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Zbigniew Makiela, Aleksy Kwilinski**

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Green Competitiveness Forecasting as an Instrument for Sustainable Business Transformation

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Abstract

Modern conditions for transforming the business environment in the context of implementing sustainable development goals, decarbonising the economy, and ensuring climate neutrality determine the need to implement effective measures at the level of individual enterprises. External challenges determine the urgency of strengthening enterprises' green competitive advantages and forming an integral level of green competitiveness. The paper offers a methodological basis for the long-term forecasting of enterprises' green competitiveness levels. The key object of the research is a set of companies representing the machine building, agriculture, and food industries, as strategic branches of Ukraine's economy. The period of 2020–2028 was chosen as the interval for foresight. The application of autoregressive integrated ARIMA modelling by means of the non-linear least squares method made it possible to determine transformation vectors, marketing determinants, and target orientations for increasing the integral level of green competitiveness. The assessment of the results showed that the leading enterprises in the optimistic scenario are PJSC "SVF Agrottron" (agro-industrial complex), where the predictive value of green competitiveness is 0.84; PJSC "Wimm-Bill-Dunn Ukraine" (food industry), for which the predictive value is 0.73; and PJSC "Motor Sich" (mechanical engineering), for which the predictive value of green competitiveness is 0.74. The results of the evaluation revealed the leading enterprises according to the optimistic scenario for the

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agro-industrial complex, food industry, and mechanical engineering. The research substantiates the claim that the priorities of the strategy for increasing the level of green competitiveness and the relevant determinants of its implementation should be determined considering the transformation scenarios of its level.

Key words

sustainable development, green competitiveness, forecasting, transformation.



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Introduction

The approved Sustainable Development Goals 2030 underscore the critical need for companies to transform their management technologies based on green economy principles. As competition intensifies across sectors, developing green competitive advantages becomes essential for enterprises aiming to boost their overall green competitiveness (Brych et al., 2021; Chen et al., 2023; Gavkalova et al., 2022a). The convergence and complementary effects generated during the formation of these green competitive advantages play pivotal roles in ensuring the sustainable development of enterprises. They enable expansion in competitive positions in both domestic and global markets, enhancing investment attractiveness and capitalisation (Hussain et al., 2021; Kwilinski et al., 2024; Szczepańska-Woszczyzna et al., 2022). Moreover, the management of green competitiveness should extend beyond merely analysing past and current indicators. A deep understanding of the competitive environment, including its distinct features and the systems and processes within it, is crucial. This comprehensive awareness aids companies in making informed strategic decisions that foster sustainable competitive advantages (Kwilinski, 2023; Letunovska et al., 2022; Vaníčková et al., 2020). Forecasting within the business environment is particularly valuable as it allows for the simulation of various scenarios, helping evaluate decisions and changes aimed at strengthening green competitive advantages. The effective forecasting of green competitiveness is instrumental in identifying priority areas for market analysis, planning the development of new green products and services, and making strategic decisions about ecological renovations (Dacko-Pikiewicz, 2019; Hakhverdyan et al., 2022; Kwilinski et al., 2023a; Korobets et al., 2020). It also supports the formation of a green brand and the greening of overall company activities. Such forecasting serves as a foundation for strategic decision-making, ensuring that companies not only adapt to but also anticipate changes in market demands and environmental regulations, thereby securing a competitive edge in the increasingly green-focused global market (Vysochyna et al., 2022; Yermachenko et al., 2023).

This study aims to forecast the green competitiveness of Ukrainian enterprises within the machine-building, agriculture, and food industries, which are strategic sectors of Ukraine's economy. The paper addresses a gap in the theoretical landscape of green competitiveness theory with a developed approach that employs the ARIMA model for forecasting green competitiveness.

The paper has the following structure: the literature review section delves into existing research, exploring definitions, components, and previous models of green competitiveness, particularly focusing on forecasting models used in sustainability. This section also identifies gaps in the current literature that this paper aims to address. The methodology section describes the research design and approach, detailing the data sources, analytical tools, and software used for forecasting green competitiveness; the research results section presents the findings, utilising various statistical displays such as tables and graphs to clarify the data; the discussion section explores how the results are interpreted in light of the reviewed literature, exploring how they connect with established theories and what implications they hold for businesses focusing on sustainability; and the conclusions section summarises

the key findings and their theoretical and practical implications, while recommendations for businesses and suggestions for future research areas are also provided, acknowledging the study's limitations.

