheorized and empirically underexamined. Evidence remains fragmented, since single country accounts dominate and multi-country analyses often treat territorial governance as background. This article addresses part of that gap by providing a structured cross-case comparison of Italy, Germany, and Sweden from 2020 to 2022 and by testing relationships between excess mortality, socioeconomic indices, and restrictive measures.

2. Literature review

The COVID-19 pandemic exposed weaknesses in governing institutions, inadequate crisis preparedness, and the absence of effective strategies. A shortage of timely and reliable information hindered evidence-based policymaking. Limited analytical capacity among political actors contributed to delayed responses and an inability to take prompt, effective decisions in emergencies (Howlett, 2009). Consequently, the role of political actors requires careful analysis, as they bear political responsibility for the implementation and outcomes of public health policies.

Many scholars argue that standardization within the health system enhances governance efficiency and they, therefore, advocate for a centralized approach that facilitates hierarchical decision-making structures (Elson, 2009; Zhong, 2010), a view further supported by Gilbert and Picard (1996), who concluded that centralization is optimal when the central government has full access to information related to costs. Similarly, centralization enables economies of scale and prevents the suboptimal use of scarce resources by local government stakeholders (Rubio, 2011). However, universal solutions often fall short of expectations. Political tensions and disputes among different governance levels frequently cause disruption within the centralized systems (Tselios, 2023). Scholars highlight that decentralized systems, by contrast, promote better knowledge acquisition and usage, particularly when being informed about local circumstances is crucial. Finally, some scholars advocate for a hybrid model, suggesting that a combination of centralized and decentralized systems may foster governance synergies (Maltsev, 2023).

During the COVID-19 pandemic, critical information was frequently replaced, shaping the distinctive responses of political actors who worked based on the information available at a given time. Responses to the COVID-19 pandemic varied among countries not only in terms of scope, intensity, and speed of reaction, but also exhibited considerable variations within countries. This research focuses on three EU member states: Italy, Germany, and Sweden.

In Italy, the primary decision-makers responsible for anti-epidemic measures were national political authorities. As the Italian Constitution does not offer distinct provisions for internal emergencies,

the government, invoking the legislative decree of the Civil Protection Code, declared a state of emergency on January 31, 2020 (Parolari, 2024). Italy's multi-level governance further obstructed policy implementation. Legislative and administrative authority is shared between central and regional governments. Within the healthcare system, the central government allocates healthcare funding by regions, while regional government is responsible for the organization of health services (Bosa et al., 2022). During the first wave of the pandemic, national measures were not differentiated. Namely, the same measures uniformly applied across all regions, regardless of infection rates. The lack of coordination between the national and regional government emphasized the issue of governmental emergency measures, highlighting the lack of institutional collaboration and sufficiently defined and targeted measures. This prompted the adoption of the Law Decree, which authorized regional governments to propose and implement urgent measures related to the COVID-19 pandemic, including stricter restrictions than those proposed by the national government. As a result, regional measure differentiation emerged, allowing local governments to tailor measures based on their contagion index (Nicola & Scaccia, 2021). Italy subsequently split their regions into zones and adopted a color-coded risk classification system: red zones indicated high-risk areas, orange zones medium-risk, and yellow zones low-risk, based on the infection rates, active case numbers, and hospital capacity (Pelagatti & Maranzano, 2021). The color-coded system remained in place until March 31, 2022, when Italy officially lifted the state of emergency (Parolari, 2024). The effectiveness of the pandemic response was hindered by the fact that, for example, the employee expenditure restrictions introduced in 2004 resulted in a decline in the professional capacities of healthcare personnel (Noto et al., 2020). Furthermore, the bailout programs implemented in 2007 in certain regions led to a reduction in hospital capacity, a freeze on staff recruitment, and the introduction of additional co-payments for pharmaceutical expenses (Bordignon & Turati, 2009; Piacenza & Turati, 2014). To combat the pandemic, the decree *Cura Italia*, adopted on March 17, 2020, allocated an additional €1,410 million to the national health requirement and extended tax credits for workplace sanitization and protective equipment (Italian Government, 2020). In comparative perspective, Italy's fiscal stimulus was relatively modest. During the same period, Germany set up 11% of GDP of additional spending and foregone revenues and 24% of contingent liabilities (IMF, 2021a).

Germany is a federal state composed of sixteen constituent states, where the responsibility for public healthcare is delegated to local health authorities. Local authorities had the autonomy to adapt national-level pandemic measures, including restrictions on public gatherings, suspension of mass events, closure of schools, restaurants, bars and shopping centers, as well as the imposition of quarantines and the temporary closure of domestic borders, to suit local needs. The only exception was the unilateral and centralized decision to close international borders (Hegele & Schnabel, 2021). In collaboration with the Robert Koch Institute and other research institutions, local authorities collected and analyzed available pandemic-related data, thereby contributing to Germany's overall pandemic management efforts (Brunn et al., 2022). However, by early 2021, it became apparent that the uniformity of the federal state strategy was inadequate. In response, the Infection Protection Act was amended in April 2021 to introduce the "emergency brake" measures, which empowered the federal government to enforce mandatory curfews and other restrictive measures (Hyde, 2021). The main mechanism Germany used against the COVID-19 pandemic was based on four core principles: prevention, detection, containment, and treatment (Wieler et al., 2021). In 2022, per capita health spending was €7,767 (adjusted for differences in purchasing power), the highest in the EU and among the highest in the WHO European Region (Blümel et al., 2024). Such substantial investment in healthcare provided a well-coordinated and stable healthcare system, together with professional and scientific institutions, which constituted an important foundation for Germany's management of the SARS-CoV-2 outbreak. Testing centers were rapidly set up, with high daily sample collection, and the country efficiently used its extensive intensive care unit capacity. Even though the COVID-19 pandemic brought about the deepest recession in Germany's post-war history, the economy regained stability by October 2020. This stabilization was supported not only by extensive aid programs at all levels of government and by a Keynesian-inspired fiscal strategy that accepted declining tax revenues while covering additional spending through public borrowing, but also by the crucial role of the Fed-

eral Ministry of Finance and the Federal Ministry of Economic Affairs, which relied on their prior experience in managing the 2008 global financial crisis (Auerbach, 2012; Färber, 2021).

During the COVID-19 pandemic, Sweden did not declare a state of emergency, as its constitution permits such a declaration only in times of war (Pierre, 2020). Instead, the Swedish response placed responsibility on citizens, relying heavily on voluntary social distancing and individual self-regulation. This approach was underpinned by Sweden's legal framework and cultural emphasis on safeguarding fundamental human rights and fostering civic accountability. Swedish core strategy for making new measures aimed at "flattening the curve" and was aligned with the objectives of Sweden's 2019 emergency pandemic plan: to reduce mortality, minimize population morbidity, and mitigate adverse effects on individuals and society. The Public Health Agency of Sweden (PHA) played a central role in shaping the national pandemic response strategy. The PHA issued voluntary guidelines, recommending proper hand hygiene, physical distancing, staying home when ill, and avoiding non-essential travel (ibid.). The majority of decisions in Sweden were made through a centralized approach, with 21 regions following national guidelines (Askim & Bergström, 2022). Although the government issued guidelines, each region bore responsibility for the performance of the healthcare system, and its coordination was facilitated by the Swedish Association of Local Authorities and Regions (ibid.; Pierre, 2020). By the end of 2020, regions began adapting measures according to the virus spread rate (Pierre, 2020). The Swedish model faced widespread criticism, particularly for delays in issuing recommendations and the perceived *laissez-faire* approach by authorities. In response, a temporary Pandemic Law was passed in January 2021, which enabled the authorities to take more assertive action toward suppressing the spread of the virus, including limitations on the size of public and social gatherings, temporary closures of hospitality and other business activities, and reinforced guidelines on physical distancing and remote work (Winblad et al., 2022). The Swedish government introduced a comprehensive package of financial relief measures in anticipation of the economic downturn expected from the containment policies. According to IMF (2021b), the authorities' extensive support program was both well-timed and well-suited to the circum-

stances. The Swedish Parliament approved twelve budget amendments directed at citizens, businesses, and vulnerable groups in the first year of the pandemic (Government Offices of Sweden, 2020a). These measures included combined tax cuts of approximately €0.76 billion in 2021, €0.94 billion in 2022, and €1.51 billion in 2023 (Government Offices of Sweden, 2020b). The National Institute of Economic Research estimated that the measures implemented in 2020 in response to the pandemic outbreak amounted to approximately €17.27 billion (National Institute of Economic Research, 2020). Furthermore, to ease the financial burden on companies and safeguard employment, a furlough scheme was introduced, employers' social security contributions were reduced, and rental subsidies were provided for vulnerable sectors such as consumer durables, hotels, and restaurants (Government Offices of Sweden, 2020b).

3. Methodology

This study uses an exploratory research design to deepen the understanding of key dimensions of governance structure, the strictness of containment measures, health system preparedness, and economic capacity, and to examine how these factors relate to policy effectiveness measured through excess mortality (Mueller, 2004). Existing research remains fragmented, since most analyses concentrate on individual countries, while cross-national studies rarely place territorial governance at the center of explanation. In response to this limitation, three cases were selected to reflect contrasting state organization and decentralization, providing a basis for comparing institutional responses to the COVID-19 pandemic. The cases of Italy, Germany, and Sweden were examined with the aim of capturing distinct approaches to policymaking, particularly in the implementation of anti-epidemic policies. Italy adopted a centralized approach, while Germany, as a federal state, followed a decentralized one. In contrast to the mandatory measures enforced by these two countries, Sweden pursued a more liberal approach, grounded in voluntary public compliance with government recommendations. Moreover, unlike Germany and Sweden, which actively involved scientists in shaping their pandemic response strategy, Italy largely depended on its political institutions. These cases collectively illustrate distinct models of crisis management, which become relevant when examining their rela-

tionship with excess mortality. Nevertheless, while Italy, Germany, and Sweden are heterogeneous examples of crisis management strategies, they do not capture the full complexity of all EU member states. Accordingly, any generalization should be made with caution given the small-N design and the article's limited scope. In this context, it is crucial to extract lessons related to factors identified in this study that may influence countries' crisis management and pandemic response, and to derive appropriate conclusions based on them.

This research uses qualitative and quantitative approaches, indicating a mixed-methods design. Saunders et al. (2003) note that the combination of quantitative and qualitative methods improves the generalization and validity of research findings. The use of both methods allows for an in-depth examination of the characteristics and specificities of the units of analysis, which are elements that are often overlooked in studies which are purely quantitative (Landman, 2002). This integration represents the core advantage of the mixed-methods approach. Namely, by leveraging the complementarity of qualitative and quantitative analyses, researchers enable a more nuanced and thorough understanding of the phenomenon (Johnson et al., 2007).

Italy, Germany and Sweden constitute the three units of analysis and the foundation of the qualitative framework, designed as a cross-case study. As Gerring (2008) argues, this selection strategy reflects the most diverse case selection, which is particularly suitable for this research as it aims at exploring the correlation between excess mortality and various economic, health, and political factors in countries characterized by distinct governance structures. The cases were chosen to capture a spectrum of variation in relevant variables, which in turn shaped differences in outcomes. Thereby, the method of selecting the most diverse cases is emphasized due to the representativeness of acquired results compared to other small-sample methods (ibid.). Cross-case analysis is employed in this research. This method is suitable as it investigates processes and outcomes in each case, identifies patterns and combinations of factors contributing to differences in outcomes, and explains how these are determined by local conditions (Miles & Huberman, 1994).

The analysis of quantitative data relies on the application of the MIDAS regression model. MIDAS regression is a statistical analysis that allows for modeling relationships between variables measured at different temporal frequencies (such as daily, weekly, and annual data), without requiring aggregation to a common, lower frequency. This approach enables the informational richness of high-frequency predictors and contributes to more precise modeling of dynamic effects over time (Ghysels et al., 2004; Ghysels et al., 2007). In this research, MIDAS regression was applied to examine the effects of daily public policy measures (e.g., stringency measures) and annual socioeconomic indicators (e.g., GDP and healthcare expenditures) on weekly excess mortality during the COVID-19 pandemic. The utilization of this methodology allows for the comprehensive use of information from a mixed-frequency dataset, minimizes information loss due to aggregation, and captures nuanced, time-lagged effects of policy interventions on health-related outcomes (Ghysels et al., 2007).

Secondary data analysis is employed through a systematic examination of existing documented sources. The approach integrates theoretical frameworks with established datasets to inform the design of effective anti epidemic policies. Publicly available data were drawn from the World Health Organization (WHO), the World Bank, Eurostat and the Organisation for Economic Co-operation and Development (OECD), supplemented by other relevant sources.

The list of variables tested in this research is presented in Table 1 below.

Table 1 List of research variables

	Concept	Operationalization	Data source
Dependent variable	Excess mortality	Difference between the number of reported fatalities and the expected number of fatalities	OECD
Independent variable	Restriction measures	Stringency index	Database: The Oxford Covid-19 Government Response Tracker (OxCGRT)
	GDP	GDP per capita	World Bank
	Healthcare expenditure	Total public and private expenditure	Eurostat
	Health coverage	UHC index	WHO
Control variables	Age and gender	Proportion of women in total population; Average age	OECD

Source: Author

In order to analyze the collected data, the following regression equation is specified:

$$Excess\ Mortality_t = \beta_0 + \sum_{k=0}^{K} * \beta_1 Stringency\ Index_{t-k}$$
$$+ \beta_2 GDPpc_t + \beta_3 Healthcare\ Expenditure_t + \beta_4 UHC_t \cdot$$
$$+ \beta_5 AgeY_t + \beta_6 AgeM_t + \beta_7 AgeE_t + \beta_8 FEM_t + \epsilon_t$$

In this formulation, the summation over *k* represents the distributed temporal structure of the daily stringency index, while *t* denotes the time period during which the variables were observed. All variables included in the analysis were log-scaled prior to estimation in order to standardize measurement scales and facilitate meaningful comparative analysis.

The dependent variable in this research is excess mortality and the data were collected from the OECD. Excess mortality is calculated by comparing the number of reported fatalities to the expected number of fatalities, which is derived from the average number of deaths recorded over the five-year period from 2015 to 2019 (OECD, 2023). The independent variables in this research include restriction measures, GDP per capita, healthcare expenditure, and health coverage. Restriction measures are operationalized through the stringency index, which encompasses parameters such as school and workplace closures, cancellation of public events, limitations on mass gatherings, public transport suspension, stay-at-home requirements, and restrictions on national and international travel (Mathieu et al., 2020). These data are obtained from the OxCGRT, a comprehensive database tracking governmental policy related to implementing restrictive measures

(Hale et al., 2021). The total economic activity within national economy is represented by GDP per capita, defined as the gross domestic product generated by local producers, increased by product and service taxes minus subsidies excluded from market prices, divided by the average population size (World Bank, 2025a). Healthcare expenditure comprises total public and private spending on the healthcare system, including government schemes, social health insurance schemes, compulsory private insurance schemes, voluntary health insurance schemes, non-profit institutions financing schemes, enterprise financing schemes, household out-of-pocket payment, and rest of the world financing schemes (Eurostat, 2025). The UHC index is calculated as the geometric mean of fourteen tracer indicators categorized into four domains: reproductive, maternal, newborn, and child health; infectious diseases; non-communicable diseases; and service capacity and access. The first domain includes indicators such as family planning, antenatal care, vaccinations, and paediatric care. The second domain covers treatment parameters for tuberculosis, HIV, malaria, and basic sanitation. The third domain assesses tobacco use and the prevalence of hypertension and diabetes. The final domain evaluates access to hospitals, health workforce availability, and health security (World Bank, 2025b). Demographic variables, including the proportion of women in the total population and average age, are incorporated as control variables to account for population characteristics across the countries included in the study.

The aforementioned variables are analyzed to test the following theory-driven hypotheses, which link governance, economic capacity, and health-system efficiency to expected outcomes.

Hypothesis 1 (H1): A higher stringency index is connected to lower levels of excess mortality.

Building on the Italian case, where initially uniform and weakly coordinated national rules were replaced by delegated authority for stricter, locally tailored restrictions based on contagion indices, effective policy response is contingent on decisive and targeted measures. Accordingly, H1 posits that a higher stringency index is associated with lower excess mortality.

Hypothesis 2 (H2): Greater GDP per capita is negatively correlated with excess mortality.

Evidence from Germany's 11%-of-GDP package, contrasted with Italy's modest stimulus, shows how economic strength enables expansive interventions that bolster health care. This suggests that a greater ability to finance additional spending through public borrowing directly supports the health system and thus lowers excess mortality.

Hypothesis 3 (H3): Increased healthcare expenditure results in reduced excess mortality.

Drawing on Germany's high per capita spending, which enabled strong institutions and swift testing, H3 posits that increased healthcare expenditure, by strengthening structural and operational capacity, reduces excess mortality.

Hypothesis 4 (H4): Wider UHC contributes to lower excess mortality rates.

Consistent with governance-efficiency logic, UHC enables uniform service provision that improves coordination and access and lowers excess mortality.

Following the WHO's assessment that SARS-CoV-2 posed a significant threat to global public health, a Public Health Emergency of International Concern (PHEIC) was declared on January 30, 2020. The WHO declared a global pandemic on March 11, 2020. Three years later, on May 5, 2023, the WHO determined that COVID-19 no longer constituted a PHEIC. This study focuses on the period from 2020 to 2022, a period marked by widespread implementation of restrictive policy measures aimed at controlling the pandemic (WHO, 2025).

While MIDAS regression analysis offers a methodologically innovative approach to the analysis of data with differing time frequencies, this research is subject to several limitations such as the modest sample size (specifically, the limited number of countries observed), which may impact the statistical reliability and the generalizability of the findings. Additionally, the potential presence of multicollinearity among predictors could compromise the stability and interpretability of the regression estimates. The limited within-country variability of key variables further reduces the likelihood of detecting significant correlations. Moreover, although the stringency index is widely used, it has inherent measurement limitations, stemming from its operational definitions and the manner of data collection. Lastly, the research may be affected by omitted variable bias, as unobserved factors not included in the model could influence the dependent variable.

4. Results

Table 2 shows the results of the conducted quantitative analysis. These estimates should be read as indicative patterns within a small, purposive sample and timeframe (2020–2022) and are not generalizable beyond the studied cases. The table includes the regression coefficients for each variable, along with the standard error, t-statistic, p-value, and the variance inflation factor (VIF). The VIF measures the extent to which the variance of a regression coefficient is inflated due to multicollinearity. A VIF value of 1 indicates no correlation between the observed variable and the others in the model, while higher values suggest increasing levels of multicollinearity. According to commonly accepted interpretation guidelines, a VIF value above 4 may warrant further examination, whereas values exceeding 10 are typically considered indicative of severe multicollinearity (Marquardt, 1970; Cohen et al., 2013). Among the analyzed variables, a strong correlation was identified between GDP per capita and UHC, indicating significant multicollinearity. The high degree of multicollinearity for LGDPPC (15.24) and LUHC (11.44) means that coefficient magnitudes for these covariates should be interpreted with caution. This can be attributed to the fact that they were measured on an annual basis, and the number of observations is relatively small, which further highlights one of the limitations of the research. This finding underscores the need for caution in interpreting individual coefficient estimates, as multicollinearity can inflate standard errors, obscure the independent contribution of predictors, and in some cases alter the direction of estimated effects. The small-N design of this study further amplifies these issues and limits the generalizability of the findings, which should therefore be regarded as indicative patterns rather than definitive causal relationships.

Table 2 Analysis results

Variable	Coefficient	Std. Error	t-Statistic	p-value	VIF
Intercept (β_0)	-0.13	1.75	-0.07	0.94	-
LFEMPC	-0.2029	0.0185	-10.97	<0.001*	7.84
LMEANAGE	0.253	0.030	8.43	<0.001*	6.82
LGDPPC	-0.100	0.00457	-21.88	<0.001*	15.24
LHEXP	0.101	0.00478	21.13	<0.001*	3.17
LUHC	0.4664	0.668	0.70	0.49	11.44
Series: LSTR(-0) Lags: 4					
Lag 0	-0.081			0.61	
Lag 1	0.093			0.59	
Lag 2	0.084			0.58	
Lag 3	-0.108			0.61	

Source: Author

The MIDAS regression results indicate that the lagged effects of the stringency index are small and fluctuate in sign. None of these effects are statistically significant, as evidenced by the Almon lag polynomial results (p > 0.58). The distributed time effects of the daily stringency index do not show significance, suggesting that short-term changes in the stringency index have no measurable impact on excess mortality. Given the absence of statistically significant evidence that recent variations in the stringency index influenced excess mortality in the examined model, the H1 is not confirmed. Within the context of the present sample, this suggests that short-term changes in policy stringency do not demonstrate a measurable association with excess mortality. However, this null result may partly reflect the limitations of the composite stringency index, which aggregates heterogeneous measures, as well as the modest number of cases examined.

In contrast, MIDAS regression reveals that four variables have a statistically significant correlation with excess mortality (p < 0.01). The log-scaled value of the proportion of women in the total population is significantly and negatively correlated with excess mortality. Specifically, a 1% increase in the proportion of women in the total population is associated with a 0.2029% decrease in excess mortality. The log-scaled value of excess mortality also exhibits a statistically significant, strong positive correlation with the log-scaled average age of the observed country's population. An increase of 1% in the average age

corresponds to a 0.253% rise in excess mortality. Interestingly, the log-scaled value of healthcare expenditure is also statistically significantly and positively correlated with excess mortality, which is unexpected as it contradicts previous findings. Namely, a 1% increase in healthcare expenditure is associated with a 0.1% increase in excess mortality. This finding contradicts H3 set in this research, which is therefore not confirmed. In addition, this relationship may reflect endogeneity or reverse causality, that countries experiencing higher mortality subsequently increase health-related spending, as well as inefficiencies in the allocation of resources, or diminishing marginal returns to expenditure beyond a certain threshold (Hensher et al., 2024). Furthermore, the log-scaled value of excess mortality is statistically significantly and negatively correlated with the log-scaled value of GDP per capita. The results indicate that a 1% decrease in GDP per capita leads to a 0.1% increase in excess mortality, thereby confirming H2.

The UHC index does not exhibit a statistically significant correlation with excess mortality in this sample. The absence of a statistically significant correlation between the UHC index and excess mortality leads to the rejection of H4. Given both its strong collinearity with GDP per capita and the relatively static nature of the index as an annual composite measure, this null result should not be taken as evidence of an absence of relationship, but rather as a reflection of measurement limitations and the constraints of the present research design.

5. Discussion

Lohsar (2024) analyzed 107 countries over the same timeframe as this study, and found a statistically significant negative correlation between the stringency index and excess mortality in 2021, with no association in 2020 or 2022, likely reflecting low early immunity and widespread vaccination by 2022. Similarly, Galmiche et al. (2024) reported an inverse correlation across thirteen Western European countries during the first thirty months. In contrast, the MIDAS regression analysis conducted in this research did not result in a statistically significant correlation between the stringency index and excess mortality. Because this finding differs from prevailing scholarship, it should be interpreted in light of methodological limitations and the pandemic context. The OxCGRT aggregates diverse restrictions, so the heterogeneous effectiveness of measures may be obscured and less effective measures can dilute the estimated impact of pivotal measures (Brauner et al., 2021). In addition, unmeasured factors such as compliance, variant transmissibility and hospital occupancy may shape the relationship between stringency and outcomes.

Using a global sample of more than 140 countries that includes the three countries examined in this study, Aizenman et al. (2022) find that a lower GDP per capita is associated with higher excess mortality. Pizzato et al. (2024) examine 29 European countries from 2020 to 2023 and likewise report a statistically significant negative correlation between GDP per capita and excess mortality. The results obtained in this research align with those findings, confirming a statistically significant negative correlation between GDP per capita and excess mortality for the three observed countries.