1. Literature review

The analysis of publications indicates that scientists use many approaches and methods for modelling sustainable development processes, depending on various research tasks. The relevance of forecasting is confirmed by its sustainable implementation in the business practices of developed countries (Munim et al., 2022; Oh et al., 2023; Drożdż, 2019). Forecasting is one of the most essential approaches in regulating the economy, understanding development prospects, and making informed decisions in the USA. The review of scholars' latest scientific papers devoted to evaluating and forecasting indicators of sustainable development and the functioning of the circular economy made it possible to distinguish the following key areas of research activity: forecasting the impact of digital technologies on the formation of the sustainable energy industry, assessing the impact of the smart grids and artificial intelligence using for the decarbonisation of the economy, and forecasting the dynamics of CO₂ emissions and the implementation of alternative energy technologies and approaches (Khalatur et al., 2022; Kolosok et al., 2022, Kwilinski et al., 2024).

The authors (Bagherian et al., 2024; Makiela et al., 2023), using the DEMATEL approach and the MICMAC methodology, investigate the potential impact of digital technologies on the energy sustainability of the European energy sector. Within the framework of the study, the future transformations of the energy market are analysed and the influence of smart production technologies on ensuring the energy sustainability of countries is predicted. Forecasting the demand and supply of electricity, J. -H. Syu et al., (2024) and Tkachenko et al. (2019) outline that greenhouse gas emissions are a problem for humanity, especially from the point of view of electricity consumption. To solve the problem, they propose developing a smart grid and implementing an artificial intelligence-based electricity management concept that includes forecasting, anomaly detection, management, and market equalisation. Hoxha et al., (2023) and Gavkalova et al., (2022b) analyse the functioning of the transport industry in the context of energy consumption. Using the ensemble stacking machine learning method, the authors forecast the demand for energy resources in Turkey's transport industry. Hoxha et al., (2023) emphasises the importance of predicting fuel demand as a basis for ensuring the sustainable development of urban transport. Cui et al. (2023) highlights that long-term forecasting of the dynamics of carbon emissions is important for managing the national macro-economy and reducing environmental pollution. Implementing the SARIMA methodology allows clustering countries according to CO₂ emission. Utkucan Şahin & Chen (2023) emphasise that forecasting greenhouse gas emissions plays an essential role in planning the development of the energy industry. Utkucan Şahin & Chen (2023) propose to apply the optimised fractional nonlinear grey Bernoulli model to study the impact of Covid-19 on CO₂ emissions from fossil fuels in the USA. Utkucan Şahin & Chen (2023) concluded that COVID-19 caused CO₂ emissions from coal, natural gas, oil and total CO₂ to decrease by 2%, 2%, 16% and 12% respectively in 2020. Rossi & Candio (2023) concluded the importance of informing stakeholders about the company's activities and plans for implementing sustainable development goals. Rossi & Candio (2023) note that the indicator of the environmental component has a positive effect on the forecast error, regardless of other controls, including social and managerial components. Guo et al. (2023) note that forecasting CO₂ emissions in regions is quite essential. Using the STIRPAT model, the authors predicted the trajectories of carbon emissions until 2060 in China's power, steel, cement, transport, coal, and chemical industries. The authors emphasise that the forecasting results form the basis for developing regional strategies for ensuring carbon neutrality. At the same time, the studies (Hossin et al., 2023; Oshodi, 2022; Williams, 2022; Ziabina et al., 2022) form