Several studies support H3 that greater healthcare expenditure reduces excess mortality. Kapitsinis (2021) analyzed 79 countries worldwide and found a statistically significant negative correlation between healthcare expenditure and excess mortality. Barrera-Algarín et al. (2020) reported the same pattern for 30 European countries. Extending this literature, Moolla and Hiilamo (2023) assessed 43 countries (high income and upper middle income economies, as classified by the World Bank), evaluating health system performance across financing, provision and public health; their sample comprised OECD members and key partner economies and again yielded a significant negative association.

By contrast, this study's estimates for the three countries indicate a statistically significant positive correlation between log-scaled healthcare expenditure and excess mortality, contradicting the prevailing findings in the literature. This unexpected result may reflect several factors. First, high healthcare spending does not necessarily imply efficient allocation; administrative complexity can impede effective deployment. In particular, COVID-19 highlighted the importance of prevention and primary care, whereas budgets concentrated in costly hospital care indicate suboptimal use of funds. Second, regional disparities in access and broader social inequalities can attenuate the effect of high spending. Third, reverse causality is plausible: countries facing severe waves may reactively raise spending, so expenditures track higher mortality. Finally, beyond certain thresholds, additional spending delivers diminishing returns (Hensher et al., 2024).

In this research, health coverage entered as an independent variable and the analysis did not yield statistically significant results. By contrast, Wang et al. (2022) found a statistically significant negative correlation between health coverage and excess mortality across 74 countries. A likely explanation for these differing results is measurement: the UHC index is an annual, slow-moving composite, calculated as the geometric mean of fourteen tracers in four domains, which does not fully align with wave-driven mortality and has limited sensitivity to qualitative dimensions such as timely access to care, health workforce availability and distribution, and operational surge capacity, all closely linked to excess mortality (Yanful et al., 2023).

6. Conclusion

In early 2020, the WHO declared the COVID-19 pandemic, and governments' insufficient preparedness resulted in severe consequences for the global economy, national health systems, and societal functioning. This research examines the pandemic responses of Italy, Germany, and Sweden from 2020 to 2022, and emphasizes distinct crisis management strategies. Italy adopted a highly centralized model. Germany, consistent with its federal structure, delegated authority to regional governments. Sweden pursued a more liberal approach, emphasizing recommendations and voluntary compliance rather than strict enforcement.

The paper's primary scientific contribution is to empirically test the relationship between governance models, economic capacity, health system characteristics, and COVID-19 excess mortality using the MIDAS regression model. The analysis suggests that the formal governance structure, whether Italy's centralized system, Germany's federal model, or Sweden's liberal approach, was not the primary determinant of excess mortality outcomes. This is evidenced by the lack of a statistically significant correlation between the stringency of anti-epidemic measures and excess mortality in the studied sample. Instead, the findings indicate that inherent national characteristics, particularly economic capacity (GDP per capita) and demographic profiles (average age), were the most significant factors shaping pandemic outcomes. Notably, the observed positive link between healthcare expenditure and excess mortality suggests that institutional governance and the efficient use of resources are more consequential for pandemic performance than expenditure levels per se.

Given the ongoing relevance of the COVID-19 pandemic, more time and research are needed to identify which strategies were truly effective. Current non-pharmaceutical interventions analyses do not yield a definitive ranking of specific measures, underscoring the need for further investigation. Priorities are to expand the sample to additional countries, examine decentralization as a core explanatory dimension, incorporate variables capturing qualitative aspects of health system performance (e.g., the Health Access and Quality Index), and test immunization coverage as an independent predictor of excess mortality.

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MARINA AND LOCAL COMMUNITY IN SOCIAL RESPONSIBILITY: A CASE STUDY OF PUNAT

Abstract

Purpose: Croatian islands have many small communities where marinas are located and play the role of local leaders. The paper analyses socially responsible behaviour of a small local community to gain insight into the level of understanding of social responsibility as well as the forms of operational activity. Research was conducted in the municipality of Punat on the island of Krk and in Marina Punat.

Methodology: Structured in-depth interviews were used to identify the factors of socially responsible behaviour in the community.

Results: The research confirms the gradual shift from spontaneous to conscious socially responsible management and behaviour. Focusing on small Adriatic towns, particularly Punat, this study explores the relationship between the marina as a local leader and the local community. Findings show a developing unity based on shared socially responsible practices. However, legal regulations currently prevent joint investment in their mutual development. This paper proposes legal reform to enable coordinated socially responsible actions between marinas and municipalities, supporting sustainable local development.

Conclusion: Socially responsible business in Croatia is emerging as key to sustainable tourism. The Punat case shows how cooperation between local government and marina leadership fosters economic development, community well-being, and destination quality, despite legal barriers hindering joint investment initiatives.

Keywords: Local marina, local community, socially responsibility, legal regulations

1. Introduction

Marinas, as a key segment of nautical tourism, serve as platforms for leisure activities and play an important role in local economic development (Luković et al., 2024). While supporting tourism, marinas also impact the coastal environment, acting as potential sources of pollution due to their commercial activities. Thus, marina management must balance service provision with environmental oversight (Martín & Yepes, 2022). Modern marina operations increasingly adopt sustainable and socially responsible practices, moving beyond short-term profit. Emerging management approaches focus on environmental responsibility and the social dimension, aiming to balance the needs of tourists, local com-

munities, and long-term development (Martín & Yepes, 2021).

Development is a constant need across all sectors, accompanied by a shift toward sustainable and socially responsible business practices. The core aim of such practices is the joint protection of resources and raising awareness of social responsibility among all community actors. In Croatia, the local community is a key driver of social and entrepreneurial activity, making it essential to analyse its development through the lens of social responsibility. This is particularly relevant for the coastal and island regions, where understanding local dynamics is crucial for broader economic and social progress (Luković et al., 2024).

Socially responsible enterprises vary widely by form and location, with marinas in small coastal and island communities in Croatia often acting as local leaders. This research focuses on the relationship between marinas and local communities, aiming to assess the degree of synergy in their socially responsible behaviour. Croatian marinas, especially those of higher categories, increasingly take on leadership roles in local development (Marušić et al., 2024).

In line with the above, the research in this article aims to assess the form of socially responsible behaviour and business between the local community and the marina that is increasingly developing on the Croatian Adriatic coast. On the Croatian Adriatic coast, one of the important and frequent local leaders is the marina, which contributes to the development of the local community by its growth. Therefore, in accordance with the aim of this research, a hypothesis was put forward stating that the marina significantly promotes the development of the destination through socially responsible business that goes hand in hand with the activities of the local community.

2. Overview of previous research

With regard to previous research on this topic, it is worth mentioning the work of Brščić et al. (2020). Brščić et al. emphasise the importance of managing destinations in the context of sustainable development in order to reduce the negative impacts of tourist flows. They presented the results of a project that tested the application of sustainable tourism indicators in coastal resorts in Catalonia, Istria

and Tuscany using the European Tourism Indicator System (ETIS).

Gračan et al. (2022) explore how the blue economy, particularly nautical tourism, affects the quality of life in Mediterranean EU countries. Their study confirms that implementing blue economy goals positively impacts local communities' well-being. The research highlights that sustainable tourism and resource management can lead to measurable social benefits.

Martín and Yepes (2022) aimed to identify the landscape values marina users associate with satisfaction and explore their role as a management tool. Research findings highlight that users mostly appreciate the sense of tranquillity and well-being, while concerns include overcrowding, excessive urban development, and poor hospitality and maintenance.

González-Morales et al. (2022) study CSR involvement in maritime tourism, focusing on relational responsibility. They identify that strong human resource management and environmental initiatives are key CSR areas. Smaller, younger companies show higher CSR engagement, particularly those adapting to change, supporting communities, and collaborating with private stakeholders.

Tippett (2022) emphasises that tourism is an important tool to connect people with nature, especially in the context of marine and coastal areas. She emphasises that sustainable coastal and marine tourism must be developed at a scale that can meet market demand, but on the condition that the environment is preserved.

In addition, Bruccoleri et al. (2023) carried out a study in Italy, which has the largest number of moorings in the Mediterranean. The quantitative survey using questionnaires included information on fossil fuel consumption for vehicles and fixed installations, electricity consumption, fuel consumption related to waste management, water consumption and waste management. Based on the results obtained, the authors concluded that all leisure travel should be closely monitored in order to reduce CO_2 emissions and their impact on the environment.

Vasiljeva et al. (2023) explore corporate social responsibility as a key factor in sustainable business development and efficiency. Their analysis shows a positive link between CSR and business perfor-

mance, which is influenced by financial stability. In financially stable firms, management does not mediate this link, while in less stable ones, management plays a motivating role. However, autocratic leadership reduces CSR engagement regardless of stability. The study highlights the importance of aligning CSR with financial stability for sustainable strategy development, particularly relevant for sustainability-focused tourism.

Fairuz Ramli et al. (2024) provide a comprehensive analysis of the impact of socially responsible development on sustainable development in specific tourism environments. By combining interviews with key stakeholders, policy analyses and surveys of tourists, the authors attempt to obtain a comprehensive picture of the complex relationships between DSR practises and sustainability indicators. The results show that the integration of socially responsible practises contributes positively to the preservation of the environment, greater involvement of the local community and greater visitor satisfaction.

Milanović Pešić et al. (2025) highlight the socio-economic benefits of natural heritage through tourism, while also noting its potential environmental harm from unsustainable practices. They stress the need for place-specific management and research to better understand tourism's impacts. Sustainable tourism is presented as a strategy for achieving lasting benefits for local communities.

3. Sustainability and social responsibility

The concept of sustainable development is closely related to resources, which are known to be naturally limited. Resources are the foundation sustainable development is built upon, which in turn supports higher-level socially responsible action.

The concept of sustainable development encompasses financial sustainability, social well-being, and environmental protection, emphasising their interdependence. As environmental and social challenges grow, companies increasingly recognise the need to go beyond profit-making and adopt socially responsible business (CSR) practices.

This approach aligns with the principles of sustainable development, integrating ethical, social, and environmental responsibility. In this context, marinas as local leaders build their growth on the development of the communities they operate in. By jointly investing in local initiatives, marinas and communities form a shared interest, enriching the tourism offer and fostering cooperation. This CSR model is increasingly present among Croatian marinas along the Adriatic coast.

With regard to the research in this paper, it is important to note that the local community is of great importance. What is also important is the role of shareholders and investors related to the business they generate profit from. Socially responsible action should become a dynamic system.

Figure 1 Major areas for social responsibility of business
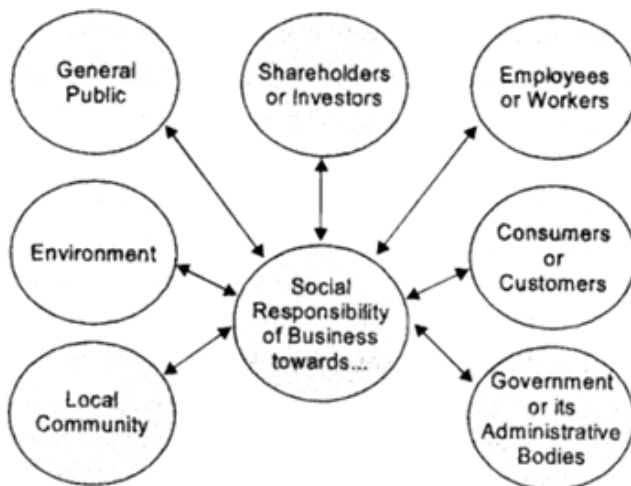
Source: NCERT Solutions for Class 11 Business Studies Social Responsibilities of Business and Business Ethics, 2019

Marinas play a key role in meeting the growing demand for nautical tourism and supporting local economic development through entrepreneurship (Martínez-Vázquez et al., 2022). As local leaders, marinas are expected to demonstrate socially responsible behaviour. Assessing CSR requires evaluating environmental, ethical, philanthropic, and economic responsibility, which must be integrated for effective governance. Social sustainability is central to planning and operating coastal and nautical infrastructure. In marina development, aligning social responsibility with community goals enhances guest experience and benefits locals, but requires long-term commitment, resources, and institutional support (Biondi & Lara, 2015).

Environmental responsibility involves minimising negative environmental impacts through practices like reducing emissions, saving energy, and supporting green initiatives. It is a common form of CSR.

Ethical responsibility ensures fair and just treatment of all stakeholders. Companies practicing this may go beyond legal requirements, such as paying fair wages or sourcing materials according to fair trade principles.

Philanthropic responsibility reflects a company's commitment to improving society, often through donations to charities or by establishing its own foundations. It goes beyond ethical and environmental actions to actively support social causes.

Economic responsibility means making financial decisions that not only aim for profit but also generate positive impacts on people, communities, and the environment (Stobierski, 2021).

Research shows that marina supports destination development through economic and environmental sustainability. Socially responsible activities in a destination should be considered across all these dimensions, helping assess the level of engagement and unity between marinas and local communities.

4. Socially responsible operation of marinas

Marinas now offer a variety of services beyond recreational sailing, enhancing the tourism offerings of their location. The range of services provided by a marina ultimately determines its competitive advantage in the market. While marinas bring economic and social benefits to their communities, they can also have negative impacts on the environment (Martínez-Vazquez et al., 2021).

Marina owners and management have faced challenges overcoming prejudices in underdeveloped coastal areas. The introduction of marinas in small, neglected towns in Croatia sparked development and attracted people back to these communities. Local pride associated with the marina motivated residents to invest in revitalising the town, with limited involvement from the central government.

This was important for the development of socially responsible activities of the marina and the local community. To illustrate this, it is necessary to conduct a PEST analysis of the macro environment. The conducted PEST analysis indicates a positive technological environment and highlights the marina's great importance to the local community and, arguably, to the entire island of Krk, especially regarding the socially responsible behaviour of entrepreneurs. What is worrying is the political environment, which is extremely poor, and the close connection with the economic environment shows a high degree of dependence of the economy on politics (Luković et al., 2022).

Negative features of the relationship between the marina and the state are generally related to high taxation, a lack of understanding of special business conditions and the system of concessionary charges, which is unacceptable.

Table 1 Four characteristics of the environment, PEST analysis of the island of Krk

		POLITICAL	ECONOMIC	SOCIAL	TECHNOLOGICAL
N E G A T I V E		Too many laws that change frequently	National GDP growth below the expected and necessary	Lack of local workforce	Level of technological literacy below the EU
		Party diversity at the regional government level	Unfavourable investment climate for small domestic investors	Arrival and engagement of uneducated immigrants	Significant generational differences in literacy
		Weak government engagement in supporting (SME) entrepreneurship	Favourable climate for foreign investors that is unfavourable for local investors	Relocation of small towns to larger cities and emigration	-
		Absence of a macro-national and regional system	Impossibility of favourable lending to small entrepreneurs	Low birth rate	-
		Political and legal solutions not accepted by the scientific community and professionals	Due to numerous small settlements, insufficient market demand prevents faster development	High level of corruption and nepotism	-
P O S I T I V E		Detailed categorisation of marinas	The GDP of the island is better than the average of Croatia	Understanding the need for significant changes in Croatia	The island's level of technological literacy is above the Croatian average
		Good setting of local community goals	Good competitiveness and occupancy of Croatian marinas and Marina Punat	The connection of the island with the mainland but also with neighbouring islands	Conditional monitoring of technological trends
		There is no great influence of state administration and politics	Development of entities that are not under the direct control of politics	High degree of acceptance of diversity	Investment in technological development by young entrepreneurs
		Outside the political activity of the central government	Good cooperation with foreign business	Increase in the number of inhabitants	Recognising foreign role models important for technological development
		-	Effective use of EU funds	-	New patents

Source: Created by the authors (Autumn 2023)

The following presents the research carried out on the form and extent of socially responsible activities of a small local community and marina in order to assess socially responsible performance. The limitations set in this research are the deviation from the same research in a large city and a large county. This could be explored in future research by comparing small local governments and municipalities with larger ones.

5. Marina and local self-government in social responsibility

In general, socio-business sustainability is key to the planning and design of coastal infrastructure, especially marinas. Marinas play a significant role in coastal tourism, especially in summer resorts and urban waterfronts; therefore, they need to be adapted to the principles of sustainable tourism (Hruška et al., 2021). Port terminal activities can also be harmful to the marine environment, such as, for example, negative impacts on the environment and the coastal area through pollution due to the release of contaminants - waste water, oil and its derivatives (Cibic et al., 2021).

The development of more socially sustainable tourism in the locality is largely connected to human activities related to ports and marinas. In particular, free time, boating, local fishing, and tourist transport, depend on adequate ports and the status of navigation routes (navigability) (Guzzini et al., 2021).

The subject of this study is Marina Punat and the municipality of the same name on the island of Krk, the Municipality of Punat.

In the first step of this study, it is necessary to define local self-government, outline its basic characteristics and see what significance it has in the wider national context. Along the Croatian coast, a number of small local self-governments were established as small municipalities (Jurić, 2021). These were places that were in danger of dying out due to demographic decline and insufficient entrepreneurial development. The problem of demography is the central problem for the survival of small towns and municipalities. When a small community is on the verge of disappearing, it is necessary to turn this negative process into a development process. As a rule, this problem is the responsibility of the state and its policy of unitary development. In order for the national policy of uniform development to be realised, there should be clear goals, and this presupposes the existence of a macro-national system based on the basic pillars of society, which Croatia has not developed yet (Luković et al., 2022). Nevertheless, the development of tourism and the possibility of developing entrepreneurship in the maritime sector after the war have enabled the emergence of private marinas in such small towns. Marina harbours proved to be a good solution. Under these conditions, the necessity and possibility of good cooperation between all parties involved was emphasised. This raises the research question of how direct and indirect cooperation is achieved, with the marina acting as the leader.

In relation to the topic of this study, it can be concluded that in smaller municipalities, regardless of party affiliation, there is a greater connection between the local government and the population. This presupposes that municipal needs are defined and implemented jointly and transparently in comparison to large cities, municipalities and counties. At the level of small local self-government, the "government-community-population" link is stronger and more direct, creating better conditions for the easier realisation of the set goals.

The dynamics of market changes as well as changes from other sources, such as strategic risks, require greater dynamics of research into small towns and municipalities along the Croatian coast (Guzzini et al., 2021). The absence of research determines the limits in the dynamics of development, in both marinas and small towns.

6. Socially responsible behaviour in tourism - examples of good practice

Today, there are numerous companies that practise socially responsible business practices and thus make a contribution. The most important examples of good practice are listed and described below.

Grupo Puntacana (GPC) is a large private company that develops and operates coastal tourism projects in the Dominican Republic. In 1998, the company established a foundation with social, cultural and educational objectives that supports a range of social needs through social and community programmes in the region such as schools, clinics and vocational training programmes (Biondi & Lara, 2015).

Another example is *Ilirija d.d.*, a tourism company in Biograd na Moru, which applies the Code of Corporate Governance, the Code of Business Ethics and Socially Responsible Behaviour in its operations. The company is also a member of the Croatian Business Council for Sustainable Development (HR PSOR). One of Ilirija's long-term goals is the motivation of employees, which, in addition to material income, is achieved by working in an environment that ensures their professional development and improvement, while taking care of their social and societal needs, respecting their personal and professional characteristics. At the same time, the Blue Flag at Kornati Marina demonstrates compliance with the international environmental and coastal protection programme, whose main objective is the sustainable development, health and safety of the community (Petričević, 2014).

Haven Kakumäe is a new marina built to the latest standards, located near the Estonian capital Tallinn. The marina's business is geared towards the needs of users, so there is a recreation centre for the whole family and for all age groups. One of the external collaborators is the "Tallinn Yacht Club", which is also committed to socially responsible action, as the sailing schools and the construction of a sailing stadium are organised in joint cooperation. The marina also works with the local community and has signed an agreement to organise the traditional "Seafaring Days" fair and the marina's Open Days (Jakulj, 2018).

Marina Frapa holds the prestigious Blue Flag award, which recognises its high ecological quality. It is also the first marina in Croatia to have a sophisticated sewage system for grey water at a

depth of 40 metres in the sea. As a socially responsible company, the marina contributes to the local community by creating green spaces, employing local residents and organising various events such as concerts, Marina Frapa Day, pageants and sailing regattas (Stipanović et al., 2012).

7. Empirical research on the socially responsible activities of Marina Punat and local self-government

Considering that the basic role of the state, namely the promotion of entrepreneurship, is developing unfavourably in small towns, the development of these small towns depends on the cooperation between the local leader—in this case, the marina—and the local government. This raises the question of the extent to which the marina and the local community act in a socially responsible manner in smaller towns.

7.1 Local government and socially responsible behaviour: The example of Punat Municipality

Punat is a small municipality, but very successful in terms of many development indicators. From the research conducted using the in-depth interview method, which focuses on socially responsible behaviour, the following insights have emerged.

The definition of socially responsible behaviour in Punat Municipality is not fully known, but the content of this term is understood. In the context of socially responsible behaviour, the management of the municipality focuses on setting goals, transparency of operations, compliance with the law and ethical behaviour. Socially responsible behaviour is therefore widely implemented, but it is a spontaneous action that requires very moral qualities from the leadership.

The leadership of the City Council has made numerous investments in the appearance and design of the town itself, as well as in the private sector, which are expected to pay off through increased business activity, i.e. sales tax. On the other hand, improved business will contribute to the overall development of the town and community.

The activities of the city administration, particularly in financial terms, are transparent and can be viewed on the city administration's website. During the short term of office of the municipality's new leadership, municipal funds have been used to improve the municipal infrastructure, build and tarmac unclassified roads and renovate existing roads, among other things.

It can be concluded that at the level of the leadership of the local community of Punat Municipality, socially responsible behaviour is well implemented in most areas of social responsibility, even if it is spontaneous behaviour. The high level of personal responsibility of the members of the leadership, local patriotism in a positive sense, good business logic and direct cooperation with the population and entrepreneurs contribute to the success and results, although the municipality's resources are limited and staffing is modest.

7.2 Marina and socially responsible business: The example of Marina Punat

The knowledge of Marina Punat's management about social responsibility and the benefits of such a business did not arise spontaneously, but through constant research and observation of global processes in the most developed economies of the EU and the world. With regard to the research topic—the importance of the local community for the marina itself and the importance of the marina for the local community—qualitative research was conducted using the structured in-depth interview method. All management functions of the marina as well as all key structures of society in the community at different management levels (from top management, owners, directors to the heads of individual departments, reception, sailors, services and additional facilities in the marina) were interviewed. In-depth interviews were used as a qualitative technique as the aim was to gain deeper insights into the real situations on the ground.

The questions cover the following topics: Awareness of the concept of socially responsible business, socially responsible business of Marina Punat based on certain indicators (Table 2); cooperation between the municipality, the marina and the Punat Tourist Board; concern for ecology (environment); investments in renewable energy sources; and public-private partnerships in the organisation of various events and numerous educational and environmental activities.

Environmental responsibility is a pillar of the social responsibility of marinas that place environmental protection at the centre of their business and activities in and around the marina. This involves maintaining the cleanliness of the sea, the coastline and the nearby beaches adjacent to and connected to the marina. The following applies to Marina Punat:

a) The method of building piers from sustainable materials that do not leave a harmful footprint on the environment, the supporting structure of the

piers is made from secondary raw materials. An additional argument in favour of environmental preservation is the fact that the structure of the jetties does not float, but is fixed and raised from the sea surface, which allows the free flow of water masses within Puntarska Draga under the jetties.

b) High standards of protection against sea and coastal pollution through ordinances regulating the acceptance of lubricating oils, their disposal, protection, and the development of new patented projects for the inconspicuous collection and disposal of waste and lubricating oils.

c) 24-hour physical and technological monitoring of the ecology of the sea and 24-hour innovative physical and technological monitoring of ships using a digital system for monitoring ships - PROACTIVE BOAT CARE, which provides ship owners with data and image information about the activities of seafarers on the ship and berth and the condition of the ship via a mobile application; integration into the digital sensor system for ship safety, whereby the marina immediately receives an alarm about the non-compliant and risky condition of the ship.

d) Supervision of the contents around the marina, which is carried out as an aid to the local self-government and its supervision system.

e) Development of an independent power supply system that makes the marina energy-independent (solar power plants, heat pumps for water heating).

f) Use of electric vehicles in daily activities and the operation of electric vehicle charging stations.

g) The ecological principles and activities to protect the environment and minimise the ecological footprint are confirmed by internationally recognised certificates and accreditations: the Blue Flag; ISO 14001 – Marina Punat was the first marina to be certified with this globally standardised certificate for environmental management, holding this certification continuously since 2010; Golden Marina Anchor – a global accreditation for marinas according to a very strict scheme implemented and monitored by the Yacht Harbour Association (TYHA); ADAC – the largest German car club rated the quality of the harbour's services with a maximum of five golden rudders; and the Clean Marina Programme assessment by the Yacht Harbour Association (TYHA) that is currently underway.

h) A supportive policy for pet ownership that includes the provision of infrastructure aimed at environmental protection.

Marina's *ethical responsibility* stems from numerous factors, most notably its prestigious international status and its interaction with companies and people from all over the world. There are numerous indicators of Marina Punat's high level of ethical behaviour and business:

a) Due to labour force shortages, the marina employs people from outside Croatia, and through education and training, employees of foreign nationality are placed on an equal footing with local employees.

b) The marina resolves any issues that arise unexpectedly or unforeseen with stakeholders and shareholders in a way that supports the realisation and satisfaction of their interests.

c) The marina is developing a special form of ethically responsible business with the local community and all its entrepreneurs.

d) The marina offers employment and accommodation for foreign workers within its accommodation capacity, as well as training and professional development.

Philanthropic responsibility is a pillar of corporate social responsibility, regardless of the size of the company, in this case the marina, which contributes through its activities to the development of the community and the society it is located in. Marina Punat plays an exceptional role in the local community through socio-economic investments in infrastructure and good cooperation with the local community and the residents of Punat Municipality. This involvement has led to several positive outcomes:

a) Accelerated development of local and community entrepreneurship, especially during the summer season.

b) Employment opportunities for the local population.

c) The capacity of the marina in alignment with the needs of the social community, both locally and nationally.

d) Financial support for numerous sporting events held within and beyond the marina.

e) Successful recruitment of labour from the local community. The marina offers accommodation for workers coming from outside or abroad.

f) Support for talented individuals through scholarships, lifelong learning, further education and professional training opportunities.

Financial responsibility is a pillar of corporate social responsibility that combines the three areas of social responsibility mentioned above. Marina Punat develops and sets goals and directs funds that focus on environmental protection, development, ethics and philanthropy. However, these plans need to be supported by financial investments in programmes, projects, donations and research, which leads to budgeting and operational activities such as:

a) Research and development of new products and patents related to ecology and self-sufficiency. Marina Punat plays the role of the owner of an EU project funded through the National Recovery and Resilience Plan of Croatia (NPOO) titled "Development of autonomous robots to increase the efficiency of processes and the organisation of activities in marinas with research on the impact on consumer habits, satisfaction and the level of tourist consumption".

b) Occupation with the possibility of investing in education, according to natural predisposition, interest and ability, different types of talents and education.

c) CSR management training initiatives, which are then transferred to employee training to develop social awareness and care for the environment in the marina.

d) Investments in the energy independence of the marina, as well as projects that ensure greater safety for boats in the marina and safe collection of waste and lubricating oil in an almost invisible way so as not to disturb boaters.

e) Investments in projects related to new and renewable energy sources.

f) Support and funding of scientific projects, in particular nautical tourism.

g) Financing of regattas and other sporting and entertainment events.

h) Ensuring transparent and timely financial reporting, including an external audit.

It can be concluded that, based on education and observation of the development of scientific thinking and society outside Croatia, the management of Marina Punat is well acquainted with socially responsible business practices and recognises their positive effects. Considering the role of Marina Punat as a local leader, the question arises as to how the socially responsible actions of the municipality and the socially responsible activities of the marina

are combined into a whole that contributes to all issues of the local community.

7.3 Liaison of socially responsible operations of the marina and the leadership of the municipality

Marina Punat has an almost completely dominant influence on the development of the local and regional economy, Punat Municipality, the entire island of Krk and Primorje-Gorski Kotar County. Punat Municipality is an attractive micro-destination characterised by the unspoilt nature of the northern Adriatic and is ideally suited for the development of nautical tourism. The majority of accommodation capacities are flats, while other types of accommodation are available to a lesser extent. The essence of the synergy between Marina Punat and Punat Municipality is the creation of a holistic product that meets the needs of tourists. To this end, the interaction of the public and private sectors and public-private entrepreneurship is necessary. Tourist activities integrate local interests in the framework of targeted business co-operation with the offer holders to create a destination product. The Punat Municipality should become a destination for quality nautical tourism, a place of relaxation, entertainment and sports, tradition and culture, aimed at tourists who want to spend an active holiday.

The cooperation between the leadership of the municipality and the marina is very intensive. The leadership of the community is aware that the marina is a key factor in the development of Punat Municipality, and together they develop projects of general social interest. Life in Marina Punat is closely connected with the life of the town, i.e. Punat Municipality and the wider community. This relationship is very strong on both sides, which is particularly evident in marina's active participation in the life of Punat. Marina has also taken part in various activities outside Punat Municipality, such as permanent and long-term care of the Sailing Society in Punat (utilisation of the marina's space and infrastructure, assistance in organising regattas, etc.), ongoing support for educational institutions, sports clubs and events, assistance to the Home for the Elderly and Infirm in Krk, financing the activities of the Association of Retirees from Punat, support for the Centre for Neglected Children "Izvor" in Selce, donations to the Ministry of Interior Krk for activities at sea, financial support for the restoration of the 16th century nativity scene on the island of Košljun, financial support and sponsorship for performances by the Cultural and Artistic Society Punat and other cultural associations that promote tradition,

and provision of playground equipment for children and for the new kindergarten.

In order to better connect the marina and the local community, it is necessary to strengthen the social responsibility of the marina and build a positive attitude of the local population towards the marina. The Marina Punat brand has great value and enables a qualitative step forward as a destination with an exclusive programme, either in terms of tourism or nautical activities. To make it clearer and more measurable, a Likert scale (ratings from 1-5) is used to evaluate the factors of socially responsible business activities of Marina Punat and the socially responsible behaviour of the Punat Municipality's administration. Given that this study analyses the attitudes of the marina's subjects and the municipality's management, the Likert scale is an appropriate tool for measurement.

Table 2 Evaluation of the views of the Marina Punat and Punat Municipality leadership

CSR indicators	Punat Municipality leadership	Marina Punat	Note
Understanding the concept of CSR	3	5	With the Punat Municipality leadership, it is spontaneous, and with Marina Punat, it is an insight into the terminology.
CSR planning	4	4	Both the municipality and the marina plan CSR well.
CSR activities	5	5	Both entities are investing heavily.
Activities to help Punat Municipality entrepreneurs	5	4	The municipality is investing in local entrepreneurship, while the marina participates actively by involving local providers of services or goods.
Activities to help entrepreneurship outside the municipality	1	5	The marina supports entrepreneurship outside Punat Municipality and cooperates with entrepreneurs outside the city.
Support for scientific research	1	5	The marina supports and encourages scientific research and uses it for the purpose of its development.
Support for education of Punat Municipality residents	1	5	The marina awards scholarships to pupils or students (e.g., waiters and chefs) or continuously invests in their education and training during their employment.
Childcare in Punat Municipality	5	5	Both the municipality and the marina distinguish themselves through their commitment to children's welfare, demonstrated by the provision of playgrounds.
Beach care	4	3	While the beaches fall under the responsibility of the municipality, which therefore assumes primary care, the marina also actively participates in beach cleaning efforts.
Care of the port area	4	2	The municipality takes care of the maritime property and the harbour area, while the marina only takes care of its own area.
Ecology in the municipality	4	2	The maintenance of ecology in the municipality falls under the responsibility of municipal services.
Investments in renewable energy sources	3	5	The marina strongly supports investments in renewable energy sources, strives for energy self-sufficiency (solar power plants, solar water heating systems, solar lighting and signalling) and develops new patents. The municipality is investing in intelligent benches, solar lighting and signalling systems.
Aspiration for cooperation	3	3	Both companies are striving to cooperate and invest together, but there are legal restrictions.

Source: Authors (February 2024)

The research results allow the conclusion that both entities implement all aspects of socially responsible business and behaviour very effectively. Namely, the Punat Municipality administration focuses

more on local needs and wishes of its residents, while Marina Punat focuses on the activities in the marina, outside the marina and outside the borders of Croatia. The marina and the leadership of the municipality cooperate well and create the conditions for accelerated development of this small municipality. Unfortunately, Croatian laws prevent better cooperation.

There is an awareness of social responsibility, but it needs to be developed and supported. Given that local self-government in Croatia represents the lowest tier in the hierarchy of authorities and is largely left to operate independently, it demands a high level of social responsibility awareness among those in charge. This also necessitates that decision-making processes be transparent, with morality aligned closely with ongoing learning and development.

8. Conclusion

Socially responsible business practices and actions are a relatively new concept in the Republic of Croatia, which has expanded the scope of management and administration of both business entities and non-profit organisations and communities. The implementation of socially responsible business practices is a challenge for tourism. It implies the ethical behaviour of the company and contribution to economic development while improving the quality of life of employees, the local community and society as a whole.

The research conducted for the purposes of this article, using the example of Punat Municipality and Marina Punat, led to the conclusion about the development of socially responsible business practices and behaviour. It was found that the socially responsible behaviour of both the municipality and the marina initially occurs spontaneously but soon evolves into a conscious concept aimed at maintaining profitability through cooperation—without which investment in development would not be possible. This means that the socially responsible behaviour of community leaders stems from an understanding of the local situation, a desire to develop their place and confidence in the potential of the entire community, which has led to investment in the development of local entrepreneurship, but also to coexistence with the marina. In other words, along the Croatian Adriatic coast, local market leaders have developed in small towns —in

this case a marina —that, like the local community today, understand the need for socially responsible business practices that foster connections with the local community. A good example are the Croatian marinas located in smaller towns and municipalities, which have gradually realised that the arrival of boaters at the marina depends not only on the quality of the marina, but also on the quality of the destination. Joint investment in the destination is therefore economically justified for both parties. In this context, a study was conducted with the aim of assessing the importance of socially responsible business practices for the unity of the local community and the marina as a local leader. The conducted study showed that the investments of the local community have significantly influenced the image of Punat Municipality, which has become an internationally known and recognised tourist destination. At the same time, the Marina Punat has assumed the role of a local leader and, with its strong international reputation in the nautical tourism market, has contributed significantly to the development of Punat Municipality and the entire island of Krk. However, the conclusions drawn from the research on Punat Municipality and Marina Punat represent a small sample size, which indicates the need for conducting a series of similar studies to gain a better insight into the applicability of socially responsible business practices along the Croatian Adriatic coast. There are numerous places along the Croatian Adriatic coast where marinas have assumed the role of a local leader, but it cannot be concluded that this applies to all marinas and all local communities on the Adriatic coast. Therefore, this paper indicates the need for further research on the topic of socially sustainable business practices and cooperation between the local community and the marina, or some other entity that plays the role of a local leader.

In order to achieve the research objective, i.e. to confirm the research hypothesis, an appropriate methodology was developed to investigate the relationship between the local community and Marina Punat. By analysing and comparing key indicators of the relationship between socially responsible behaviour of the leadership of the Punat community and the socially responsible actions of the Marina Punat management, it was found that their cooperation exists in the form of joint planning and cooperation. At the same time, joint investment by the marina and the municipality was not confirmed, al-

though similarities have been clearly documented. The reason for this is the legal obstacle of Croatian legislation that still prevents a combination of socially responsible activities of the municipality and the marina. This is an unacceptable obstacle that should be warned against.

Based on the research results, the hypothesis has been confirmed: Marina Punat plays a leadership role in the Punat Municipality and is fully aware of this responsibility, demonstrating a high level of social responsibility. In line with the core principles of social responsibility, the marina is developing four key areas of socially responsible management—political, economic, social, and technological—alongside additional forms of social responsibility. This comprehensive approach positions Marina Punat at the forefront of socially responsible marina management in both Europe and globally.

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CLUSTERING REGIONAL COMPETITIVENESS IN CENTRAL AND EASTERN EUROPE: INSIGHTS FROM THE K-MEANS METHOD

Abstract:

Purpose: This paper investigates regional competitiveness of NUTS 2 regions in eleven post-transition EU Member States in Central and Eastern Europe (CEE) from 2011 to 2021. It applies Martin's (2004) "Regional Competitiveness Hat" model to identify whether distinct regional profiles, knowledge hubs, production locations, and regions with growing yields, can be empirically validated using clustering techniques.

Methodology: The study utilises the k-means clustering method to classify 61 NUTS 2 regions based on three key indicators: GDP per capita, population density, and gross domestic expenditure on R&D. Data were standardised and tested for outliers using Mahalanobis distance. ANOVA and post-hoc Games-Howell tests were conducted to verify statistical significance and interpret the stability and movement of regions between clusters over time.

Results: The analysis produced three statistically robust and theoretically consistent clusters: knowledge hubs (e.g., Zagreb and Bucharest), production locations (regions with low GDP per capita and population density), and regions with growing yields (moderate GDP per capita and lower density). The results affirm the utility of Martin's model in the CEE context and reveal stability among clusters, with notable mobility only between production locations and growing yield regions.

Conclusion: This study confirms the applicability of Martin's framework to post-transition CEE regions and offers a dynamic, data-driven classification tool for regional development policy. It highlights GDP per capita, population density, and R&D investment as critical competitiveness indicators. The findings support targeted EU policy-making and suggest future inclusion of digitalisation and sustainability metrics.

Keywords: Regional competitiveness, CEE countries, k-means clustering, GDP per capita, NUTS 2 regions

1. Introduction

Although the European Union (EU) has one of the highest standards of living in the world, there are significant economic, social and territorial dispari-ties between its Member States and, in particular, between its different regions. These disparities can hinder the EU's global competitiveness and pose challenges for balanced development, as pointed out by Melecký and Staníčková (2014). In this con-

text, understanding the factors behind regional competitiveness is vital for designing policies that promote cohesion and growth. This paper focuses on NUTS 2 regions in Central and Eastern European (CEE) countries, nations that have undergone significant transformation since joining the EU. Using Martin's (2004) regional competitiveness hat model as a framework, this paper examines whether these regions can be grouped into three categories: knowledge hubs, production locations and regions with increasing yields. By applying k-means clustering, this paper aims to detect meaningful patterns and provide insights that could inform both academic understanding and practical policymaking.

The authors of this paper examine regional competitiveness clusters of the NUTS 2 regions of the eleven post-transition EU Member States, commonly referred to as CEE countries (Bulgaria, the Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland, Romania, Slovenia, Slovakia and Croatia), for the period from 2011 to 2021. Based on the literature review and before conducting the empirical part of the paper, the authors put forward a research hypothesis:

There is no difference in the number of clusters resulting from k-means clustering of the regions with respect to the Regional Competitiveness Hat model.

Accordingly, this study aims to answer the following research question: To what extent can Martin's (2004) Regional Competitiveness Hat model be empirically validated within the post-transition context of Central and Eastern Europe (CEE)? The central hypothesis is that NUTS 2 regions across CEE countries can be classified into three internally consistent clusters corresponding to the model's theoretical dimensions: knowledge hubs, production-oriented regions, and areas characterised by increasing returns.

The article is structured as follows. Section 1 introduces the study's background and objectives. Section 2 reviews the evolution of the regional competitiveness concept and surveys empirical applications of clustering approaches. Section 3 describes the methodological framework and presents the empirical results. Section 4 discusses the main challenges and perspectives arising from the analysis, while Section 5 concludes with a synthesis of findings, policy implications, and suggestions for further research.

2. Literature review

The competitiveness criteria serve as a basis for measuring regional competitiveness. The "na-

tional diamond" model, the "double diamond" model, the "nine factors" model, the "regional competitiveness hat" model, the "pyramid of regional competitiveness" model and the "tree of regional competitiveness" model are some of the traditional competitiveness models that can serve as a methodological basis for determining competitiveness factors (Snieška and Bruneckienė, 2009). Each model distinguishes between different methods of selecting and combining the elements of competitiveness in a general system. Over the years, policy makers and academics have paid great attention to competitiveness, especially its economic aspect. Focusing on increasingly broad strata based on companies, industries or entire countries, regional competitiveness hat has been studied from both micro and macro perspectives (Shivindina, 2020).

Martin's (2004) Regional Competitiveness Hat model identifies the key determinants of regional competitiveness, placing infrastructure within its second analytical layer (Martin, 2004; Rahmat and Sen, 2021; Ferrarini et al., 2024). As a conceptual framework, it offers a systematic approach to identifying and linking factors that enhance regional performance and has informed subsequent analytical methodologies at the European scale. For example, Ferrarini et al. (2024) use the TOPSIS multi-criteria method to assess competitiveness among EU regions, demonstrating how composite indicator techniques can effectively complement cluster-based models in revealing structural heterogeneity. Regional outcomes, regional outputs, regional throughputs and factors influencing regional competitiveness are represented by different levels of the hat. To account for the presence of external opportunities and threats, the determinants are presented on the way to the crown of the hat and then they return to the base. In many rings surrounding the production cylinder, the fundamental determinants of regional competitiveness are located at the bottom of the hat. The first ring contains the components of production (labour, capital and land). Since labour and land are less mobile, the regional powers have more influence on them. The most important determinants of the regional investment climate, including infrastructure and accessibility, human resources and the productive environment, are found in the second ring. Institutions, internationalisation, technology, demographics, location quality and environment are examples of secondary factors. Figure 1 shows the regional competitiveness hat.

Figure 1 Regional competitiveness hat
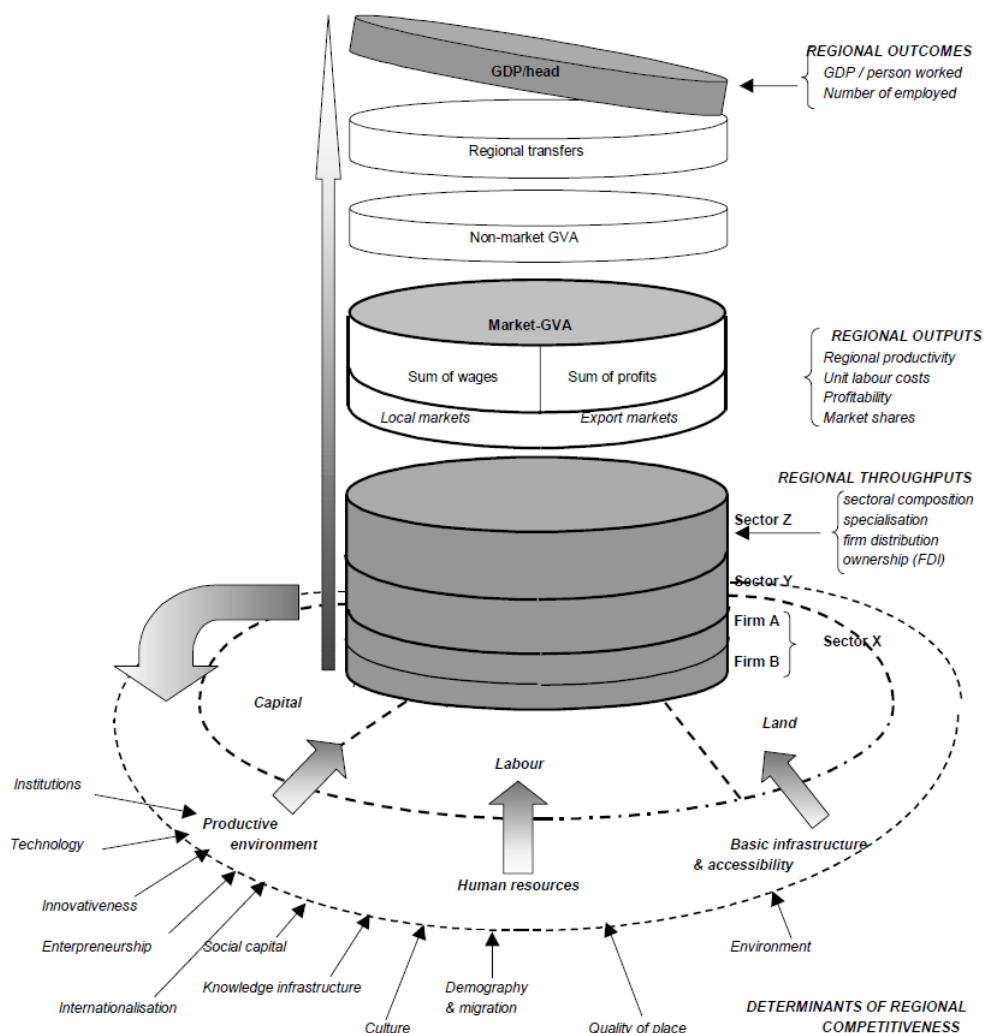
Source: Martin, 2004

These factors are all linked to regional competitiveness. The regional competitiveness hat includes a variety of flexible activities, such as the influence that multinational companies have on the availability, price and standard of determinants. The regional competitiveness hat also draws attention to how companies have become more competitive in industries that are more specialised (economic structure), gain market share, are more productive and profitable, consolidate areas with high per capita production, and promote an improved quality of life. At this level, the economy is able to deal with the opportunities and challenges of the global market. Ručinska and Ručinsky (2007) use the concept of regional competitiveness hat for their study. Considering all hierarchical and classifying divisions/types of regions, the authors choose the one that classifies them on the basis of regional competitiveness. According to Martin (2004), regions can be Regions as places of export specialisation, Regions as sources of increasing returns, and Regions as knowledge hubs. It can be said that the factors of regional competitiveness are different for each of these types of regions, but they overlap.

The three classifications of regions created by Martin (2004) are described below:

- **Regions as places of export specialisation (production locations)**

According to Martin (2004), regions compete to attract economic activity by exploiting their comparative advantages resulting from locational factors such as the availability of resources, labour and access to markets. Low- to middle-income regions specialise in industries that rely on cheap inputs and thus avoid the disadvantages of urbanisation. They attract vertical foreign investment and focus on cheaper production, often as production hubs. Factors such as labour costs, population density and access to transport hubs also influence their status as manufacturing regions.

- **Regions as a source of increasing yields (with increasing yields)**

In recent years, the concept of increasing returns has regained importance in the economy. The growth of a region is linked to the demand for its exports, with the expansion of production promoting technological change and increasing labour productivity. Martin (2004) claims that dynamic regions with an average population density and a specific economic structure become sources of increasing returns. These regions, such as Zuid-Oost-Brabant, Oost-Vlaanderen, Rhône-Alpes and Toulouse, benefit from agglomeration effects, specialised industries, labour and technological spillover effects that enable them to achieve high

and sustainable incomes and long-term competitiveness.

- **Regions as hubs of knowledge**

Martin (2004) points out that Marshall emphasised the importance of three key economies of localisation: specialised labour, supporting companies, and division of labour between companies. These interactions create a "local industrial climate" that fosters innovation and entrepreneurship. Regions that are knowledge hubs often rely on local innovation networks that include businesses, universities and other institutions, as well as the economic benefits of urbanisation. Porter's concept of geographical clusters also emphasises the importance of regions for competitiveness (Porter, 2012). Examples of innovative regions include Baden-Württemberg and Emilia-Romagna, which are characterised by high research intensity, high wages and a strong presence of universities.

In addition to the regions mentioned above, Martin (2004) also lists the following regions: space regions, balanced regions, dynamic regions, retreating regions, regions of urban specialisation and cosmopolitan regions, which lie at the interface between the three main regions mentioned above and define the three main types. The graphical representation of Martin's division into regions can be found in Figure 2 below. It is determined by two axes on which the population density and the (growth) GDP per capita lie.