integrated political strategies analyses the perspectives of China and the world's access to energy, evaluates energy intensity, the prospects for the development of renewable energy, the volume of greenhouse gas emissions, and private sector investments in the energy sector to achieve the goals of sustainable development. Hossin et al. (2023) highlight that China is making significant progress in achieving the goals of the Paris Agreement, particularly in terms of access to clean solutions in households, private sector investment in energy, renewable energy production and energy efficiency. According to European Union directives, the scientists (Mitrică, 2023; Vysochyna et al., 2022b; Chygryn et al., 2022) notes that developing alternative energy sources in the transport sector is critical due to significant air pollution. The author predicts the economic feasibility of investing in specific sub-sectors of the transport sector to reduce CO₂ emissions and atmospheric pollution. At the same time, authors (Ang et al., 2023; Kiselicki et al., 2022; Kwilinski et al., 2023b; Szczepańska-Woszczyna et al., 2023) point out that environmental, social and governance aspects play a significant role in implementing sustainable development globally. Many transnational corporations use various types of ratings, formed by specialised rating agencies, to assess the system of activity risks (Zhanibek et al., 2022; Ziabina et al., 2020; Wróblewski et al., 2021). However, the corresponding rating process is expensive and time-consuming. Therefore, the authors emphasise the relevance of forecasting for researching dynamic relationships between companies and analysing financial and dynamic network information. Thus, the formation of strategies for ecologically oriented development of enterprises and strengthening their green competitive advantages necessitates the construction of scenarios for transforming green competitiveness. Despite the powerful scientific experience of using forecasting to solve the problems of sustainable development, there is no scientific toolkit for forecasting the indicator of green competitiveness. This research fills the scientific gap regarding forming business sector transformation scenarios by forecasting green competitiveness based on autoregressive integrated moving averages (the Box-Jenkins model).

2. Methodology

Based on previous research (Yang et al., 2021) that advocates the significance of developing companies' green competitiveness as a dominant of sustainable development principles implementation, the present paper attempts to create scenarios for companies' green competitiveness (CGC) transformation. The basis of the developed approach is the ARIMA autoregressive integrated modelling toolkit by the nonlinear least squares method. The ARIMA model (autoregressive integrated moving average or the Box-Jenkins model) is a more modern and convenient time series modelling technology that combines time series and elements of regression modelling in its structure. The specified modelling method is more relevant for forecasting socio-economic indicators in the long term (the time lag is one year) and evaluating the forecast values of green competitiveness. The ARIMA methodology models trends, cycles, seasonality, and other determinants that affect the determined indicator. It uses a three-stage approach involving the following iterations (Box et al., 1994): model identification, checking the time series for stationarity, estimation of modelling parameters, diagnostic verification of obtained simulation results, and construction of relevant scenarios. To eliminate heteroskedasticity (it is not allowed to evaluate the obtained parameters of the model and carry out the forecasting procedure), the initial series of values of the green competitiveness of enterprises is checked for stationarity. Determining the stationarity of several values of green competitiveness allows, at the first stage of forecasting, to present the general view of the appropriate ARIMA model for forecasting the green competitive advantages of enterprises:

$$d(\text{CGC})_t = \alpha + \beta_1 d(\text{CGC})_{t-1} + \dots + \beta_p d(\text{CGC})_{t-i} + \delta_t + n_1 \delta_{t-1} + \dots + n_\partial \delta_{t-\partial} \quad (1)$$

where α – model constant; $\beta_1, \dots, \beta_p, n_1, \dots, n_q$ – model parameters; $\delta_t \dots \delta_{t-i}$ – white noise model; i – the order of the autoregressive part of the model; ∂ – moving average model order; $d(\text{CGC})_t$ – the first difference in the CGC in the t -th period; Prob – probability; R-squared – determination coefficient.

At the next stage, the parameters p and q in the ARIMA model are determined using the Akaike information criterion (AIC) (Portet, 2020):

$$AIC = \ln(\hat{\sigma}^2) + \frac{2(p+q+1)}{n} \quad (2)$$

where $\hat{\sigma}^2$ – expected variance; p – order of autoregressive part of the model; q – moving average model order; n – number of observations.

The object of investigation is Ukrainian companies (PJSC "Motor Sich", PJSC "Wimm-Bill-Dunn Ukraine", PJSC "SVF Agroton") within the machine-building, agriculture, and food industries. The timeframe for analysis is 2001–2019 years. The data for analysis was obtained from the open financial and non-financial reports of the selected companies, internal analytical data. Indicators of green competitiveness, as raw data for forecasting, were calculated in a previous study (Yang et al., 2021). The study applies EViews10 for calculation. The interval for foresight was chosen as 2020–2028 (after 2028, the model is inadequate).

3. Research results

To eliminate heteroskedasticity, enterprises' initial series of green competitiveness values was checked for stationarity by using Akaike criterion. Table 1 presents the empirical results of evaluating the ARIMA model with the minimum value of the Akaike criterion.