Figure 2 Typology of regions
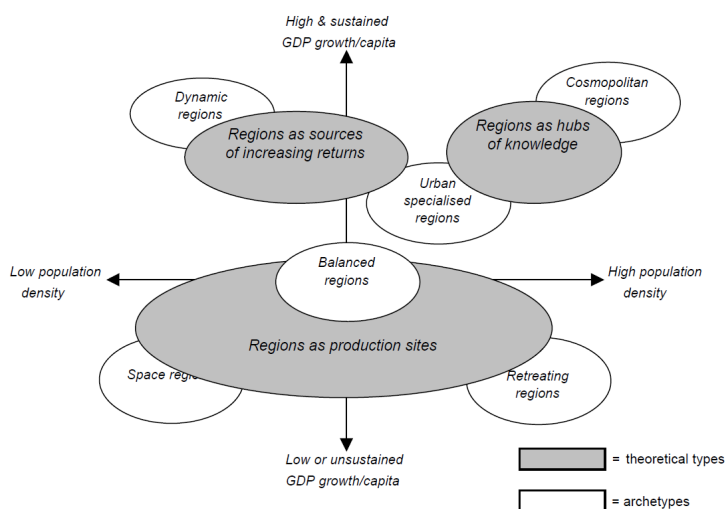
Source: Martin, 2004

From the above it can be concluded, at least in part, that the only thing that is certain for regions as hubs of knowledge is a high and growing GDP per capita and a high population density. Regions as production centres have a low GDP per capita, they tend to be on the low population density side, but not necessarily. Regions with growing yields are assigned moderately high GDP growth per capita and moderate to low population density. This confirms how difficult it is to categorise regions into a specific (theoretical) group.

The research conducted by Martin (2004) was based on the NUTS 2 regions of the then EU Member States, but also of the EU candidate countries (which include the countries that are the subject of this research, i.e., the CEE countries that are EU Member States), but the author did not have the data for the candidate countries (except for some at NUTS 0 and 1 levels). Martin (2004) draws on seven case studies, each looking at a NUTS 2 region from Belgium, Spain, France, Italy, Finland, the UK and Hungary. The only region he examined that belongs to the regions that are the subject of this paper is the Hungarian region of Nyugat (the then HU03), which belonged to the group of regions defined as production locations.

A slightly different model of the regional competitiveness hat was used by Cambridge Econometrics ECORYS-NEI and provides a methodological framework for analysing and assessing regional competitiveness (Nowak, 2011). The process involves several important steps. First, regional performance is assessed using economic indicators such as GDP per capita and gross value added to gain a basic understanding of regional success. Second, the analysis shifts to evaluating how efficiently regions use their resources, which involves looking at indicators like regional value added, profitability, market share, and unit labour costs, all of which offer insight into how productive and competitive a region really is. Third, the structure of the regional economy is explored by examining how sectors are distributed, the level of specialisation, how firms are spread out, and what types of ownership are present. The aforementioned helps reveal the underlying economic makeup of each region. Finally, the study identifies a region's potential for future competitiveness. This includes foundational elements such as infrastructure, the quality and availability of human capital, and the broader production environment. A wide range of influencing factors

are considered, among them labour costs, profitability, sectoral structure, institutional support, access to technology, innovation capacity, entrepreneurial activity, international engagement, social capital, knowledge exchange, cultural dynamics, demographic trends, migration, locational advantages, and environmental quality. Taken together, this broad and multidimensional approach offers a more complete picture of what drives regional success, integrating economic, social, and institutional factors (Nowak, 2011).

Clustering methods have previously been applied to CEE countries, and the findings of this study align closely with those of Psycharis et al. (2020), who also used a cluster-based approach to examine regional competitiveness across Europe. By classifying the regions in their study according to economic and social indicators, emerged clusters reveal differences in competitiveness, particularly between the Central and Eastern European (CEE) regions and their Western counterparts. Both studies emphasise that the most important factors for regional differentiation are GDP per capita and investments related to innovation. Conceptually, the clusters in this study (knowledge hubs, production locations and regions with increasing yields) correspond to the clusters identified by Psycharis et al. (2020), which include innovation-driven regions, transition economies and structurally disadvantaged areas. The parallels make it clear how useful clustering is as an analytical tool for analysing regional economic systems.

Although regional competitiveness has been extensively examined, recent studies highlight the need for more dynamic and data-driven approaches to capture the evolving nature of disparities within post-transition economies. Conceptual frameworks such as Martin's (2004) "Regional Competitiveness Hat" were primarily developed for Western European contexts, leaving both conceptual and empirical uncertainties regarding their relevance for Central and Eastern Europe (CEE). This research gap has been reiterated in several recent studies (Grassia et al., 2024). Grassia et al. (2024) also conducted a structure-based topic analysis of contemporary literature on regional competitiveness, revealing a growing emphasis on incorporating institutional and sustainability dimensions into competitiveness models. Their findings reinforce the need for continuous methodological refinement in evaluating regional performance, particularly in post-tran-

sition settings. Chrobocińska (2023), for example, used RCI-type indicators and clustering analyses for CEE regions, identifying persistent heterogeneity between post-transition and Western European economies. Similarly, Kouskoura et al. (2024) highlighted the increasing significance of sustainability and digitalisation metrics in competitiveness assessments. Moreover, the European Commission's Regional Competitiveness Index 2.0 (Dijkstra et al., 2023) integrates updated methodological elements that better capture innovation dynamics and institutional quality. Collectively, these contributions underscore the need to empirically revisit classical frameworks such as Martin's within the specific socioeconomic conditions of CEE countries, a task that constitutes the principal contribution of this paper.

However, this study focuses on post-transition CEE areas and provides a more thorough examination of their particular development problems and trajectories, while Psycharis et al. (2020) present a national analysis. This study highlights the institutional and spatial elements that influence regional competitiveness and provides a solid theoretical framework for interpreting the cluster results by incorporating Martin's (2004) regional competitiveness hat model. Examining the stability and mobility of regions over time is one of the key differentiators of this study. In contrast to Psycharis et al. (2020), who mainly focus on static cluster characteristics, this paper presents a transition analysis that observes the movement of regions between clusters over the observation period. The policy-relevant component that this dynamic perspective entails enables targeted recommendations for transitional zones. In addition to validating the cluster technique used in this study, a comparison with Psycharis et al. (2020) shows its particular contribution to understanding the changing regional competitive landscape of CEE regions within the wider European framework.

3. K-means cluster analysis

In this paper, a cluster analysis using the k-means method was used to group regions from the sample into clusters of these regions, which can be seen later in the paper. The research sample includes 11 post-transition EU countries (Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia,

as mentioned above, CEE countries) and the corresponding 61 NUTS 2 regions (according to the NUTS 2021 terminology). The data were collected and processed for the period from 2011 to 2021 for all regions mentioned.

Methodology

One of the common techniques for statistical data analysis that is used in many areas is clustering. This is the process of grouping similar objects into different groups, i.e., dividing a data set into subsets, with the data in each subset separated by a certain distance measure (Everitt et al., 2011; Madhulatha, 2012; Wieland, 2019; Eva et al., 2022; Gamidullaeva et al., 2022; Giełczewski et al., 2022). In clustering, the algorithms can be hierarchical or partitioned. Most studies use one of two popular heuristic methods, such as the k-means algorithm and the k-medoids algorithm method.

Clustering is a descriptive technique, and the clustering solution is not unique and depends largely on the researcher's choice. Clustering always results in groups, even if there is no group structure (Landau and Everitt, 2003; Madhulatha, 2012). Cluster analysis aims to discover groups of observations from originally unclassified data (Landau and Everitt, 2003). The k-means method assigns each point to the cluster whose centre, also called the centroid, is closest to the cluster (Landau and Everitt, 2003). The centre is the average of all points in the cluster, i.e., its coordinates are the arithmetic mean for each dimension separately for all points in the cluster (Madhulatha, 2012). As Devčić et al. (2012) stated, "the main advantage of cluster analysis lies in the objective data reduction based on the reduction of information from the entire population and the reduction of population characteristics to those of representative groups with minimal loss of information".

The preliminary analyses include the deflation of monetary variables using the consumer price index (CPI) to present the values in constant prices, the standardisation of the data by calculating z-values and the outlier analysis using the Mahalanobis distance. Deflation is performed on variables related to GDP, labour productivity and foreign investment, while standardisation allows the comparison of data expressed in different units of measurement. Outliers were identified using the Mahalanobis test and mainly relate to the capitals of CEE countries.

Results

Clustering with the k-means method set to 10 iterations has shown that by the tenth iteration there are no more differences in the cluster centres, which means that the data have reached stability and three clusters have been formed using the above method (Table 1). The number of clusters was determined according to Martin's (2004) theoretical framework, which conceptually distinguishes three regional types: knowledge hubs, production locations, and regions with growing yields. Although statistical validation methods such as the elbow or silhouette approach were considered, they were not applied, as the analysis was intended to be primarily exploratory and theory-driven, rather than to identify a purely data-driven optimal solution. Given the limited number of standardised variables and the relatively small NUTS 2 sample, such indices would likely yield unstable or misleading results.

Therefore, the selection of three clusters was based on theoretical coherence and the demonstrated stability of the iterative process, rather than on additional statistical criteria. All other k-means clustering attempts did not provide good results in less than 15 to 20 iterations, showing that 3 clusters are the most stable, as clustering ended in the tenth iteration.

During the clustering process, the k-means algorithm iteratively adjusts the cluster centres to minimise the differences within each cluster. By the tenth iteration, the algorithm reached a point where no significant changes in cluster centres were observed, indicating that the grouping had stabilised. This stability means that the division into three clusters accurately reflects the inherent structure of the data.

Table 1 History of cluster creation iterations

History of iterations[a]			
Iterations	**Change in cluster centres**		
	1	**2**	**3**
1	1.044	2.123	2.134
2	.424	.041	.022
3	.458	.149	.257
4	.151	.224	.551
5	.147	.072	.145
6	.285	.008	.036
7	.437	.000	.046
8	.126	.007	.027
9	.000	.005	.011
10	.000	.000	.000
a. Convergence achieved by little or no change in cluster centres. The largest absolute coordinate change for each centre is 0.000. The current iteration is 10. The minimum distance between the initial centres is 3.277.			

Source: Unukić, 2024

When determining the number of clusters using the k-means method for the entire period from 2011 to 2021, three variables were used, of which the results of the ANOVA test show that all variables have a statistically significant influence on the

classification of the regions into the identified clusters (Table 2). The results of the ANOVA test show that all three variables have the same statistically significant influence, as shown in the table below. This shows that there are significant differences in

the mean values of these variables between the different clusters. Population density (F = 5038.279), followed by GDP per capita (F = 440.425) and gross domestic expenditure on research and experimental development (F = 424.267) provide the greatest separation between the clusters. ANOVA tests showed statistically significant differences in the mean values of these variables between the clusters, underlining the appropriateness of three different cluster groups. The decision to group the units into three clusters is based on a combination of statistical rigour, theoretical basis and the observed stability of the clustering process.

Table 2 Results of the ANOVA test of clusters for the observed period

ANOVA						
	Cluster		Error		F	Sig.
	Mean Square	df	Mean Square	df		
Population density (gusnas)	59.166	2	.012	624	5038.279	.000
Gross domestic expenditure on research and experimental development (dBI1)	77.390	2	.182	624	424.267	.000
GDP per capita (dBDPpc)	77.914	2	.177	624	440.425	.000
* F-tests should only be used for descriptive purposes, as the clusters were selected to maximise the differences between the cases in the different clusters. The observed significance levels were not corrected for this and therefore cannot be interpreted as tests for the hypothesis that the means of the clusters are equal.						

Source: Unukić, 2024

The analysis of the cluster analysis results in Table 3 shows that three clusters have emerged, which differ significantly in terms of their number. Clusters 1, 2, and 3 contain 22, 411, and 194 regions, respectively.

Table 3 Number of clusters

Number of cases in each cluster		
Cluster	1	22
	2	411
	3	194
Valid		627
Missing		.000

Source: Unukić, 2024

The post-hoc tests are carried out according to the calculated clusters and can be seen in Table 4 Since the assumption of homogeneity of variance of the observed variables was violated ($p < 0.05$), the authors use the Games-Howell test, which shows the differences between the clusters obtained on the basis of the observed variables.

Table 4 Games-Howell test

Multiple Comparisons							
Games-Howell							
Dependent Variable	(I) QCL_1 Cluster Number of Case	(J) QCL_1 Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Zgusnas Zscore (Population Density)	1	2	2.379*	.078	.000	2.184	2.575
		3	2.289*	.078	.000	2.093	2.486
	2	1	-2.379*	.078	.000	-2.575	-2.184
		3	-.089*	.010	.000	-.113	-.066
	3	1	-2.289*	.078	.000	-2.486	-2.093
		2	.089*	.010	.000	.066	.113
ZdBDPpc Zscore (deflated GDP per capita)	1	2	1.798*	.095	.000	1.559	2.035
		3	.894*	.101	.000	.644	1.144
	2	1	-1.798*	.095	.000	-2.035	-1.559
		3	-.903*	.043	.000	-1.005	-.802
	3	1	-.894*	.101	.000	-1.144	-.644
		2	.903*	.043	.000	.802	1.005
ZdBI1 Zscore (deflated gross domestic expenditure on research and experimental development)	1	2	.726*	.128	.000	.402	1.049
		3	-.347*	.137	.044	-.686	-.008
	2	1	-.726*	.128	.000	-1.049	-.402
		3	-1.073*	.049	.000	-1.189	-.956
	3	1	.347*	.137	.044	.008	.681832
		2	1.073*	.049	.000	.956	1.189
* The mean difference is significant at the 0.05 level.							

Source: Unukić, 2024

Looking at the characteristics of the clusters obtained, i.e., their average values in the observation period, they can be assigned characteristic names following the example of Martin (2004). Cluster 1 is characterised above all by the highest average GDP per capita (approx. 19,058 euros/person) and the highest average population density (1,447.7 persons/km2). For the reasons mentioned above, Cluster 1 will be referred to as the hub of knowledge in the remainder of the text.

Using the same variables to determine the name of the cluster and the region groups of Martin (2004), Cluster 2 is characterised by the lowest GDP per capita (7,833.86 euros/person) and the lowest population density (83.19 persons/km2), so that it can be classified into the group of regions as production

locations and Cluster 2 bears this name in the text that follows.

As Cluster 3 has a relatively high GDP per capita (13,468.79 euros/person) and a relatively low population density, it can be classified into the group of regions with growing yields according to Martin (2004) and will bear this name in the text that follows.

Cluster 1, regions as hubs of knowledge, comprises 22 observation units that refer to the regions of two large cities, the Croatian capital Zagreb (HR05) and the Romanian capital Bucharest (RO32). Throughout the observation period, these two capitals belong to Cluster 1, which is not unusual as capitals usually have the highest GDP per capita and the highest population density.

Cluster 2, regions as production locations, contains the largest number of observation units, namely 411. This cluster is characterised by the lowest GDP per capita, the highest foreign direct investment per capita, the longest duration of compulsory education and the lowest population density. In 2011, Cluster 2 comprised 43 regions, in 2012 - 41 regions, in 2013 - 43 regions, in 2014 - 40 regions, in 2015 - 36 regions, in 2016 - 37 regions, in 2017 - 36 regions, in 2018, 2019 and 2020 - 34 regions, and in 2021 - 33 regions. It is evident that there have been changes in the regions during the observation period, but only between Cluster 2 (regions as production locations) and Cluster 3 (regions with growing yields), as Cluster 1 (regions as hubs of knowledge) has an unchanged number of observed units throughout the observation period.

Cluster 3 (regions with growing yields) comprises 194 observation units and is characterised by average GDP per capita values, lower population density, the largest share of employees in the manufacturing sector and the highest availability of the Internet in the regions. This cluster comprised 12 regions in 2011, 14 regions in 2012, 12 regions in 2013, 15 regions in 2014, 19 regions in 2015, 18 regions in 2016, 19 regions in 2017, 21 regions in 2018, 2019 and 2020, and 22 regions in 2021.

Table 5 shows the transition matrix of the clusters for the first and last year of observation.

Table 5 Transition matrix[1] (2011–2021)

Transition from → to	Hubs of Knowledge	Production Locations	Growing Yields	Total
Hubs of Knowledge	2 (Stable)	0	0	2
Production Locations	0	27 (Stable)	6	33
Growing Yields	0	7	15 (Stable)	22
Total	2	34	21	57

Source: Authors, based on data available in Unukić, 2024

Looking at the stability of the clusters, it can be seen that the hubs of the knowledge cluster, represented by Zagreb and Bucharest, have remained completely stable and have maintained their high GDP per capita and population density. Most of the regions in the manufacturing cluster have also been able to maintain their position, which is due to a consistent economic structure based on cost advantages and export specialisation. Similarly, the growing yields cluster was also stable, with most regions continuing to show moderate GDP growth and low population density.

Mobility between clusters was observed mainly between production locations and growing yields, with some regions moving upwards due to improved competitiveness and growth momentum. Conversely, regions that moved from growing yields to production locations may indicate stagnation or lower productivity. The shifts between hubs of knowledge and other clusters were negligible, underlining their consolidated position.

The hubs of knowledge cluster shows remarkable stability, which underlines its established role as an economic leader. Although the production locations cluster is largely stable, it shows moderate transitions to the growing yields cluster, reflecting the evolving economic structures. The growing yields cluster shows both upward and downward mobility, indicating that it is more dynamic but also more susceptible to economic change.

Policy implications according to transition matrix include:

- To maintain their leadership role, knowledge centres need continuous investment in innovation and infrastructure.

- For production locations, policy should focus on structural change, such as promoting R&D and workforce development.

- In the growing yields cluster, downward movers need targeted interventions to counter stagnation, while upward movers would benefit from strategic investments in productivity-enhancing sectors to consolidate their progress.

The following Figures 3 and 4 provide an overview of the changes in the clusters during the observation period.

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1   Diagonal cells (e.g., Knowledge Hubs → Knowledge Hubs) represent regions that remained in the same cluster throughout the observed period; off-diagonal cells (e.g., Production Locations → Regions with Growing Yields) represent regions that transitioned between clusters.

Figure 3 Clusters throughout the observed period
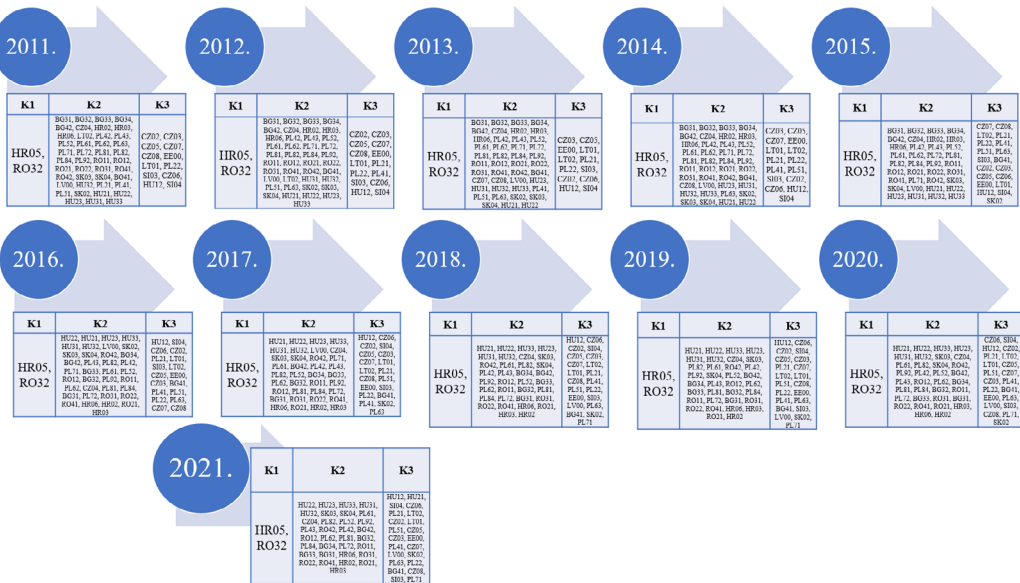
Source: Unukić, 2024

Figure 4 Maps of clusters in 2011 and 2021
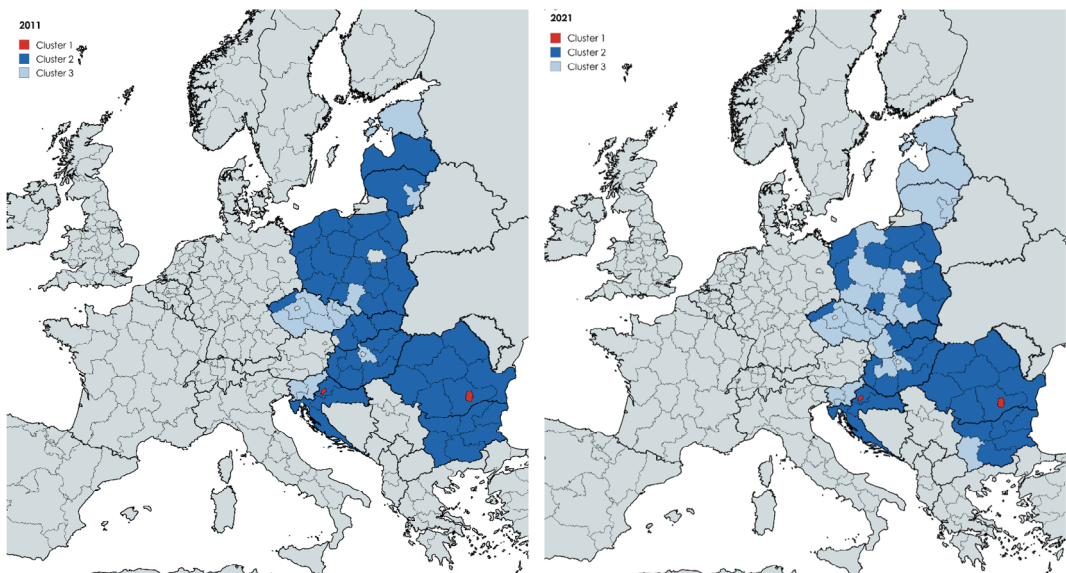
Source: Authors, based on data available in Unukić, 2024

4. Discussion: Challenges and perspectives

The empirical findings support Martin's (2004) conceptual framework within the CEE context, confirming the presence of regional differentiation that corresponds to the model's theoretical categories. Nonetheless, several challenges remain. The on-

going divergence in competitiveness levels among post-transition CEE regions raises questions about the long-term effectiveness of the EU cohesion policies in promoting convergence.

While traditional indicators such as GDP per capita and R&D intensity remain relevant, emerging evidence (Kouskoura et al., 2024) shows that sustainability and digital capacity are increasingly shaping regional competitiveness outcomes. Similarly, recent spatial clustering analyses (Sánchez & Cuadrado-Roura, 2024) indicate that stronger sectoral specialisation contributes to regional resilience—an aspect not fully captured by the current quantitative framework.

Future research should therefore combine statistical clustering techniques with spatial econometric and network-based approaches to better encompass qualitative dimensions such as governance efficiency, institutional quality, and innovation networks.

5. Conclusion

This study is an exploratory effort to empirically test Martin's (2004) Regional Competitiveness Hat model in the context of post-transition EU member states of Central and Eastern Europe. Although the analysis provides meaningful insights, it is preliminary in scope and calls for further empirical investigations using broader datasets and expanded indicator frameworks.

According to the research results, the first cluster includes the capital cities Zagreb (H505) and Bucharest (RO32). This cluster is characterised by a high GDP per capita and a high population density, which places it in the group of regions as hubs of knowledge, according to Martin's (2004) classification. The second cluster is marked by a low GDP per capita and a low population density, placing it within the category of production locations. In contrast, the third cluster shows an upward trend in GDP per capita while maintaining a low population density, features that align with Martin's definition of regions with growing yields.

In this study, the Hungarian region of Nyugat-Dunántúl falls into the second cluster, just as it did in Martin's original research. The region is characterised by a relatively low GDP per capita but stands out for its strong productivity and high levels of foreign investment. The k-means clustering results

align well with Martin's regional competitiveness hat model, supporting the existence of the three regional types (knowledge hubs, production locations, and regions with growing yields), as outlined in his framework. This alignment not only reinforces the validity of Martin's model, but also extends its relevance to the NUTS 2 regions of Central and Eastern Europe during the 2011-2021 period. In doing so, the findings demonstrate that the model holds up well in the context of post-transition EU countries, where economic and institutional transformations have been particularly significant. In the hypothetical case of contradictory results, these findings would indicate either methodological limitations or the existence of unique regional dynamics that Martin's framework does not fully capture, thus providing opportunities to refine the theoretical model. The novelty of this research lies in the application of Martin's model to CEE regions—a context largely unexplored in previous studies. Moreover, the real value of this study comes from combining the model with advanced methods like k-means clustering, which adds a strong, data-driven foundation. By doing so, the research offers practical insights into key factors that influence regional competitiveness, such as GDP per capita, population density, and R&D spending. These findings help identify distinct regional patterns and support the central hypothesis of the paper.

The findings of this study are highly relevant for shaping regional development policies within the European Union, especially in Central and Eastern Europe (CEE). By categorising regions into three aforementioned distinct groups, the study offers a clear and practical framework for crafting tailored economic strategies. This classification helps policymakers recognise the unique strengths and challenges of each region. For instance, knowledge hubs could benefit from increased investment in education, research, and innovation, while manufacturing-based regions (production locations) may need better infrastructure or reforms in labour market policies.

The study also identifies key drivers of regional competitiveness, such as GDP per capita, population density, and spending on research and development. These insights can guide the allocation of EU cohesion funds and national resources, helping ensure that financial support goes where it can have the greatest impact, whether to boost high-potential areas or support those in need.

Importantly, the research sheds light on the economic transitions that CEE countries have undergone in recent decades. This makes it particularly valuable for understanding how competitiveness is evolving in the region. Moreover, it offers lessons for EU candidate countries, providing a useful model for their integration and development strategies.

Overall, by providing solid empirical data, this study supports the EU's cohesion policy and underscores where efforts to reduce regional disparities should be focused. This alignment with EU objectives makes development initiatives more effective in promoting balanced growth and economic convergence across the Union.

Despite valuable contributions of the study, several methodological limitations should be acknowledged. The clustering approach was guided by theoretical reasoning rather than formal validation indices, such as the elbow or silhouette method. The analysis was based on a limited set of variables (GDP per capita, population density, and R&D expenditure), which, although central to regional competitiveness, do not fully capture institutional quality, infrastructure, or human capital. These factors may have affected the precision and explanatory depth of the clusters. Future research should therefore expand the set of indicators and include complementary validation techniques to strengthen methodological reliability and provide more nuanced insights into regional dynamics.

Looking ahead, the study also lays a foundation for future policy-making. It calls for expanding the research to include more regions, particularly EU candidate countries, and suggests incorporating new indicators, such as digitalisation and green economy metrics. Doing so would offer deeper insights into emerging competitiveness trends and help policymakers stay ahead of evolving regional challenges.

To build a more complete picture, future research should broaden its scope to cover the entire European economic landscape. This would allow for a richer understanding of regional dynamics across varying levels of development and adaptation, and ultimately support more inclusive and forward-thinking regional strategies.

Building on the findings presented here, several open questions warrant further exploration. To what extent might digitalisation and the green transition reshape the spatial patterns of competitiveness across CEE? How do institutional quality and governance capacity interact with economic variables to influence cluster stability? Furthermore, can the inclusion of non-economic factors (such as social capital or innovation culture) enhance the explanatory power of Martin's framework? Addressing these questions would contribute to a more comprehensive understanding of regional dynamics and support further refinement of competitiveness theory.

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OWNERS' PERSPECTIVES ON KEY INTERNAL FACTORS FOR A FAMILY BUSINESS GENERATIONAL TRANSITION: THE CROATIAN CONTEXT

Abstract

Purpose: Generational transition presents a significant challenge for family businesses in Croatia, where most entrepreneurs are encountering succession for the first time. This study explores internal factors that influence the transition process from the perspective of family business owners.

Methodology: This research uses a mixed-methods approach, combining a questionnaire completed by 35 family business entrepreneurs with a focus group involving 6 entrepreneurs at various stages of generational transition.

Results: Most entrepreneurs recognize the importance of succession but tend to treat it as a one-time event rather than as a structured, long-term process. A significant number of them lack formal succession plans and rely on informal decision-making, shaped more by family dynamics than by strategic considerations. Furthermore, generational transition is often postponed until a "right moment", reflecting a reactive rather than proactive approach driven by emotional ambivalence, fear of identity loss, and uncertainty about successors' motivation and readiness.

Conclusion: Successful succession requires more than structural planning; it demands recognition of the deeply personal, emotional and cultural dimensions of a family business environment, along with more responsive and human-centered support systems. The findings show that the older generation's delay in initiating succession is not primarily due to a lack of knowledge, but instead arises from emotional ambivalence, fear of identity loss, and uncertainty about the younger generation's motivation. This emotional reluctance highlights a significant gap in existing support structures, which often focus on legal, financial, or educational aspects, while neglecting the psychological and relational support essential for a successful transition.

Keywords: Generational transition, family businesses, internal factors, owners' perspective, Croatian context

1. Introduction

Among older generations of entrepreneurs, there are psychological barriers that hinder timely planning of generational transitions. Although entrepreneurs are aware of the benefits of timely planning, psychological barriers, most often associated with fear of their own mortality, frequently deter them from taking action and jeopardize the continuity of the family business they have built themselves (Lansberg, 1988; Duh et al., 2006). By accepting the need to plan a generational transition, one accepts one's own mortality. This is extremely difficult for individuals who have spent much of their lives as family entrepreneurs, living with the belief that they control their own destiny. By managing the business, they manage their own fate, as they see the company as an integral part of their identity. Additionally, they believe they control the fate of their family, their employees, and their employees' families. Entrepreneurs perceive the loss of such power, or at least the perception of such power in the business, as a threat to their position within the family as well (Handler, 1994).

The loss of power poses a significant problem for the entrepreneur and discourages them from planning a generational transition. At the same time, the entrepreneur's children, traditionally regarded as the natural successors of the family business, are entering adulthood. The challenges of growing up, which include starting their own young families, developing their careers, and the need for financial independence and autonomy, often conflict with the interests and goals of other stakeholders connected to the business, especially the older generation of entrepreneurs. If the conflicting interests and goals of the main stakeholders in the generational transition are not acknowledged and properly managed, the sustainability of the family business across generations becomes questionable. Generational transition is not feasible without a family successor who is ready to take over ownership and management of the family business from the older generation, and a business owner who is willing to hand over the company to the younger generation.

Since the owner's willingness to hand over the company to the next generation of successors is the first and most essential prerequisite for implementing a generational transition, this research will be dedicated specifically to the issue of generational transition from the perspective of the family business owner who must make the decision to withdraw from the company, and to the preparation of the younger generation to assume a leadership position in the family business. The aim of this study is to deepen the understanding of the generational transition process as well as the accompanying dilemmas and uncertainties by identifying the factors that influence or may influence the generational transition process in the future, from the perspective of family business owners.

2. Literature review

This section of the paper provides a literature review on generational transition in family businesses. The following subsections provide a theoretical and contextual analysis of generational transition in family businesses and identify the factors affecting this process. The section begins with basic information about business transfers to establish a foundation for understanding a specific form of leadership and ownership change - generational transition. Although succession within family businesses is the primary focus, the literature review adopts a broader scope to capture the wider context, challenges, and frameworks relevant to business transfers in general.

2.1 Business transfers

According to the European Union, a business transfer refers to the transfer of ownership of a company to another person or legal entity, thereby ensuring the continuity of the company's existence and business operations (Mezulić Jurić & Alpeza, 2017). This process constitutes a fundamental phase in the life cycle of a company. Nevertheless, various legal, financial, tax-related, organizational, and emotional factors can pose significant obstacles, making the transfer of ownership challenging for many businesses. Business transfers are increasingly recognized as vital for ensuring economic continuity, particularly within the small and medium-sized enterprise (SME) sector. As a growing number of business owners approach retirement age, the implementation of effective transfer mechanisms becomes essential for preserving employment, maintaining supply chains and supporting local economies (European Commission, 2013).

Unlike start-ups, business transfers involve pre-existing operational structures, assets and customer bases. However, they tend to be more complex than

start-ups due to challenges such as emotional attachments, succession planning and legal or fiscal complications (Ip & Jacobs, 2006). These complexities are especially pronounced in family-owned businesses, which represent a substantial portion of SMEs across Europe. Approximately 450,000 companies, employing around 2 million people in the European Union, undergo ownership transfers each year. Alarmingly, around 150,000 of these businesses fail to adequately address the challenges inherent in the transfer process, thereby placing roughly 600,000 jobs at risk (Mezulić Jurić & Alpeza, 2017).

Although a business transfer represents a critical and complex phase in the life cycle of any enterprise, it is mostly associated with family businesses, which are particularly vulnerable during this process due to the overlap between ownership, business and family relationships (Tagiuri & Davis, 1982). Sharma et al. (2003) emphasized that family businesses often lack formal succession plans, instead relying on informal mechanisms that jeopardize continuity. Other scholars have identified psychological and interpersonal barriers, such as founders' reluctance to relinquish control or intergenerational conflict, as key components to successful transitions (De Massis et al., 2008). No matter what factors appear as barriers to successful business transfers, considering the importance of this process—especially in SME economies— overcoming these barriers seems essential for preserving economic value and employment.

2.2 Generational transition in family businesses: A theoretical and contextual analysis

Family businesses constitute a dominant economic force in both developed and transitional economies. In the European Union alone, nearly 23 million SMEs generated €3.9 trillion in added value and employed approximately 90 million people in 2015 (Mezulić Jurić & Alpeza, 2017). Given their economic significance, particularly in countries such as Croatia where family businesses account for over 50% of SMEs, the sustainability of these enterprises is of critical importance (Alpeza & Peura, 2012). Despite their contribution, intergenerational succession remains one of the most precarious phases in the life cycle of family businesses. Globally, research indicates that only 30% of family businesses successfully transition to the second generation, and fewer than 15% reach the third (Morris et al., 1996). This pattern of decline is common across

different cultures, reflected in proverbs that say that "wealth does not survive three generations".

Donnelly (1964) was among the first to highlight the need for a distinct research focus on family businesses, recognizing their unique structures, objectives, and challenges. His foundational definition of businesses involving at least two generations of a family with direct influence over operations remains relevant. However, contemporary scholarship has expanded this view, framing family businesses as complex systems shaped by identity, emotion, and social dynamics (Tagiuri & Davis, 1982; Sharma, 2003). Scholars have increasingly turned attention toward understanding why many first-generation businesses fail to outlive their founders (e.g., Lansberg, 1988). During the 1990's, researchers like Morris et al. (1997) developed models to examine the determinants of successful succession, emphasizing the importance of structured planning.

The transition process has been conceptualized as a phased sequence comprising vision development, successor training, candidate selection, and leadership handover, as articulated by Le Breton-Miller et al. (2004). Historically, scholarly focus tended to concentrate on tangible aspects of the transfer process, such as legal, financial, and operational factors. More recently, however, there has been a growing recognition of the importance of psychological and emotional dimensions. Early contributions by Lansberg (1988) highlighted the psychological barriers that impede succession, using case studies of prominent family businesses to examine leadership transitions.

Weesie (2017, p. 58) identified several psychological barriers that inhibit succession planning, including: "(1) fear of mortality; (2) anxiety related to retirement and existential void; (3) difficulty in selecting among children as heirs; (4) jealousy and rivalry among potential successors; (5) role changes and perceived loss of authority; (6) resistance to formal succession planning; and (7) mistrust toward potential successors". These psychological obstacles, though intangible, play a decisive role in the outcome of business transfers. For example, fear of identity loss or diminished purpose after retirement can hinder founders from initiating or completing the transition process (Weesie, 2017; DeTienne, 2010; Kets de Vries, 2003).

Such psychological states cannot be adequately addressed through conventional organizational

planning alone. Although these factors are often invisible, they are integral to the success or failure of intergenerational succession. Therefore, effective planning must incorporate emotional and symbolic elements that influence decision-making and continuity.

2.3 Factors affecting generational transition in family businesses

Scholars studying family entrepreneurship have employed various theoretical frameworks to explain the forces that shape competitive advantage and influence the success of generational transitions. Several key theories illuminate these dynamics.

Agency Theory addresses potential conflicts of interest within family businesses, particularly the founder's reluctance to transfer control (Jensen & Meckling, 1976; Schulze et al., 2001). The Behavioral Agency Model expands on this framework by considering non-financial goals, such as emotional attachments and identity concerns, that may compromise rational decision-making in succession planning (Wiseman & Gomez-Mejia, 1998; Gomez-Mejia et al., 2007). In contrast, Stewardship Theory posits that family members often act as intrinsically motivated stewards who prioritize long-term organizational interests over personal gain (Davis et al., 1997).

Recent literature emphasizes the importance of involving stakeholders early to anticipate their needs and develop timely policies, especially in family business succession. Building on Freeman's stakeholder theory (1984), Sharma (2003) criticizes the view of family businesses as homogenous and advocates for individualized stakeholder maps to identify roles and expectations of family members, employees, and owners. This approach is grounded in Systems Theory, particularly Tagiuri and Davis's (1982) three-circle model, which highlights the dynamic interaction of family, business, and ownership subsystems in shaping succession outcomes.

Building on the systemic and stakeholder perspectives, the Resource-Based View (RBV) further enriches the understanding of generational transition by emphasizing the transfer of unique, company-specific assets that underpin competitive advantage. While Systems Theory and stakeholder frameworks focus on the relational and structural dynamics within family businesses, RBV directs attention to the critical role of intangible resources, such as tacit knowledge, social capital, and reputational goodwill in ensuring continuity and long-term success during succession (Barney et al., 2001). These assets, typically rooted in the owner's personal experience and social networks, necessitate careful and intentional transfer to the next generation. Thus, RBV complements the broader theoretical discourse by highlighting that management of both relational and resource-based factors is essential for a successful generational transition in family firms.

Based on these conceptual models, De Massis et al. (2008) identify five categories of factors influencing generational transitions, i.e. individual, relational, financial, environmental, and process-related:

- Individual factors concern the personal characteristics, motivations, and preparedness of stakeholders directly involved in succession.

- Relational factors pertain to the quality of interactions and levels of trust between stakeholders.

- Financial factors involve the availability and allocation of internal resources.

- Environmental factors refer to changes in the external business context, including market and regulatory conditions.

- Process factors relate to the presence of formalized procedures, routines, or practices that support succession planning.

These factors do not operate in isolation; rather, they interact in complex ways. For example, weak relational dynamics may amplify financial stress, while a volatile external environment may expose deficiencies in internal processes. Therefore, successful transitions require a systems-oriented approach that acknowledges the interplay between internal and external forces. A lack of strategic awareness regarding environmental conditions can significantly undermine transition efforts. Without a proactive approach to managing external relationships, businesses risk adopting reactive strategies that compromise long-term sustainability.

Unlike earlier research that predominantly emphasized structural or technical aspects of transition, this study focuses on internal dimensions of generational transition, particularly from the perspective of internal stakeholders, those most directly involved in and influential over the process—older generation of family business owners.

3. Methodology

Internal factors influencing generational transition in family businesses were identified through a multi-phase research process, combining secondary data analysis with primary research methods. The primary data were collected using a structured questionnaire and a focus group, targeting the senior generation of family business owners, who are most directly involved in making decisions about succession.

3.1 Research sample and sampling criteria

The research focused on the older generation of family business entrepreneurs, defined as current family business owners aged 35 and above, since this is typically the stage when generational transition becomes a relevant consideration and continues through their gradual withdrawal from active leadership. This group was selected as a key stakeholder in the succession process. Accordingly, only family business entrepreneurs who expressed a clear interest in generational transition and were either in the phase of considering potential successors or already engaged in a later stage of the transition process were included in the study.

3.2 Data collection process

The data collection process was carried out in two distinct phases. The first phase involved structured data collection through a survey designed to identify the key problems and needs perceived by the older generation of family business owners in relation to generational transition. The second phase consisted of a focus group discussion, which enabled an in-depth exploration of the causes of these issues, as well as possible approaches and roles of various stakeholders in addressing them.

Phase 1: Survey method

The first phase of the research was conducted in November 2019, in conjunction with the Family Business and Business Transfer Week (4 - 8 November 2019), organized by CEPOR - SMEs and Entrepreneurship Policy Center. The goal of this event was to raise awareness among Croatian SME owners of the importance of timely succession planning.

The survey was conducted both in person at this event and online via a link distributed through email to family entrepreneurs from the researcher's private database. The final sample consisted of 35 respondents from the older generation of family business entrepreneurs.

The questionnaire was specially designed for the purposes of this study and underwent pre-testing with 30 respondents. The pre-test included open-ended questions, lasting approximately 20 minutes per respondent, and aimed to explore key problems and needs related to generational transition. Based on these responses, as well as insights from relevant academic literature, the main thematic categories were defined and incorporated into the final instrument:

1. Individual characteristics of the older and younger generations

2. Opportunities for career development and ambition fulfillment

3. Relationships and communication with internal business stakeholders

4. Transition planning

5. Financial security

6. Stability of the business environment.

The final questionnaire was structured in three parts:

- Part 1: Demographic data, basic business information and interest in succession

- Part 2: A series of closed-ended statements on problems and needs, rated on a 5-point Likert scale (from 1 = strongly disagree to 5 = strongly agree), with an option to select "X" if uncertain

- Part 3: Two open-ended questions for further elaboration on perceived problems and needs

Phase 2: Focus group method

To gain deeper insight into the internal dynamics and contextual nuances behind the survey findings, a focus group was conducted with members of the senior generation actively considering or undergoing generational transition.

The session took place during the same Family Business Week in November 2019, lasted 60 minutes, and included six family business owners at various stages of succession. All participants were over 35 years of age and expressed a strong interest

in generational transition, making them well-suited for in-depth qualitative research.

The focus group was facilitated by one of the co-authors, who has undergone extensive training and has experience in group work, with the support of a professional moderator skilled in qualitative methods. The discussion was initiated by presenting the main survey results, followed by guided dialogue based on open-ended questions.

A detailed qualitative report was produced based on the discussion which, together with the survey results and secondary data, formed the basis for a comprehensive analysis of the internal factors affecting generational transition in family businesses.

4. Results

The results of the conducted research will be presented in the following sections. The presentation begins with a general overview of respondents' attitudes toward generational transition, followed by a detailed analysis of key internal factors influencing this process from the perspective of the older generation of family entrepreneurs. The analysis brings together data from both research phases (the survey and the focus group) to present a comprehensive understanding of the internal dynamics that influence the generational transition process in family businesses. Selected quotations from participants are included to illustrate specific findings and enrich the interpretation of the data.

4.1 Findings from the survey

This section presents the results of the survey aimed at identifying internal factors that influence generational transition in family businesses, based on responses from the older generation of entrepreneurs, highlighting key insights into their perceptions, challenges, and readiness for generational transition.

The survey received fewer responses than expected, despite targeting entrepreneurs with a demonstrated interest in the subject matter. Out of 110 questionnaires distributed, 41 were returned; however, 6 were excluded from statistical analysis due to incomplete or incorrect responses. Consequently, the final sample comprised 35 respondents, predominantly representing the older generation of family business entrepreneurs, with 71% identified as founders. The remaining 29% were members of the second generation who had experienced the first generational transition.

The demographic composition included 57% males and 43% females, with an average age of 49 years (ranging from 35 to 69). The age distribution was relatively balanced: 29% of respondents were under 45 years old, 40% in their fifties, and 31% over 60. The majority of the respondents' companies were established in the 1990s (60%), with limited liability companies constituting the most common legal form (77%). Key sectors of activity included tourism and hospitality, trade, and other services (collectively 54%), followed by manufacturing (20%). Most businesses were founded based on recognized market opportunities (63%), whereas only a minority (6%) cited necessity as the primary motivation.

Regarding generational transition intentions, 57% of respondents expressed a desire to proceed with the transfer, 14% opposed it and 29% remained undecided. Those favoring succession often cited business-related reasons, such as ensuring stability and maintaining operational continuity. Conversely, respondents who were undecided or resistant frequently referenced the preferences and interests of their children as influential factors. Indecision was further associated with uncertainties about successors' capabilities and the inherent stresses of entrepreneurial life.

Despite 74% of respondents reporting multiple potential successors, generational transition is commonly deferred until a "right moment" is perceived, typically contingent upon the readiness of both generations. While 57% of respondents rated the entrepreneurial qualities of their successors positively, assessments of their knowledge and experience were comparatively lower. Nevertheless, 71% showed interest in their successors' professional ambitions and 60% valued their opinions concerning business management.

Notably, 29% of respondents admitted to postponing the decision regarding succession and only 37% had developed and openly communicated a formal succession plan. Furthermore, over 17% were uncertain about the existence of such a plan, indicating a generally low awareness of the critical importance of proactive and timely succession planning.

The final two questions of the questionnaire were open-ended, inviting entrepreneurs to share their perspectives on the challenges and needs related to generational transition within their family busi-

nesses. While some respondents noted external factors such as *"economic development"*, *"new trends"* and *"procedural legal and economic issues* *of generational transition"*, the majority emphasized internal challenges, which can be categorized as follows:

Table 1 Challenges related to generational transition

Challenges:	
Interest and motivation of the younger generation	Concerns regarding the younger generation's engagement, describing it as a lack of motivation to *"actively enter the job market in general, and the family business in particular".*
Emigration of potential successors	Migration of successors to larger cities or abroad. As one respondent stated: *"the biggest problem for me is that there is a possibility that they will move from their hometown and then they would not be able to continue doing this job".*
Multiple potential successors	Managing expectations and roles among several successors.
Intergenerational gap and competition	Differences in *"professional conduct, priorities, values"* and *"work habits"* of the younger generation. One participant expressed frustration with intra-family rivalry: *"I really can't understand or follow all that male outsmarting and competition about who will win instead of cooperating so that everyone is satisfied and the whole family can move forward together".*
Unique business characteristics	The younger generation's *"lack of knowledge of all aspects of the company and its core values".*
Separation of ownership/management from operations	*"Exhaustion experienced by the older generation"* due to excessive operational involvement, accompanied by a desire to dedicate more time to the preparation and mentoring of potential successors.

Source: Primary data collected by the authors

In addition to these challenges, entrepreneurs articulated several key needs they hope to address through successful generational transition:

Table 2 Needs related to generational transition

Needs:	
Family harmony	The importance of maintaining *"the best possible result with the least possible stress"*, promoting *"happiness of children"*, ensuring *"making all successors equal in the management system"* and fostering *"personal development of husband and sons for more humility and service instead of arrogance and competition".*
Family security	Need for *"a more secure financial situation for future successors"* along with *"safety and stability for all".* One entrepreneur noted: *"if the family business became a safe place for the successor where he could realize his ideas, make mistakes, learn and develop, then there would be no worries about what would happen to the company after my retirement".*
Job security and professional development	Maintaining *"a positive working atmosphere and profitable business"* was critical, alongside ensuring *"business training and education of successors"*, *"quality education and experience of the younger generation"* and the need for *"young forces in the business, someone who will bring new ideas and try to implement them".* One respondent highlighted the operational challenge, stating: *"organize production better with less direct personal involvement to facilitate an easier transition to the younger generation".*
Preservation of family business tradition	Desire *"to make potential successors interested"* and *"to make someone interested in entrepreneurship".*

Source: Primary data collected by the authors

A pervasive concern among respondents was the uncertainty surrounding the successors' ability to take over the business, succinctly captured by one participant's comment: *"How can we be sure that they will be able to do it?"* This fear touches on deeper worries about preserving family harmony, ensuring business stability, and maintaining the continuity of a family legacy.