Table 1. Empirical results of ARIMA estimation of the model with the minimum value of the Akaike criterion

Companies	Coefficient	Prob	R-squared
PJSC "Motor Sich"			
α	0.0321	0.002	0.46
$d(\text{CGC})_{t-1}$	-0.4086	0.059	
PJSC "Wimm-Bill-Dunn Ukraine"			
α	0.0221	0.007	0.48
$d(\text{CGC})_{t-1}$	-0.4776	0.051	
PJSC "SVF Agroton"			
α	0.0075	0.044	0.46
$d(\text{CGC})_{t-6}$	0.3701	0.028	

Source: calculated by authors

The results of the calculations showed that during forecasting for the long-term period (2020–2028) under a realistic scenario, the highest level of green competitiveness will be: PJSC "SVF Agroton" (agro-industrial complex – 0.84); in PJSC "Wimm-Bill-Dann Ukraine" (food industry – 0.73); in PJSC "Motor Sich" (mechanical engineering – 0.74). According to an optimistic scenario, with long-term forecasting, the level of green competitiveness can even reach its maximum value of 1. Their leading positions in the respective industries explain high forecast levels of green competitiveness for the analyzed enterprises. In particular, Agroton is the largest diversified vertically integrated agricultural producer in Eastern Ukraine. The main activity of the "Agroton" group of companies is cultivating,

processing, storing, and selling crops such as sunflower and wheat. In addition, the "Agroton" group of companies is engaged in animal husbandry and food production. The company uses an environmentally friendly method of processing No-till, which involves a complete rejection of conventional ploughing. The essence of the technology is that the soil is covered with a layer of mulch, and natural processes enrich it, allowing it to recover naturally. This forms a flat surface, protects the soil from air and water erosion and weeds and creates valuable microflora. PJSC "Wimm-Bill-Dann Ukraine" is also a leader in terms of its products' quality and environmental friendliness. The company implemented a quality and safety management system based on the international standard ISO 9001: 2008 requirements and received a certificate for ISO 22000: 2005. The food safety management system was also certified to comply with the international standard ISO 22000:2005 requirements. Everything ensures high product quality and environmental safety of the production itself.

Figures 1-3 present the foresight results for machine-building, food industry enterprises, and the agricultural sector. The forecasting results are given for three enterprise leaders in these industries. According to a realistic scenario, calculations prove that the forecast value of the integral level of green competitiveness for PJSC "Motor Sich" was 0.74. The pessimistic and optimistic trends in enterprises' green competitiveness dynamics indicate a large gap between them.

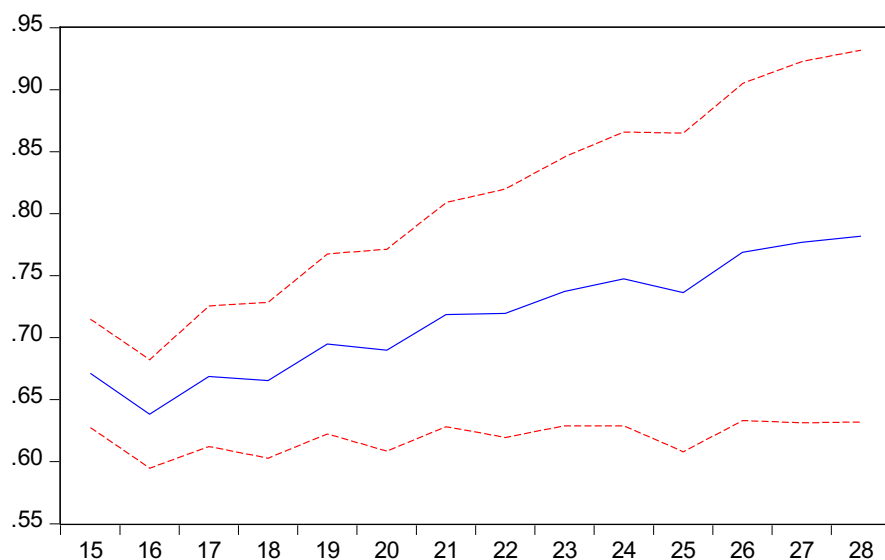


Figure 1. Graphical interpretation of the forecast dynamics of changes in the integral level of green competitiveness of PJSC "Motor Sich."

Source: created by authors

However, even the integral level of green competitiveness under the pessimistic scenario exceeds the level of 0.55, which indicates that its value falls into the interval above the average, and the forecast value under the optimistic scenario will reach almost the maximum level of 0.95. Figure 2 presents the foresight results for the food industry enterprise PJSC "Wimm-Bill-Dann Ukraine" for 2020-2028. The results of the calculations prove that under a realistic scenario for the PJSC "Wimm-Bill-Dann Ukraine" enterprise, the forecast value of the integral level of green competitiveness was 0.73. In turn, implementing the pessimistic scenario will ensure an integral level of green competitiveness of at least 0.50.

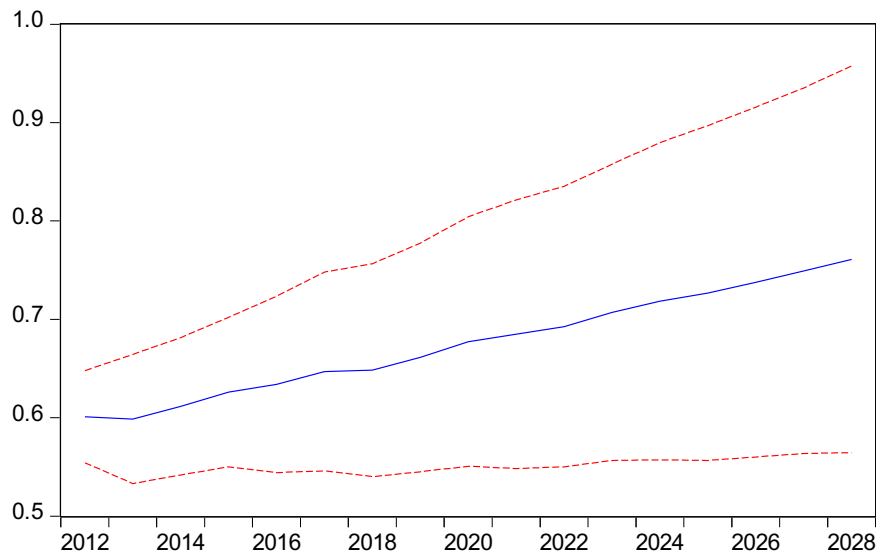


Figure 2. Graphical interpretation of the forecast dynamics of changes in the integral level of green competitiveness of Wimm-Bill-Dann Ukraine PJSC

Source: created by authors

At the same time, under the optimistic scenario for PJSC Wimm-Bill-Dann Ukraine, the maximum value of the integral level of green competitiveness will approach 1. Figure 3 presents the foresight results for the agro-industrial complex enterprise PJSC "SVF Agroton" for 2020-2028.