Many of the undecided entrepreneurs placed family interests above business priorities, with their decisions regarding generational transition often shaped by the successors' motivation and their own challenging experiences in entrepreneurship. The absence of a defined timeline for transition was widespread, with most respondents waiting for the "right moment", typically influenced by the readiness of the next generation, the owner's retirement plans, and personal circumstances.

In some cases, ownership and management transitions were planned to occur simultaneously, without sufficient preparation, which can intensify existing difficulties. Furthermore, a significant number of respondents reported not having a formal or shared transition plan. Decisions were frequently delayed due to the younger generation's perceived lack of interest, motivation or competence, as well as pronounced intergenerational differences in values and work styles.

These insights highlight the pressing need for structured support mechanisms and practical tools that can help family businesses navigate the complexities of generational transition in a more timely, confident and sustainable manner.

4.2 Focus group findings

In the second phase of the research, a 60-minute focus group was conducted with six (6) entrepreneurs who were at various stages of the generational transition process. The objective was to deepen the understanding of internal challenges identified in the survey and to explore the potential roles of key stakeholders in addressing them. The discussion began with a presentation of the survey findings and was structured around two central insights: (1) a considerable number of respondents expressed indecision regarding the generational transition and had yet to define a clear timeline for its implementation, and (2) generational transition is predominantly perceived as an event rather than a process, reflecting a general lack of awareness about the importance of systematic planning.

The following section presents the results of the focus group discussion, structured around two central themes:

1. Many respondents are undecided about the generational transition and the timing of its implementation–causes and consequences.

Participants identified that the uncertainty and indecision surrounding generational transition stem from factors involving three main groups:

- Older generation of owners: They remain highly engaged in daily operations and often see no reason to pass the leading role in business. Succession is perceived as a voluntary choice rather than an obligation. Additionally, they report limited time available to focus on transition planning and express a desire for their children to experience a less stressful professional life.

- Potential successors: Many show a lack of interest and insufficient passion for the family business. They also lack adequate knowledge of the business and industry, which impedes their readiness to assume leadership roles.

- Family business: The businesses face operational uncertainties during the transition period and are generally unprepared for succession. They rely heavily on informal organizational structures that heavily depend on the active involvement of the owners, making the transition more complex.

These interconnected challenges collectively contribute to persistent indecision and hinder the timely development of a clear and structured generational transition plan.

The older generation of respondents acknowledges resistance to external pressures encouraging their retirement, expressing that they do not feel ready to step down despite such expectations. As one owner stated: "*even though I belong to the well-known group aged over 60, I absolutely do not feel that it is time for me to retire*". The older generation highlights that they are currently experiencing peak productivity in the business, as their children have become more independent, allowing them to devote greater attention to work. However, they observe a noticeable lack of passion in the younger generation and

express reservations about their readiness, which they attribute to differing values and personalities. While recognizing that their deep involvement in daily operations hinders the effective preparation of successors, they find it challenging to change long-established work habits. They prefer to leave the decision about the generational transition to their children, understanding that their motivations differ from those of the founders. Despite these concerns, they maintain a positive view of their children's entrepreneurial spirit and remain supportive of their initiatives, especially given the uncertain future of the family business during the transition period.

2. *Understanding generational transition as an event, not a process, and a lack of awareness of the need to plan generational transition–identifying ways to solve these problems and those responsible for solving them.*

Participants commonly see generational transition as a single event, when ownership and management are officially handed over. However, they recognize that the preparation of successors is a gradual, informal process starting from birth, encompassing early involvement in the family business and informal learning through participation. Despite this understanding, they admit to insufficient systematic efforts in preparing successors, primarily due to time constraints imposed by business demands:

- Successful and growing businesses require full entrepreneurial engagement, limiting time available for succession preparation.
- Businesses facing income uncertainty demand even greater operational involvement by owners, further impeding knowledge transfer.

Entrepreneurs believe that addressing successor preparation is an internal matter, primarily the responsibility of the family and trusted employees, with minimal reliance on external institutional intervention. Respondents expressed skepticism towards state initiatives and institutions, calling for simpler, more transparent frameworks developed collaboratively with entrepreneurs.

Initiatives such as CEPOR's are positively viewed for fostering experience sharing among entrepreneurs and exposing younger generations to real-life challenges in family business succession, thus normalizing typical transition issues.

Concerns were raised about legal uncertainties, lack of transparency and corruption, which undermine core entrepreneurial values like dedication, innovation, and perseverance. These systemic issues contribute to discouragement among both current owners and their children, influencing decisions about whether to pursue entrepreneurial careers. As they emphasize, *"as long as the government and institutional structures nonchalantly cover political mistakes by imposing burdens and shifting costs onto entrepreneurs, the issue of generational transition remains a pressing concern",* with a significant risk of further encouraging youth migration— not driven by economic necessity, but by the pursuit of dignity and opportunity.

5. Discussion

This research builds upon and contributes to the growing body of research on business transfer in Croatian family-owned SMEs. Two recent and relevant studies provide an important reference point. The first study is Business Transfer Barometer Croatia (Mezulić Jurić & Alpeza, 2017), which offers an overview of the state of business transfers in Croatia. The second study is the comparative research by Alpeza et al. (2018) titled "The Challenges of SME Business Transfers: The Evidence from Croatia and Finland." This study aimed to explore and compare the attitudes of entrepreneurs aged 55 and older in Croatia and Finland toward business transfer, with the goal of offering policy recommendations to enhance the effectiveness of national business transfer ecosystems. Both studies highlighted lack of timely planning for generational succession, the postponement of decision making, and the central role of family members in the continuation of business operations.

The results of this research confirm many of the earlier findings. As in the Business Transfer Barometer Croatia report, a significant portion of business owners do not have a clearly defined or openly communicated transition plan. Only 37% of respondents in this research reported having such a plan and more than 17% are unaware of whether such a plan even exists, reflecting a low level of awareness and preparedness, which is in line with earlier insights. Furthermore, this research reaffirms the perception of generational transition as an event rather than a process and confirms that planning is often delayed until the "right moment" in which entrepreneurs,

to a large extent, do not fully withdraw from their leadership role but continue to be actively involved in the business operations, a pattern also observed by Mezulić Jurić & Alpeza (2017).

However, this research also introduces some important new elements. Notably, it offers a more nuanced, qualitative perspective into the internal emotional and interpersonal dynamics that shape succession decisions, which is an area underexplored in prior research. While Alpeza et al. (2018) found that 61% of business owners aged 55+ expect to be succeeded by a family member, this research reveals a greater degree of uncertainty: although 57% express a desire for generational transition, 29% remain undecided and 14% are opposed to this idea. This discrepancy suggests a gap between expectations and actual succession readiness, possibly influenced by rising concerns about successor motivation, emigration, and generational value misalignment.

In addition, this research draws attention to broader socio-cultural and systemic issues that indirectly affect succession, such as distrust in institutions, legal uncertainty, and perceived devaluation of entrepreneurial effort. These were not as prominently addressed in earlier studies yet appear to significantly influence both the older generation's willingness to initiate succession and the younger generation's desire to engage in family business. The findings also emphasize that although technical and legal aspects of succession are important, emotional security, family cohesion, and successor interest are equally, if not more, influential in determining outcomes.

As emphasized in the study by Alpeza et al. (2018), a significant number of entrepreneurs (65%) expect support in the business transfer process; however, they tend to underutilize available expert support and often seek professional guidance too late in the business transfer process. This delayed engagement can hinder the development of a structured and timely succession plan, potentially increasing the risks associated with the transition. This research points to the importance of peer learning and entrepreneurial community support, with research participants valuing initiatives like the Family Business Week and CEPOR's programs more than institutional interventions. This reinforces the call for bottom-up, experience-based learning models as complementary tools to policy frameworks. While confirming many earlier findings about business transfer in Croatia, this research adds valuable depth by focusing on the emotional, relationship-based, and value-driven aspects of generational transition. It offers a more complete picture of the challenges family businesses face and the types of support they may need.

6. Conclusion

This research offers several original contributions that go beyond reaffirming previously recognized challenges in generational transition. By combining survey research with focus group discussions, this research provides a more comprehensive understanding of how family business owners in Croatia perceive and manage the process of generational transition. Unlike earlier research that predominantly emphasized structural or technical aspects, this study reveals the critical impact of emotional readiness, value alignment, and interpersonal dynamics on succession outcomes.

Importantly, the research emphasizes a key insight that the older generation's delayed decision making often stems not from a lack of knowledge, but from emotional ambivalence, fear of identity loss, and uncertainty about successors' motivation. This emotional hesitation highlights a significant gap in existing support systems, which tend to focus on legal, financial or educational tools, while neglecting psychological and relational support necessary for successful transitions.

Moreover, this study draws attention to a disconnect between entrepreneurs' needs and the existing support ecosystem, particularly in terms of awareness, accessibility and the relevance of available institutional measures. The findings suggest that entrepreneurs favor informal, peer-based learning environments and trust-building platforms that are mostly absent from the current policies and institutional programs.

Ultimately, this research highlights that successful generational transition is not merely a matter of planning and policy but a deeply personal, value-driven process that highlights the need for support systems that take into account emotional, cultural, and relationship-based aspects of family businesses. For future initiatives, this calls for the development of more empathetic, trust-based approaches and the creation of such support ecosystems that bridge formal institutional efforts with informal, experience-sharing platforms among entrepreneurs.

One of the key limitations of this research was the difficulty in identifying and recruiting motivated respondents across different stages of the research. A considerable amount of time and effort was required to locate and motivate participants to engage in the research process. Additionally, individual experiences of the respondents may have influenced the findings. Specifically, participants tended to prioritize and assign greater importance to factors that had direct and significant consequences for their own experiences and family businesses, while potentially overlooking other factors of equal relevance that did not resonate as strongly with their personal or business contexts. This subjectivity may have affected the comprehensiveness and generalizability of the results. Although the empirical research was conducted in late 2019, its conclusions remain highly relevant. The main challenges of generational transition in family businesses identified by this research are deeply rooted and persist over time. Recent developments, including economic uncertainty and shifts in the business environment, have only reinforced the need for more nuanced, emotionally aware support systems. Furthermore, recent studies in the Croatian context confirm that many of the identified barriers and gaps in institutional support still exist and the effects and consequences of youth migration and its impact on the generational transition process are yet to fully unfold. Together, these developments highlight the ongoing relevance and practical significance of this research.

Future research should focus on identifying the challenges of cross-sectoral cooperation and analyzing good practices from other countries to provide comprehensive support for family businesses in the process of generational transition.

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SALARY INCREASE AS A DRIVER OF PRODUCTIVITY

Abstract

Purpose: The paper analyzes the relationship between wages and labor productivity across Croatian sectors (2019–2023), focusing on sectoral and temporal specificities. The main goal is to confirm the positive relationship between wage growth and productivity and highlight sectoral differences. The study is based on theories of efficiency wages, human capital investment, and sectoral heterogeneity. A review of previous research emphasizes the importance of technological innovation and sector-specific characteristics in productivity.

Methodology: Data from the FINA database were used for descriptive statistics, correlation analysis, and a fixed-effects panel regression model, allowing for control of sectoral and temporal influences.

Results: A 1% wage increase is associated with a 0.738% productivity growth. The highest effects were observed in sectors C (Manufacturing) and J (Information and Communication), while sectors I (Accommodation and Food Services) and R (Arts and Entertainment) showed weaker impacts. Significant productivity growth was recorded in 2022 and 2023. The results confirm the theoretically expected positive relationship between wages and productivity and emphasize the need for sector-tailored policies—technological modernization for more productive sectors and human capital investments for less productive ones.

Conclusion: The positive relationship between wages and productivity calls for targeted policies addressing sector-specific needs. Study limitations include potential data constraints, while future research should focus on cross-country comparisons and additional productivity factors.

Keywords: Average wage, productivity, industries, human capital

1. Introduction

The connection between wage levels and labor productivity is one of the central issues in labor economics and management. This topic becomes particularly significant in the context of economic growth, labor market changes, and the specificities of individual sectors, where the extent to which wage increases can drive employee efficiency is often debated. Labor productivity plays a crucial role in ensuring the competitiveness of companies and the stability of the economy. Therefore, understanding the relationship between wages and productivity is essential for designing effective business strategies and economic policies.

This paper examines the relationship between average monthly net wages and labor productivity across different sectors of the Croatian economy during the period from 2019 to 2023. The observed period includes several critical phases: stable eco-

nomic growth before the COVID-19 pandemic, the economic shock during the pandemic, and recovery in the post-pandemic years. The research aims to answer whether wage growth stimulates an increase in labor productivity and whether there are significant differences between sectors in this regard.

This research deals with the study of labor productivity and considers whether there are differences between economic sectors in the way this productivity is linked to the level of wages. The starting point of the analysis is found in the theories of labor economics, especially in the theory of human capital, which emphasizes the importance of investing in employees. Investments such as wage increases can encourage greater employee motivation, reduce workforce turnover, and improve work efficiency. However, previous research from different countries indicates that the effects of wage increases are not the same in all sectors and depend on the level of technological development, labor market conditions, and the wider macroeconomic environment.

The aim of this paper is to determine whether there is a relationship between average wage and labor productivity, and to examine whether this relationship differs between sectors and in different time periods. To achieve this, a multi-level analysis was applied, which includes basic statistical indicators, correlation analysis, and a panel regression model with fixed effects. This approach allows for a more precise analysis because it takes into account the specificities of each sector and the changes that occur from year to year.

Based on theoretical assumptions and existing research findings, a hypothesis is proposed that an increase in average wages has a positive and statistically significant impact on labor productivity in various sectors. The hypothesis is tested using association analysis and regression models that include sectoral and temporal differences.

The value of this research is reflected in a detailed analysis at the level of individual sectors over several years, which provides a deeper understanding of the relationship between wages and productivity in the context of the Croatian economy. The results obtained can serve as a basis for the development of public policies that encourage productivity growth through a better payment system and targeted investment in employees.

The paper is structured into several sections. The introductory section is followed by an overview of the relevant literature and theoretical frameworks dealing with the relationship between wages and productivity. The third section describes the data sources and the methodological approach to the research. Section four presents the research results, while the fifth section interprets these results and compares them with previous findings. Finally, the conclusion brings a summary of the most important findings, recommendations for application in practice and suggestions for future research.

2. Theoretical background

One of the fundamental concepts in analyzing the relationship between wages and productivity is the theory of human capital developed by Gary Becker (1964). According to this theory, employees represent the company's key assets, and investments in them through education, training, and wage increases directly contribute to productivity growth.

Efficiency wage theory (Solow, 1979; Shapiro & Stiglitz, 1984) has been expanded to include models that view salaries as a tool to reduce employee turnover and increase employee engagement. A similar contribution is made by the agency theory developed by Jensen and Meckling (2019), according to which increasing salaries can reduce moral hazard problems and better align employees' interests with the organization's goals. Kato and Kodama (2015) confirm this claim through empirical research in Japanese industry, where higher wage levels were associated with a reduction in work errors and an increase in accountability.

In modern management, psychological factors are increasingly gaining importance in the analysis of the relationship between wages and productivity. According to Herzberg's two-factor theory (Giroux, 1960), wages are a "hygienic factor" that eliminates dissatisfaction, but do not necessarily serve as motivators themselves. Mehta (2012) confirms this thesis, pointing out that non-material factors such as interpersonal relationships and the intrinsic value of work are stronger predictors of employee satisfaction and, indirectly, their efficiency. Nițescu (2021) complements this perspective by emphasizing the importance of a reward system that combines a fixed salary, bonuses, and non-financial benefits, especially when aligned with individual and organizational goals.

Empirical research over the last decade has revealed complex relationships between wages and

productivity, often depending on regional and sectoral circumstances. In advanced economies, such as OECD countries, the findings show a strong correlation between wage increases and productivity growth. Bloom and Van Reenen (2007) analyzed over 10,000 companies and showed that companies that invest in wages record lower turnover and higher investments in human resources. By contrast, in developing countries, connectivity is weaker due to institutional deficiencies and a lack of investment in human capital.

In parallel, Bildirici and Alp (2008) point out that high tax burdens on labor, including contributions and other fiscal obligations, erode the link between net wages and real productivity, especially in countries with strong informal economies. Piketty and Saez (2014) warn that high economic inequality makes it even more difficult to achieve the positive impact of wage increases, especially in low-tech sectors.

Sectoral approaches further confirm the heterogeneity of the effects of wage growth. Kline and Moretti (2014) find that in high-tech sectors, such as IT and science, wage increases are associated with exponential productivity growth, while in more traditional industries this effect is more moderate. Knar (2025) proposes non-linear models of wage determination in highly specialized sectors, where the optimal salary is defined as an emotionally satisfactory threshold that encourages employee cooperation, motivation, and self-realization in the long run.

3. Data and methodology

This study analyses two key variables: labor productivity and average net wages. Productivity is defined as value added per employee expressed in euros, while wages are observed through the average monthly net earnings by sector in the period from 2019 to 2023.

The database includes 85 observations, covering 17 economic sectors over five years. The data include key financial indicators by sector–in addition to wages and productivity, indicators such as profitability and liquidity are also included. All data were taken from FINA, based on the annual financial statements of Croatian companies, which ensured methodological consistency and sectoral comparability. The classification of activities is based on the NKD 2007, Croatia's National Classification of Activities.

Although the analysis primarily focuses on the relationship between wages and productivity, it is recommended to include in future research additional factors such as the level of investment, the educational structure of employees, or R&D expenditures.

To improve the interpretation of the results and reduce possible statistical deviations, the variables were transformed into natural logarithms. This allows the coefficients to take on the meaning of elasticity, i.e. to estimate how the percentage change in wages reflects the change in productivity.

Initially, descriptive analysis was carried out to describe the basic characteristics of the data, including means, ranges and deviations. The results were also presented graphically–scatter diagrams with regression lines provided the first insights into the correlation of the observed variables, while trend graphs enabled the monitoring of their changes over time and sectors.

After that, correlation analysis was carried out using the Pearson coefficient, which showed a positive correlation between average wages and labor productivity.

The main statistical tool used in the study was a panel regression model with fixed effects. This approach makes it possible to remove specific characteristics of sectors that remain unchanged over periods (e.g., workforce structure, technological equipment), while additional time variables control wider economic impacts such as the pandemic or legislative changes.

The validity of the model was confirmed by a series of diagnostic tests: White's test excluded heteroscedasticity, Durbin-Watson statistics (value 2.14) showed that there was no autocorrelation, and an analysis of the variance inflation factor (VIF) did not indicate the presence of multicollinearity.

To further ensure reliability, robust standard errors were used. The regression results are presented in tables, with graphical representations of coefficients that give a clearer insight into specific effects by sector and year.

Data processing was carried out in the Python programming language, which ensured the accuracy of the calculation and high-quality visualization of the results. Such an approach allows for a detailed

and reliable analysis of changes in productivity and wages over time and different economic activities.

4. Research results

The results of this study provide insights into the relationship between average monthly net wages and labor productivity across various sectors of the Croatian economy during the 2019-2023 period. The findings are presented in several stages, starting with descriptive statistics, followed by correla-tion analysis, and concluding with the results of the fixed-effects panel regression model.

4.1 Descriptive statistics

This part presents a basic overview of data related to the two main variables of the research, namely average monthly net earnings and labor productivity. Key statistical indicators, such as mean, deviations from the average, minimum and maximum recorded values, and quartile distribution, were calculated. For better clarity and easier understanding, all results are summarised in Table 1.

Table 1 Descriptive analysis results

Statistic	Average Net Salary (€)	Labor Productivity (€)
Count	85.00	85.00
Mean	907.04	43,305.21
Std	198.84	24,715.78
Min	605.61	15,907.45
25%	765.01	27,439.17
50%	871.65	34,221.72
75%	1,033.75	49,679.42
Max	1,603.21	120,603.30

Source: Authors' calculation

On average, net salaries in the analyzed activities amount to slightly more than 900 euros, but there are quite large differences between individual sectors. This is confirmed by the fact that salaries range from about 600 to over 1,600 euros, and the deviations from the average are significant.

For example, in industrial sectors such as manufacturing, employees generally earn higher wages. Salaries in these activities are well above average, which can be linked to higher investments in knowledge and equipment. In contrast, in tourism and hospitality, salaries are more modest, which also reflects the lower total value generated by these activities.

A similar pattern is observed when examing productivity. In some sectors, especially those dealing with technology and industry, employees generate significantly higher value per person, while in other sectors, such as services, productivity remains considerably lower.

These data indicate that it is not only about different salaries, but also about different levels of efficiency and investment in people and technology. This can be an important starting point for understanding the causes of sectoral disparities and for further analysis of the relationship between wages and productivity.

4.2 Correlation analysis results

To determine the strength and direction of the relationship between average net wages and labor productivity, a correlation analysis was conducted using Pearson's correlation coefficient. The calculated value of the correlation coefficient is **0.581**, indicating a moderately strong positive relationship between these two variables. This means that an increase in average wages is generally accompanied by an increase in labor productivity. However, the relationship is not perfect, suggesting the presence of other factors that also influence productivity.

Graph 1 Relationship between average net salary and labor productivity
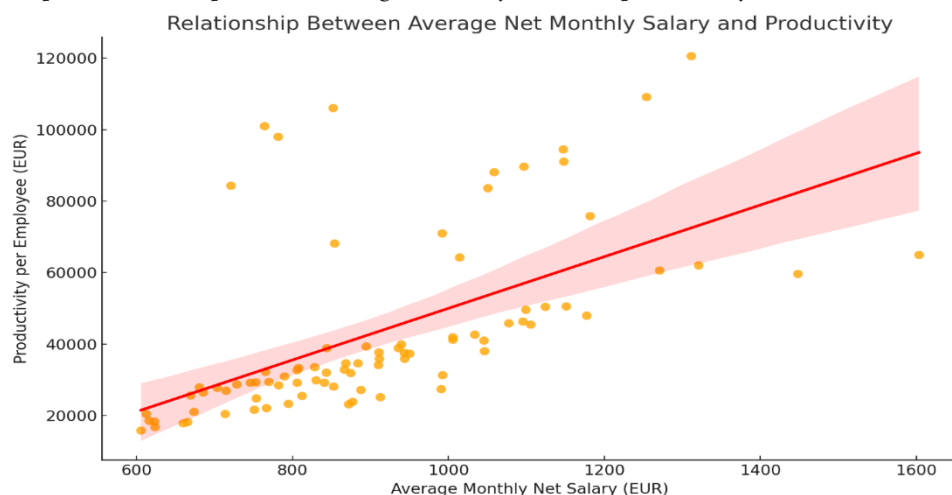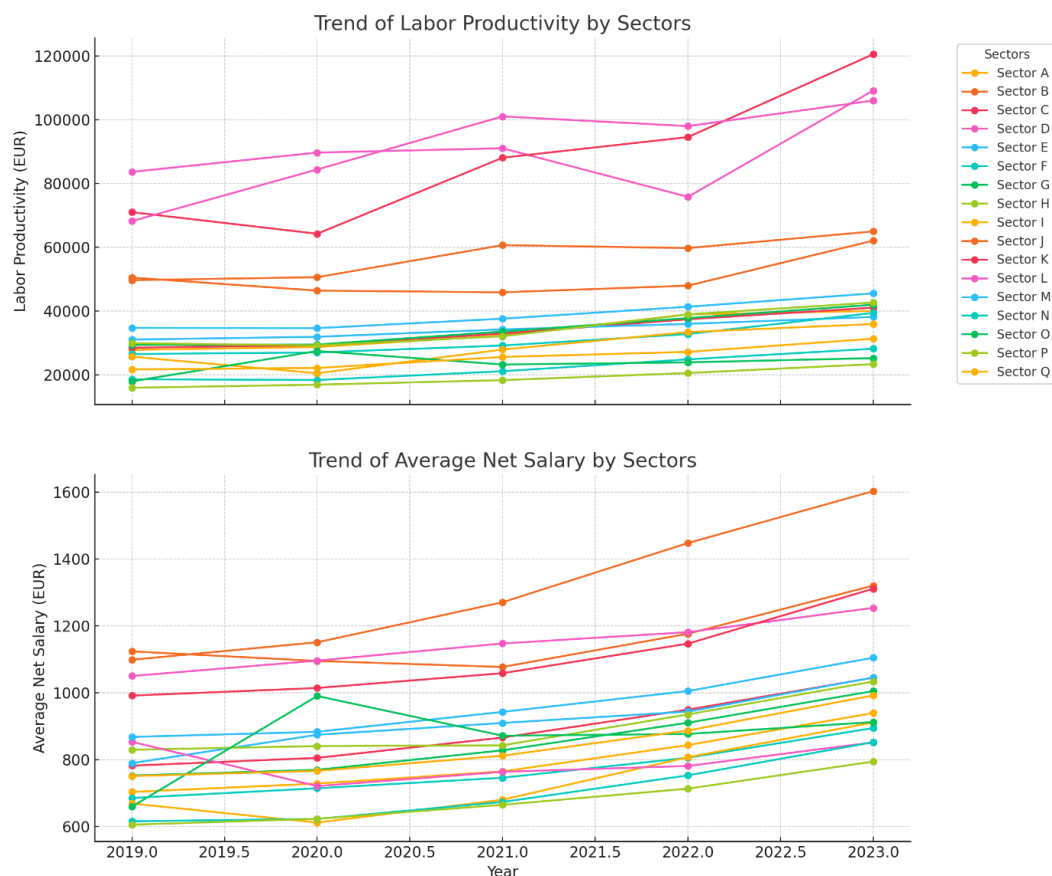

Source: Authors

Graph 1 depicts the relationship between average net wages and labor productivity for all sectors during the observed period. Each point on the graph represents a specific sector in a particular year. The red regression line illustrates the overall trend in the relationship between these two variables.

The positive slope of the regression line clearly indicates that labor productivity increases as average net wages rise. In other words, sectors with higher wages, such as C (Manufacturing) and J (Information and Communication), tend to achieve higher labor productivity. Conversely, sectors with lower wages, such as I (Accommodation and Food Services) and R (Arts and Entertainment), are positioned in the lower part of the graph, suggesting weaker performance in terms of productivity.

These findings confirm the calculated correlation coefficient value (0.581) and provide visual evidence of the positive relationship between the variables. However, the distribution of points around the regression line also indicates some variability—certain sectors deviate from the general trend. This opens up opportunities for further analysis of factors influencing this relationship.

Graph 2 Trend of labor productivity and average net salary by sectors over the years

Sectors by letters.[1]
Source: Authors

Graph 2 shows the trends in labor productivity and average net wages by sector over the observed years (2019-2023). Special emphasis is placed on the dynamics within individual industries to identify patterns over time.

Most sectors exhibit an upward trend in labor productivity and wages, suggesting a general positive development during the observed period. However, there are significant differences between sectors:

- Industrial sectors (C) and technological sectors (J) consistently show growth in both variables, indicating investments in human capital and technological advancements.

- Sector I (Accommodation and Food Services) demonstrates lower growth rates, with a noticeable decline in the COVID-19 pandemic year, reflecting its seasonal nature and reduced operations.

- Sectors H (Transportation and Storage) and F (Construction) exhibit more unstable trends, likely due to fluctuating market conditions and a lack of technological investments.

1 Sectors by letters: A - Agriculture, Forestry, and Fishing; B - Mining and Quarrying; C - Manufacturing; D - Electricity, Gas, Steam, and Air Conditioning Supply; E - Water Supply; Sewerage, Waste Management; F - Construction; G - Wholesale and Retail Trade; Repair of Motor Vehicles; H - Transportation and Storage; I - Accommodation and Food Service Activities; J - Information and Communication; K - Financial and Insurance Activities; L - Real Estate Activities; M - Professional, Scientific, and Technical Activities; N - Administrative and Support Service Activities; O - Public Administration and Defense; P – Education; Q - Human Health and Social Work Activities; R - Arts, Entertainment, and Recreation; S - Other Service Activities

These results point to positive dynamics in certain industries, particularly in the industrial and technological sectors, where wage increases are accompanied by productivity growth. The increases in these sectors are likely linked to greater investments in workforce training, modernization of production processes, and the adoption of new technologies.

The correlation analysis results confirm a positive relationship between average wages and labor productivity, supporting the assumption that wage growth can act as an incentive for increased work efficiency. However, the differing growth dynamics across sectors indicate that additional factors, such as technology investments and workforce structure, play a significant role in shaping this relationship. Sectors with higher wages and productivity, such as C and J, represent examples of a positive trend, while sectors like I and R lack the necessary drivers for stronger productivity growth.

4.3 Panel regression analysis results

The main objective of this research was to determine the extent to which average wages influence labor productivity, taking into account sector-specific characteristics and temporal changes. To measure the impact of wages on productivity as accurately as possible, a fixed-effects panel regression model (FEM) was employed. This model is particularly suitable as it allows for the elimination of the influence of sectoral characteristics that remain constant over time, while simultaneously controlling for shared changes specific to individual years.

The study utilized panel data that combined two dimensions: the sectoral dimension (industries) and the temporal dimension (the period from 2019 to 2023). The main advantage of this approach compared to classical analyses (such as cross-sectional or time series) lies in its ability to control for unchanging characteristics specific to each sector, such as workforce structure, technological level, or organizational specificities.

The model was log-transformed to reduce heteroskedasticity and ensure linearity in the relationship between the variables. Model specification is as follows:

$$Ln(Productivity_{it}) = \beta_0 + \beta_1 \ln(Net\_Pay_{it)} +$$

$$\mu_i + \gamma_t + \varepsilon_{it},$$

where the variables are defined as follows:

- $Ln(Productivity_{it})$: log-transformed labor productivity for sector iii in year ttt,

- $ln(Net\_Pay_{it)}$: log-transformed average net wage for sector iii in year ttt,

- μ_i : sectoral fixed effects that control for time-invariant sector characteristics,

- γ_t : temporal dummy effects that control for changes common to all sectors during specific years,

- ε_{it} : random error.

The transformation of variables into logarithmic form allows the coefficients to be interpreted as elasticities—that is, a 1% change in average wages can be understood as a certain percentage change in labor productivity.

The results of the panel regression analysis showed a positive and statistically significant relationship between average net wages and labor productivity. The coefficient for the variable ln(Net_Pay) is 0.7381, with a p-value of less than 0.01, confirming its high statistical significance.

An increase in the average net wage by 1% leads to a 0.738% increase in labor productivity, assuming that sector-specific characteristics and temporal effects are controlled for. This result supports the hypothesis that wage growth acts as an incentive for improving employee productivity.

Graph 3 Sector fixed effects: Impact of sectors on labor productivity
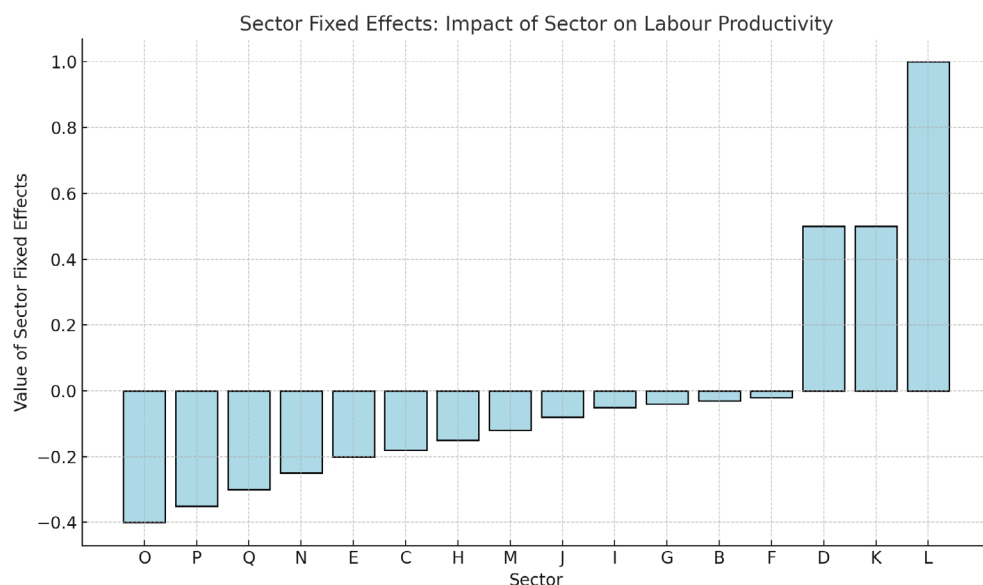
Source: Authors

In addition to the main coefficient measuring the relationship between wages and labor productivity, the analysis also examined sectoral fixed effects. These effects provide deeper insights into the specific characteristics of individual industries by isolating the influence of time-invariant sectoral characteristics, such as workforce structure, business organization, or technological advancement, which are not directly captured by wages.

As shown in Graph 3, the results reveal significant differences across sectors:

1. Sectors with positive fixed effects

Sectors like D (Electricity, Gas, Steam and Air Conditioning Supply), K (Financial and Insurance Activities), and L (Real Estate Activities) exhibit positive fixed effects. This suggests that even after accounting for wage levels, these sectors achieve higher-than-expected labor productivity. Such outcomes can be attributed to factors including:

- Greater investments in new technologies and automation,
- A higher proportion of skilled labor,
- Strong organizational structures and continuous innovation efforts.

2. Sectors with negative or low fixed effects

Certain service sectors demonstrate negative or low fixed effects, indicating below-expected productivity levels even when average wages are considered. Possible reasons include:

- Limited technological adoption,
- Predominance of labor-intensive activities,
- Seasonality of work (especially in hospitality),
- Lower value-added production processes,
- A higher share of low-skilled workforce, hindering substantial productivity improvements.

These findings emphasize the structural strengths of high-performing sectors and highlight areas where targeted investments and policy interventions are necessary to boost productivity growth in lagging industries.

5. Discussion and limitations

The results of this study confirm the existence of a positive and statistically significant relationship between average wages and labor productivity. These findings provide empirical support for key theoretical frameworks, such as efficiency wage theory (Shapiro & Stiglitz, 1984) and human capital theory (Becker,

1964). According to these theories, wage increases can serve as a strong motivator for employees, reduce workforce turnover, and encourage greater engagement and more efficient work.

The regression analysis results support the proposed hypothesis (H1), confirming that wage growth significantly contributes to labor productivity improvements across different sectors.

The empirical analysis revealed that the benefits of wage increases are most pronounced in industrial and technological sectors (C - Manufacturing and J - Information and Communication). The key reasons for these outcomes likely include:

- Investments in technological modernization,
- Greater application of innovations,
- Highly skilled workforces that enable better adaptation to the modern market demands.

In contrast, service sectors (I - Accommodation and Food Services and R - Arts and Entertainment) show a limited impact of wage increases on labor productivity. These results suggest that service industries are often burdened by:

- Lower levels of technological development,
- Labor-intensive processes that hinder efficiency improvements,
- Seasonal fluctuations in operations (particularly in hospitality).

These insights suggest that sector-specific policies may play a crucial role in enhancing labor productivity. For instance, service industries could benefit from investments in business digitalization, workforce skill development, and fostering technological innovations. Such measures could reduce their dependence on labor-intensive processes and improve overall efficiency.

Limitations of the study

Although the results provide valuable insights, the research has several limitations that should be considered when interpreting the findings:

1. Temporal limitation

The data covers the period from 2019 to 2023, which represents a relatively short time frame. While this period includes significant economic changes such as the COVID-19 pandemic and post-pandemic recovery, it is insufficient for analyzing long-term trends in the relationship between wages and labor productivity.

2. Sectoral data aggregation

The data were analyzed at the aggregated sector level, meaning that intra-sectoral differences were not captured. For example, within the same sector, there may be significant variations between:

- Small and large enterprises,
- Companies with different levels of technological development,
- Companies with highly skilled and low-skilled employees.

Future research should aim to address these limitations by extending the time frame and incorporating more granular data to account for intra-sectoral variations and long-term trends.

Moreover, the simplified model specification, using only wages and productivity, was chosen to maintain a clear focus on the primary relationship. Nevertheless, future research should expand the model by including variables like sectoral investments in innovation, technological adoption rates, and workforce skill levels, to build a more robust explanatory framework.

6. Conclusion

This study examined the relationship between average wages and labor productivity in Croatian sectors during the period from 2019 to 2023. By applying a fixed-effects panel regression model, the influence of time-invariant sectoral characteristics and common yearly changes was removed, yielding reliable and precise results.

The main conclusions show that wage increases have a positive effect on labor productivity growth, with industrial (C - Manufacturing) and technological sectors (J - Information and Communication) reaping the greatest benefits. This can be attributed to higher investments in technology, innovation, and a highly skilled workforce. On the other hand, service sectors (e.g., I - Accommodation and Food Services and R - Arts and Entertainment) exhibit weaker effects, suggesting that their productivity is constrained by a lack of technological modernization, lower added value, and the seasonal nature of their operations.

To improve productivity in sectors with lower performance, structural reforms are needed to encourage investments in technology, business digitalization, and workforce training.

For future research, it is recommended to extend the time frame of analysis to observe long-term trends in the relationship between wages and productivity. Additionally, using more detailed microeconomic data at the firm level and including additional factors such as innovation, investment, and human capital development would enable a deeper understanding of the mechanisms influencing labor productivity.

These findings provide a foundation for policymaking aimed at steering economic development toward higher productivity through targeted investments and the promotion of innovation, particularly in sectors currently lagging behind.

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THE PATH TO SELF-EMPLOYMENT: ANALYSIS OF THE MOTIVATION AND SPECIFIC CHARACTERISTICS OF WOMEN ENTREPRENEURS

Abstract

Purpose: The article analyses the motivation and main characteristics of self-employed women, focusing on the situation in the Republic of Croatia. The aim is to identify the specificities of female entrepreneurship, understand the motivational factors that encourage women to become self-employed and examine the challenges they face in order to create support for their further development and strengthen the entrepreneurial ecosystem.

Methodology: A qualitative methodology was used, starting with data collection through semi-structured interviews with three self-employed women entrepreneurs in Croatia. The interviews focused on the motivational factors for starting an entrepreneurial activity and the personal characteristics of the interviewees. The collected data were analysed using descriptive analysis and the responses were interpreted using thematic analysis to gain insight into the experiences and attitudes of interviewees.

Results: The results show that women in Croatia are motivated by the desire for independence, autonomy, creativity, and the desire to create new value, rather than the direct need for income. Respondents emphasise the importance of family and community support, but also challenges such as social and cultural norms and the need to balance work and family responsibilities.

Conclusion: The study confirms that the motivational factors and characteristics of female entrepreneurs are more complex than the common stereotypes and that they are the key to success in entrepreneurship. Understanding the specificities of female entrepreneurship is crucial for developing the entrepreneurial environment and promoting greater equality and economic growth.

Keywords: Self-employment, female entrepreneurs, motivation, characteristics, qualitative study

1. Introduction

In today's dynamic environment, in which major changes are taking place in all areas of society, economic and social development is inconceivable without entrepreneurship and innovation.

Using their resources and competences and operating under conditions of uncertainty and risk, entrepreneurs discover, evaluate and exploit opportunities with the aim of generating profits (Gartner, 1990, Shane & Venkataraman, 2000), influencing the economic growth and development of the country they operate in (Munyo & Veiga, 2024). For this reason, it is very important to know who entrepreneurs are and what characteristics they have (Shane, 2003). Within entrepreneurship studies, more and more attention is being paid to the study of gender differences in order to better understand the specificities and challenges faced by different groups of entrepreneurs (DeMartino & Barbato, 2003; Manolova et al., 2007; Popescu, 2012; Guzman & Kacperczyk, 2019).

In terms of the gender aspect of entrepreneurship, entrepreneurship is still predominantly perceived in society as a male career choice. Trends show that women are less likely to choose entrepreneurship as a career path compared to men (Manzanera-Román & Brändle, 2016; Kovaleva et al. 2023), and the reason for this may lie in various cultural and social factors (Cardella et al., 2020). Entrepreneurship is more challenging for women from the beginning due to difficulties in obtaining information, lack of networks and financial resources, gender discrimination and lack of education, management skills and experience in ownership. Most problems occur when they try to balance work and private life, as they spend most of their free time on family responsibilities and housework (Vrdoljak Raguž, 2020). In order to achieve gender equality and women's empowerment, numerous initiatives are being implemented (Datta & Sahu, 2021), some of which are in line with the UN Sustainable Development Goals (5. Gender equality and empowerment of all women and girls), which aim to ensure gender equality, i.e. to ensure equal opportunities for participation in society, economy and politics and to promote women's empowerment at all levels (United Nations, n.d.). Changes in social norms, technological advances, better access to education, broader market opportunities and the availability of modern family planning methods have led to women being more frequently and actively involved in various professional and entrepreneurial activities (Lingappa & Rodrigues, 2023).

Although women's participation in entrepreneurship has increased in recent years (Kovaleva et al., 2023), the field of female entrepreneurship is still under-researched (Toros & Altınay, 2019). Considering the research gap in this area, it is important to investigate who female entrepreneurs are, what characteristics define them, what motivates them to choose entrepreneurship as a career path and what challenges they face (Toros & Altınay, 2019; Sufian et al., 2022) in order to create an encouraging and supportive environment for their further development. In this context, special attention is paid to women entrepreneurs in the Republic of Croatia in order to identify their specificities. The focus of this paper is primarily on self-employed women.

2. Literature review

2.1 Characteristics of entrepreneurs

Entrepreneurs possess a number of characteristics that contribute to their ability to lead and manage a business in a dynamic business environment. There is a connection between the personal characteristics of entrepreneurs (internal locus of control, need for achievement, intellectual activities, analytical thinking and complex problem solving) and the financial performance of the business they manage (Zhang & Bruning, 2011). Considering that the characteristics of entrepreneurs are linked to the business performance of the company (Khosla & Gupta, 2017), identifying those characteristics is important for understanding, developing and promoting them so they are prepared to successfully respond to the challenges of the business environment they operate in (Shane, 2003; Khosla & Gupta, 2017). Some of the key characteristics of entrepreneurs are the need for achievement, a strong internal locus of control, high self-efficacy and innovation. Entrepreneurs also tend to take calculated risks, which enables them to recognise and exploit market opportunities. The experience and specific professional knowledge that entrepreneurs acquire through their work are also important components of entrepreneurial characteristics (Frese, 2009). According to research by Buble and Kružić (2006), the most important characteristics of entrepreneurs include self-confidence, i.e. belief in oneself and one's abilities, perseverance, the ability to set real-

istic goals and responsibility towards oneself, one's family, employees, customers, suppliers and other partners. In addition to these qualities, entrepreneurs also have a number of key skills. Among the most important are self-discipline, people management skills, communication skills, strategic planning skills, delegation of tasks and decision-making skills (Buble & Kružić, 2006). Entrepreneurs are characterised by skills such as the ability to self-assess their own strengths and weaknesses, well-developed negotiation, conflict and problem-solving skills, and effective time management to fulfil agreed commitments (Štavlić, 2022).

Although many characteristics are universal for all entrepreneurs, research has shown that women entrepreneurs have specific traits and skills that are important to their business success. Research by Barrick and Mount (1991) has shown that women who are extroverted, talkative, outgoing, assertive and ambitious as well as conscientious, reliable and persistent are more successful in their businesses compared to women entrepreneurs who do not possess these traits. In addition, female entrepreneurs often have strong communication skills, are good with people, flexible and tolerant. They have developed creative thinking skills and work with a lot of enthusiasm and energy (Manzanera-Román & Brändle, 2016; Oberman Peterka et al., 2016).

Although women entrepreneurs have high levels of self-efficacy and believe that they can effectively overcome challenges and make the right decisions even when outcomes are uncertain, research shows that women have a greater fear of risk compared to men, which may influence their approach to business and decision-making (Gerke et al., 2023; Kovaleva et al., 2023). They are more likely to opt for safer options to avoid the possibility of a negative outcome. It is important to identify the characteristics of female entrepreneurs so that these characteristics can be developed and nurtured.

2.2 Motivational factors

The entrepreneurial process begins with the motivation that leads the entrepreneur to decide to start a business (Baron & Henry, 2011). Various motivators influence the decision to become an entrepreneur as a career choice. Studies on entrepreneurial motivation can be categorised into research related to different phases of an entrepreneurial venture: during the start-up of the business, growth and exit. Research on entrepreneurial motivation during the

start-up phase usually focuses on the investigation and identification of intrinsic and extrinsic motivators (Murnieks et al., 2019).

Intrinsic motivation represents an inner drive to explore, learn and challenge oneself and to develop one's skills (Ryan & Deci, 2000). These motivators provide individuals with satisfaction and motivate them to engage in entrepreneurial activities from non-monetary aspects such as the desire for independence, autonomy in decision-making (Alstete, 2003; Wilson et al., 2004) and the realisation of creative ideas and innovations using their own skills and abilities (Tan et al., 2016). Forces that influence the creation of a business include a number of other intrinsic motivators related to the realisation of personal desires such as self-actualisation and the desire to continue the family tradition (Westhead & Wright, 1998; Edelman et al., 2010).

Extrinsic motivation, on the other hand, arises from the desire to receive rewards or from the need for recognition by the environment, rather than from personal satisfaction (Ryan & Deci, 2000). Such motivation is aimed at gaining income and wealth, power, social status or praise from others (Sufian et al., 2022). Extrinsic motivation also includes incentives from the environment that can have a motivating effect on other people. For example, support from the environment and role models with their examples and experiences can have a motivating effect on other entrepreneurs, which is why entrepreneurs are often inspired to become entrepreneurs by their parents, mentors or successful entrepreneurs outside their own family (Bosma et al., 2012).

When women enter entrepreneurship, they are most often driven by intrinsic motivators (Rosa & Dawson, 2006), such as the desire for independence and autonomy, the desire to innovate, the desire to contribute to society, and creative freedom. In addition, many women want to continue family traditions, often with the support of family and the wider community (Franck, 2012; Kovaleva et al., 2023). Family support, which may take the form of emotional support, family care or financial assistance, is often important to the success of women entrepreneurs. This support enables them to focus on the growth and development of their businesses on the one hand and to balance family life on the other (Kovaleva et al., 2023). In addition to intrinsic motivators, the most common extrinsic motivator is the desire to achieve income and financial security (Franck, 2012).

In addition to positive motivators, negative motivation is also often a strong incentive to take up entrepreneurial activity (Kirkwood, 2009; Franck, 2012; Ismail et al., 2021). Despite the increase in the number of women in the labour force in recent decades (Kovaleva et al., 2023), structural barriers such as limited access to quality jobs or leadership positions persist (Powell & Butterfield, 2003). Unemployment, lack of business opportunities or dissatisfaction with existing working conditions in the workplace on the one hand and concerns related to raising one's own children on the other hand can be an important factor in women's decision to become entrepreneurs.

Recognising and understanding the different motivations that drive women to become entrepreneurs is important for building an appropriate entrepreneurial ecosystem and providing support to help them improve their entrepreneurial success.

2.3 Self-employed women

For a better understanding of female entrepreneurship, self-employed women should be additionally analysed due to their special characteristics and framework conditions. Women tend to own businesses in highly competitive sectors with low profit margins, which are unlikely to grow and perform less well (Marlow, 2002). A well-being gap has been shown to exist between women entrepreneurs in low-, middle- and high-income countries, with greater gender inequality, lower levels of financial development and more traditional cultural values increasing this well-being gap, while on the other hand higher levels of education, fewer children and a greater preference for risk and stimulation reduce this gap (Love et al., 2024). Patrick et al. (2015) separated married and unmarried women when examining their self-employment. They found that family responsibilities and societal attitudes towards gender roles were the most important factors for married women when deciding to become self-employed. For unmarried women, on the other hand, the local business climate and individual characteristics play a role. Ferrín (2023) discussed several interesting aspects of self-employed women. Women's entrepreneurial motives depend on individual resources: The more resources women have, the more likely they are to start a business out of opportunity rather than necessity. The type of gender order and the economic situation also play a role: in societies with double incomes, women are more

likely to start a business out of opportunity, while high unemployment favours self-employment out of necessity. Finally, in societies with greater gender equality and better economic conditions, women are less dependent on their own resources when deciding whether to start a business. Annink and Dulk (2012) showed that a high degree of autonomy helps women to achieve their professional and personal life goals. However, they found that women are a heterogeneous group and that autonomy varies depending on the type of work, working time arrangements and customer expectations and that women are not always able to utilise autonomy successfully due to these factors. Factors such as the industry or family commitments not only affect the decision to become self-employed, but also the development and success of the business. This also became clear during the COVID-19 pandemic. Graeber et al. (2021) found that self-employed women were a third more likely than men to lose income due to the COVID-19 pandemic, mainly because they were more likely to work in the hardest-hit industries and were more affected by government restrictions. Differences in household responsibilities also contribute to this difference, but to a lesser extent than the influence of industry structure.

3. Methodology

Qualitative approach was used in this paper to understand women in entrepreneurship by identifying their characteristics, motivations for entering entrepreneurship and self-employment, focusing on female entrepreneurs in the Republic of Croatia. The sample for this research consists of three self-employed female entrepreneurs from the Republic of Croatia. There are several reasons for this type of case selection. Firstly, it is due to the nature of qualitative research, the aim of which is a better understanding of complex problems and not the generalisation of results (Marshall, 1996). If the research problem requires substantial information, a small number of cases is appropriate, assuming that generalisation is not expected (Coviello & Jones, 2004). Case studies can be justified with a very small number of cases—even just one—if the aim of the research is to analyse the phenomenon in context in depth (Yin, 2009). This paper is primarily guided by qualitative research as a type of research that looks at meaning rather than making generalised hypotheses (Crouch & McKenzie, 2006; Mason, 2010) and seeks to answer the two parts of the research ques-

tion: (1) the motivating factors of female self-employed entrepreneurs, (2) their characteristics.

Data for this study were gathered through semi-structured interviews. One of the most commonly used methods for data collection in research with a qualitative methodology are interviews (Taylor, 2005) in the form of a semi-structured interview (DiCicco-Bloom & Crabtree, 2006). Semi-structured interviews were used to allow flexibility in answering the questions and to give entrepreneurs the opportunity to freely express their own views, perspectives and experiences.

The data in this study were analysed using descriptive analysis, which is used in qualitative research. The qualitative data obtained from the interviews was transcribed into a written document by an audio recorder in the first stage of data processing. The participants' statements were then reviewed in detail, and selected quotes from the interview transcripts were interpreted and analysed to answer the research questions presented in the next section of this paper.

4. Results and discussion

According to GEM 2023/24 Women's Entrepreneurship Report, there is still significant inequality regarding entrepreneurial activity, i.e. 10.9% of women, compared to 13.8% of men, were starting new business, and only 6.2% of women owned an established business, as opposed to 9.5% of men (Global Entrepreneurship Monitor, 2023). However, it has been shown that women are less likely to report a business exit, which is a significant finding.

The gender imbalance in entrepreneurial activity in Croatia has been clearly visible for five years (Table 1).

Table 1 TEA index by gender in Croatia

	2019	2020	2021	2022	2023
TEA men	13.0	16.1	15.5	17.0	16.4
TEA women	8.0	9.3	9.2	9.5	9.9
TEA men/TEA women	1.6	1.7	1.7	1.8	1.7

Source: Authors' creation based on GEM Reports

Differences in entrepreneurial activity by gender in Croatia are consistently above the European Union average and show a constant tendency for more men than women to be involved in newly founded companies. As for the reasons for starting a business, for many years the predominant motive for men in Croatia was the creation of a large fortune or achieve a high income. However, according to the latest GEM report for Croatia, this percentage has levelled off: 55.5% for men compared to 37.0% for women in 2022, and 53.2% for men compared to 54.5% for women in 2023. There are several other differences found in 2023: the reason 'to make a difference in the world' for women entering entrepreneurial activity increased, leading to a difference of 10 percentage points compared to men; the gap between women and men in starting a business venture increased significantly (from 6 percentage points in 2022 to 14 percentage points in 2023) because they do not have the opportunity to get a job; and finally men are more likely to continue the family tradition (26.1% vs. 21.4%) (Singer et al., 2024). The reasons for the gender imbalance in entrepreneurial activity are mostly the result of the (non-)availability of services that are essential for the organisation of family life and whose content is mainly included in the "job description" of women in the family (childcare, domestic services, after-school programmes for children, care for the elderly, etc.) (Singer et al., 2024).

Most female entrepreneurs are active in the field of professional, scientific and technical activities (FINA, 2024). The highest share of exclusively female-owned businesses in the total number of entrepreneurs is in Bjelovar-Bilogora County (23.9%), the lowest in Brod-Posavina County (18.7%) (FINA, 2024).

4.1 Self-employed women in Croatia

Entrepreneur A has a business that provides business consultancy, financial advice, bookkeeping and accounting, but is also involved in the preparation of project proposals for EU funded projects. In the meantime, she has also published her own book

on personal finance, which she distributes independently.

Entrepreneur B, who started her own entrepreneurial career with her husband on a family farm, later started her own reflexology and aromatherapy business.

Entrepreneur C has dedicated her entire professional life to floristry and has been running her own flower shop as a self-employed person for many years.

4.1.1 Case A

Entrepreneur A decided to take up an entrepreneurial activity for several reasons. Her main motivation was the freedom and flexibility of being her own boss, but also the feeling of satisfaction from her own achievements and successes.

"Being an entrepreneur has many advantages, but of course, it also comes with some disadvantages. The advantages that motivated me were the freedom to organise my working hours, the freedom to decide for myself when and how much I work, the opportunity to solve problems creatively and the fact that I don't have a boss to report to and ask where I am and what I'm doing. An entrepreneur has a lot more responsibility and obligations, but also a lot more freedom and a greater sense of satisfaction when something is achieved and successful."

"Although I am not an entrepreneur who employs other people, just myself, through my work I endeavour to solve perceived problems in the community and provide services that make life or business easier for others and improve their lives. I am driven by the desire to create new value."

A key factor in her career path was the fact that she was born into an entrepreneurial family where she quickly recognised the quality of life of an entrepreneur. She is characterised by a positive approach, optimism and composure when solving problems and cites a lack of desire to compete in the market as a weakness.

"I was born into a family of entrepreneurs. My father owned a catering business and later a local shop. My grandmother owned a large and successful restaurant as well as property that she rented out. Since I was a child, I have witnessed the difference in the quality of life of people who work for others and those who work for themselves, and I always wanted to be in control of my life and my time."

What the entrepreneur herself sees as important characteristics of a successful entrepreneur are creativity, vision, the need for success and the focus on a product or service when a need is recognised in the market. The key traits she possesses that are responsible for her success are perseverance, motivation, optimism, but also responsible behaviour and a sensible willingness to take risks when making decisions, as well as the ability to solve problems.

"I approach problems constructively. I don't make hasty decisions. I first research all the relevant information and only then, based on my intuition, which I listen to without question, do I make important decisions. The meaning of my entrepreneurial activity lies in the interaction with the people I work with. Every day is an opportunity to brighten someone's day, perhaps with a kind word, a small favour and a job well done."

What is also very important for an entrepreneur is her willingness to change and her desire to constantly learn and improve new knowledge and skills. She herself realises that entrepreneurs are an important factor in society, bringing about development and change in all areas. On the other hand, she believes that entrepreneurship is not particularly valued in Croatia, which is due to the influence of certain cultural and social norms. Nevertheless, she is optimistic about entrepreneurship in the future, especially when it comes to young people.

"Entrepreneurial opportunities are all around us. Especially if you are young and full of imagination, creativity and ideals, you should dare to develop your entrepreneurial ideas. Every little idea has the potential to improve the society we live in, and in doing so, a young entrepreneur can create a fantastic opportunity for a very good life. Good ideas can make you happy, fulfilled and rich–so it's worth the effort."

4.1.2 Case B

Case B is primarily motivated by the freedom that an entrepreneurial career offers. She wanted to build her business primarily on her own knowledge and strengths and not keep working for the people she perceives to be less qualified than she is.

"I really value freedom, and as an entrepreneur I can freely organise my business and make decisions."

"As an employee, I was in situations where my superior was the least educated and least capable person in the entire team. That was hard for me to bear. I

didn't want to risk something like that happening again, so I started my own business."

She finds inspiration in anyone who has a passion for their work. Passion for her work and perseverance are her strengths, and she is also aware that she has the necessary knowledge and the will to deepen this knowledge. She describes the fact that she works alone and doesn't have her own space to work in as a weakness.

"I know a lot of people, so it was easy for me to start a new job, even though I wasn't known as a reflexologist and aromatherapist. I am dedicated to my work, I have the knowledge, the will and the passion for the work I do. I am willing to learn what I don't know yet."

"I learn every day. Although there are no schools or teachers in Croatia from whom I could learn more about reflexology, I am learning because I have found teachers in the world. I am constantly learning new techniques that I incorporate into my work with clients. I regularly organise free events to which I invite my clients and in this way I maintain our good relationship. Personal development is very important to me and I work a lot on it."

In her opinion, the most important qualities that a successful entrepreneur must have are self-confidence, a sense of responsibility, and a strong drive to achieve something. The key to this is hard work, because even if the results don't materialise, this is not a reason to give up, but rather a motivation to keep working. She emphasises that the key characteristics contributing to her success are passion for her work, strong perseverance and motivation, and a belief in and focus on the quality of service she provides to her clients. She is responsible and also shows a need for independence.

"To be an entrepreneur, you have to be responsible. They have to be willing to change. It's good if they have a high level of self-confidence and self-esteem, are open to new insights and show perseverance. That they don't see a bad result as a disaster, but as motivation to do better next time. It is good to be around people and their potential customers. It is important that a person is willing to work on their personal development, because our business can only grow as far as we ourselves grow."

This entrepreneur also mentions the problem of social and cultural norms and believes that the problem lies in society because it often sees entrepreneurs and entrepreneurship in a negative context and uses the word "criminal". Nevertheless, she believes that young people should be told: *"Go forward with an open mind and an open heart".*

4.1.3 Case C

The entrepreneur in case C found her motivation for starting an entrepreneurial activity partly in the desire for autonomy and independence, and partly in the pursuit of material benefits.

"My main motivation was autonomy and freedom in decision-making, but of course also a source of income."

She began her entrepreneurial journey in the same industry in which she had previously worked as an employee. This experience reduced the uncertainty of taking over a business.

"After working in this industry for a long time, I was given the opportunity to take over the business where I had previously worked. I already had a lot of experience in this industry and was able to gain an insight into the business. I knew the processes, so taking over a business was nothing new to me. I was ready to take on responsibility and continue running the business."

She finds inspiration in her inner motivation and the conviction that the desired results can be achieved with persistent work and effort.

"I can't say that I was inspired by anyone in particular. I knew that I could only succeed with a lot of work and effort."

In addition to hard work and perseverance, she considers physical endurance, good communication with customers, organisational and leadership skills and the ability to recognise and follow trends to be her greatest strengths and the key to success in business. In her opinion, these are qualities that successful entrepreneurs should also have.

"I try to follow trends and put the relationship with the customer at the centre of my business – this's my personal path. I also think it's important to take responsibility and limit risk. The work I do is cyclical and related to special occasions and seasons. Therefore, I think it is very important to organise my daily work well and plan future activities. It is very important and essential to plan resources, labour and time."

She points out exhaustion and tiredness as her biggest weaknesses resulting from the intense workload.

However, she also sees weaknesses and limitations in the wider environment, which are mainly reflected in laws and administrative regulations, but also in the negative perception of society, where entrepreneurs are not sufficiently recognised and valued.

"I have been an entrepreneur in this industry for a long time and it has never been easy. I believe that entrepreneurship today, but also at the time when I was just diving into the entrepreneurial waters, is very challenging. You have to keep up with all the laws that are constantly changing and adapt to the market with prices. Unfortunately, I don't think we entrepreneurs have much influence on that."

"I believe that entrepreneurs are often not recognised and appreciated as much as they could and should be. However, I believe that changing this attitude in

Croatia would open up additional space for the development of entrepreneurship."

Although she describes entrepreneurship as a difficult and challenging path, she considers it a rewarding career choice. The entrepreneur advises others not to be afraid and to remain persistent —through commitment and perseverance, obstacles can be overcome and goals achieved.

"Find out what you love to do and stick with it. I would advise them not to be afraid. That they should pursue their goals and dreams. That nothing is unattainable if you put in the effort and work hard and, of course, have a bit of luck."

The case studies of the three entrepreneurs revealed some similarities and differences arising from their characteristics, traits and skills. This is illustrated in the table below.

Table 2 Analysis of characteristics of female self-employed entrepreneurs

	A	B	C
Motivation for starting a business venture	Freedom, flexibility, "being your own boss"	Freedom to make decisions, "being your own boss"	Independence and freedom, "being your own boss", achieving financial benefits
Inspiration and role models	Entrepreneurial family	Any person who has a passion for work	Inner motivation and the belief that through persistent work and effort, desired results can be achieved
Strengths and weaknesses	Strengths: optimism, problem-solving skills Weaknesses: insufficient desire for competition	Strengths: passion for work Weaknesses: no own space to work	Strengths: perseverance, physical endurance and good communication with customers Weaknesses: exhaustion and tiredness
Characteristics of a successful entrepreneur	Makes decisions responsibly and consciously takes risks, possesses problem-solving skills	Responsibility, persistence, motivation and optimism in the work they do, focus on service, need for autonomy	A person who listens to and recognises the needs of the market and builds and maintains quality relationships with their clients/customers. It is also very important and essential to plan resources, manpower and time effectively
Key characteristics for success	Persistence, motivation, optimism and the need for autonomy	Passion for work	Passion for work, taking responsibility and moderate risk, developed organisational and leadership skills

Source: Authors' creation

The table shows that the female entrepreneurs interviewed have several characteristics in common. They are very similar in that all three have a need for independence, a trait consistently highlighted in the literature as central to entrepreneurial motivation, especially among women (Alstete, 2003; Wilson et al., 2004; Rosa & Dawson, 2006). In addition

to the intrinsic motivators, one entrepreneur mentioned financial motives as a driver for entering entrepreneurial activity. The desire to achieve financial benefits is often cited in the literature as one of the main reasons for becoming an entrepreneur (Shane et al., 2003; Carter et al., 2003; Al-Jubari et al., 2019).

They are characterised by a high level of motivation and perseverance in their work, but also by optimism because they believe in what they are doing and are excited about the opportunity to acquire new knowledge and skills that will bring satisfaction to them personally, but also to their customers, which aligns with research showing that successful entrepreneurs display self-confidence, perseverance, and responsibility (Buble & Kružić, 2006; Shane, 2003). They take risks carefully because they do not make hasty decisions before analysing all the circumstances, reflecting findings that entrepreneurs tend to take calculated risks and are prudent in decision-making (Frese, 2009; Khosla & Gupta, 2017). They have a high degree of responsibility in their work and successfully solve problems because they take a constructive approach to problem solving, consistent with studies that emphasise problem-solving skills and responsibility as key entrepreneurial traits (Buble & Kružić, 2006; Štavlić, 2022).

The differences are minimal because in the interview they mentioned characteristics that are largely similar. Entrepreneurs B and C have a slightly more pronounced passion for their work and thus a greater need for achievement and success than A, who cites an insufficient desire for competition and differentiation as a weakness. This aligns with research showing that the need for achievement, passion for work, and self-confidence are important for entrepreneurial success, but that individual differences in motivation and personality can exist (Barrick & Mount, 1991; Zhang & Bruning, 2011).

According to the characteristics discussed in the theoretical section, the example shows that female entrepreneurs have the following characteristics: diligence, a sense of responsibility, an adequate willingness to take risks, a decision-making ability, developed organisational and leadership skills, problem-solving skills and certainly the ability to assess their own strengths and weaknesses, all of which are supported by literature as fundamental for successful entrepreneurship (Buble & Kružić, 2006; Štavlić, 2022; Shane, 2003). It can be said that the interviewed female entrepreneurs possess characteristics that theoretically describe a successful entrepreneur. Although it is widely believed that money is the main reason for starting a business (which is the case in one case), all female entrepreneurs are primarily motivated by independence, autonomy and creative freedom of action, as research

consistently shows that intrinsic motivators such as independence and autonomy are key drivers for women entrepreneurs (Rosa & Dawson, 2006; Alstete, 2003; Wilson et al., 2004). All three have a great passion for the work they do, a desire to create new value and knowledge, and are open to new knowledge. They have a clearly defined goal, focus on their product/service, listen to customers' needs and endeavour to fulfil them. They are persistent and courageous and have recognised an opportunity that they have turned into a lucrative business, which has led to a higher level of self-confidence, reflecting findings that successful entrepreneurs are goal-oriented, customer-focused, and self-assured (Gartner, 1990; Shane & Venkataraman, 2000; Khosla & Gupta, 2017).

5. Conclusion

Entrepreneurship is an important dimension of economic and social development as it drives and restructures the economy towards new technologies and new areas. The aim of this paper was to understand the motivation and characteristics of self-employed women entrepreneurs. The interviewed women entrepreneurs share key characteristics such as high motivation, perseverance, optimism, a sense of responsibility and a willingness to take risks. Although there are small differences in the emphasis on passion for work or the need for achievement, all three women emphasise the importance of independence, creative freedom and the creation of new value as the main motivating factors. Their behaviour and characteristics confirm that successful female entrepreneurs are those who manage to identify and seize opportunities in the market through a combination of commitment, self-criticism and openness to new insights. There are several limitations to this paper. A small sample size of only three self-employed women in Croatia serves as a good starting point for understanding this topic but significantly limits the possibility of generalising the conclusions to the broader population of women entrepreneurs. It must be emphasised that these are preliminary results and that a more comprehensive study should be conducted with a larger sample of self-employed women. Although the qualitative approach allows for a deep understanding of motivations and characteristics, it does not allow for quantitative testing of hypotheses or statistical generalisation of results. The study was conducted exclusively on examples from

Croatia, which limits the transferability of the results to other countries or other cultural contexts. In accordance with the results of the study and its limitations, it is recommended that quantitative research be carried out on a larger sample of self-employed women in different regions of Croatia so that the results can be generalised to the population as a whole. Future research could also include male self-employed entrepreneurs in order to analyse

gender differences in motivation, characteristics and challenges. Furthermore, it is recommended to observe the development of self-employed women over time and analyse changes in motivation, business success and obstacles they encounter at different stages of business. Furthermore, the research could cover different economic sectors and regions to identify specific challenges and opportunities for women entrepreneurs in different contexts.

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Conference review

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Twenty-first Conference on Interdisciplinary Management Research – Osijek, IMR XXI 2025

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INTERDISCIPLINARY MANAGEMENT RESEARCH CONFERENCE – IMR 2025

The *Interdisciplinary Management Research (IMR) 2025 – 21st International Conference* brought together academics, researchers, and practitioners from various countries to exchange and share their latest research findings and professional experiences across diverse areas of management and related disciplines. As an established interdisciplinary platform, IMR fosters dialogue among scholars and professionals on contemporary trends, theoretical developments, and practical challenges in management, as well as in related fields such as business administration, financial economics, industrial organisation, law and economics. A distinctive feature of the IMR conference is its strong focus on postgraduate research. It provides an encouraging environment for PhD students to present and discuss their work, receive valuable feedback from fellow doctoral candidates, faculty members, and industry experts, and enhance their academic and professional networks. The collegial and supportive atmosphere of the conference continues to promote open discussion, collaboration, and the exchange of innovative ideas within the management research community.

1st day of the Conference

The *Interdisciplinary Management Research XXI conference, held at the Faculty of Economics and Business in Osijek on 23–24 October 2025*, was officially opened by Professor Sunčica Oberman Peterka, Dean of the Faculty of Economics and Business in Osijek. The opening ceremony featured two distinguished keynote speakers. Associate Professor Marina Stanić delivered an insightful lecture titled "*Application of Biometrics in Research – Insights into Individual Behaviour and Decision-Making,*" exploring how biometric methods can enhance the understanding of human actions and choices. Professor Željko Požega presented "*Contemporary Challenges in Employee Motivation,*" addressing the modern dynamics and factors that shape workforce engagement.

Academic dialogue and a wealth of research topics

After the plenary session, the conference continued with several parallel sessions covering a wide range of interdisciplinary research areas, including behavioural economics, labour market activation, or-

ganisational culture and employee innovativeness, digital transformation and marketing, financial risk management, strategic decision-making, tourism and hospitality management, sustainability and green practices, artificial intelligence in education, cultural heritage branding, and corporate social responsibility.

2nd day of the Conference

The second day of the Conference, held on 24 October 2025, was dedicated to informal academic and cultural activities that encouraged networking and interdisciplinary exchange among participants. The programme took place in the historic Tvrđa fortress, offering participants the opportunity to experience the city's rich cultural heritage.

Conference attendees visited the Archaeological Museum Osijek and the Museum of Slavonia, where they explored exhibitions highlighting the region's historical and economic development. These off-site activities provided a relaxed and inspiring environment for further discussion, collaboration, and the strengthening of academic partnerships initiated during the first day's sessions.

The diversity of this year's research topics clearly demonstrated the importance of an interdisciplinary approach, and participants from five countries provided fertile ground for further academic discussion and collaboration through the presentation of 28 research papers. All presented papers are included in a collection indexed in the world's leading databases, underlining the academic significance and global reach of the IMR conference. With its strong tradition and excellent organisation, IMR XXI 2025 confirms that interdisciplinary research plays a key role in modern management and business through the exchange of ideas and collaboration between different professions.

Guidelines for authors

Description of the journal

Ekonomski Vjesnik / Econviews – Review of Contemporary Entrepreneurship, Business, and Economic Issues is intended for researchers and practitioners, and devoted to the publication of papers that contribute to the theoretical, methodological and empirical insights in the complex field of economics. Articles can be based on quantitative as well as qualitative analyses; they can be a synthesis of previous research and discuss open issues in specific areas of social and economic practice. The journal welcomes papers focused on different levels of analysis (from individual cases to small or large samples) and contexts (SMEs and large companies, industrial sectors, local, regional and national economies, international economics, branches of economy, healthcare and education, labour and demographics, natural resources and other socioeconomic frameworks).

The journal is focused on research in economics, business economics and entrepreneurship, however, as these are closely intertwined with other disciplines – information and technical sciences, law, sociology, psychology and other fields – multidisciplinary submissions are also welcome.

Types of papers

The journal publishes reviewed papers (scholarly articles), research reports, scholarly debates and reviews. Individual issues can be dedicated to more specific topics. Submissions will undergo a double blind review. Within the peer review process, papers published in the journal are categorized in one of the following categories: original scientific papers, preliminary communications, review papers and professional papers. Papers must be in English.

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Submissions should not be published earlier or be under consideration for publication elsewhere. The papers should be submitted electronically to the Open Journal System: https://hrcak.srce.hr/ojs/index.php/ekonomski-vjesnik
In addition to the main manuscript, a separate file should be sent containing a contact information of each author and recommendation of at least two reviewers.

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There are no strict requirements but all manu-scripts must contain the essential elements, for ex-ample: Title; Abstract; Keywords; Main part of the paper: Introduction, Review of previous research (Theoretical framework), Methodology, Results, Discussion, Conclusion, References. Such article structure is recommended for scholarly articles in the category of scientific papers.

Papers must be formatted so as to allow printing on paper size 210 X 297 mm. Times New Roman or Arial font, size 12 (unless otherwise stated herein) should be used, and line spacing should be 1.5.

The margins (left, right, top and bottom) should be 25mm wide. The text should be aligned with both the right and left margins (justified). The paper should have between 4500 and 7500 words. Above the title, in the upper right corner, the authors state JEL classification of the article.

Detailed guidelines for authors can be found at https://hrcak.srce.hr/ojs/index.php/ekonomski-vjesnik/about/submissions. Papers that do not ad-here to these guidelines will not be considered for publication.

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