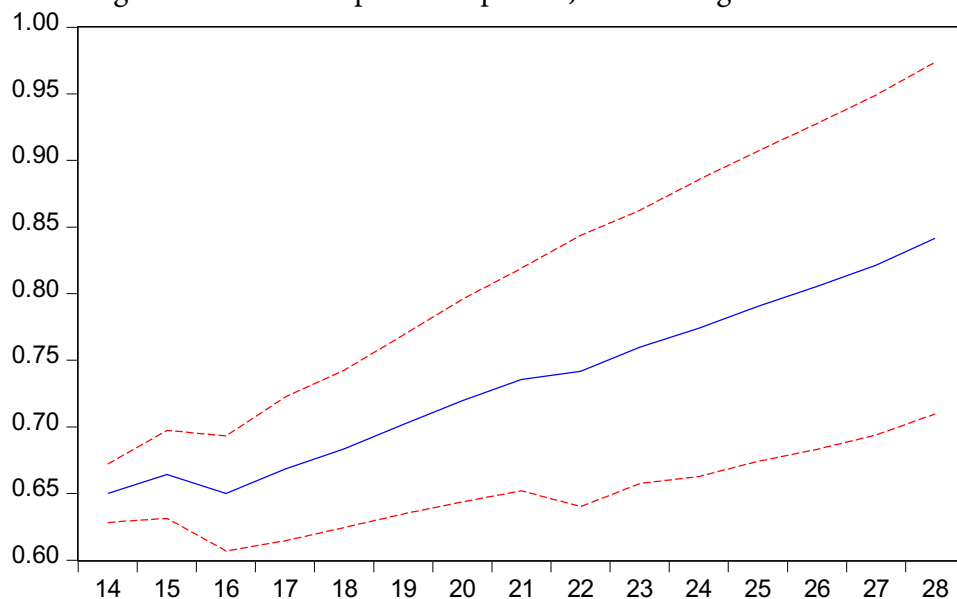


Figure 3. Graphical interpretation of the forecast dynamics of changes in the integral level of green competitiveness of PJSC "SVF Agroton".

Source: created by authors

The calculations show that, under a realistic scenario, the forecast value of the integral level of green competitiveness for PJSC "SVF Agroton" was 0.84. This enterprise is a leader in terms of green competitiveness. At the same time, under the pessimistic scenario, the level of green competitiveness in 2028 will reach 0.68. Implementing the optimistic scenario will provide the maximum predictive value of green competitiveness at 0.98.

4. Discussion

The long-term forecasting of the transformation of the level of green competitiveness was carried out using the ARIMA autoregressive integrated modelling toolkit by the nonlinear least squares method. The calculations made it possible to single out the leading enterprises according to the level of green competitiveness within the framework of an optimistic scenario, the implementation of which will ensure the maximum integrated level of green competitive advantages of enterprises. The result obtained in the paper doesn't contradict the relevant research in the forecasting of social and economic indicators in connection with environmental determinants. Thus, the paper (Liang et al., 2024) uses a combined forecasting model by integrating autoregressive integrated moving averages and reference vector regression models for forecasting carbon emissions at the city level. The authors conclude that the proposed approach ensures high efficiency of the forecasting process. To ensure the decarbonization of the economy, the authors (Verma et al., 2023) emphasize the importance of forecasting atmospheric pollution by PM_{2.5} emissions in densely populated areas of cities. Using a combination of CATALYST, ARIMA and LSTM models gave the authors high performance in forecasting particulate matter pollution 2.5. However, researchers from China (Zou et al., 2024) use the ARIMA method to forecast research trends in energy transformation and formalize relevant clusters of scientific publications. Scientists (Li & Zhang, 2023) emphasize that using statistical autoregressive integrated moving averages for forecasting the level of carbon dioxide emissions makes it possible to form strategic guidelines for climate change prevention. In particular, understanding the trajectory of CO₂ emission changes will justify several environmental policy measures to reduce environmental pollution. In turn, the authors (Srivastava & Jha, 2023; Kwilinski, 2019) apply the methods of forecasting the generation rate of solid household waste, considering indicators of socio-economic development of the regions, to substantiate the prospective directions of waste management policy in India. The application of ARIMA and GM models for forecasting the scale of public consumption and the potential of ecosystems allowed the authors (Liu et al., 2023) to formalize the ecological footprint and assess the sustainability of ecosystems for planning the development needs of regions.

Building green competitive advantages will increase the competitiveness of industries and supply chains, contributing to climate-efficient solutions and promoting green technologies (Tambovceva et al., 2017; Sannikova et al., 2023; Kwilinski et al., 2023c; Rajiani et al., 2020). The development of climate-neutral industries and the formation of their green competitive advantages should be ensured by several systemic strategic measures: implementation of reforms, regulatory acts and initiatives related to climate change and efficient use of resources, stimulation of green investments, and development of energy saving; introduction of environmental standards and green labelling, transformation of the market in the direction of the development of efficient equipment, green technologies and ecological construction; development of financing mechanisms, encouragement of green investments at the enterprise level, use of leasing, creation of energy service companies, etc.

Conclusions

Long-term forecasting of the transformation of enterprises' green competitiveness level involves using the ARIMA autoregressive integrated modelling toolkit by the nonlinear method of least squares. The evaluation results showed that the leading enterprises in the optimistic scenario are PJSC "SVF Agrottron" (agro-industrial complex) – 0.84; PJSC "Wimm-Bill-Dunn Ukraine" (food industry) – 0.73; PJSC "Motor Sich" (mechanical engineering) – 0.74. Implementation of the optimistic scenario will ensure the maximum integrated level of green competitive advantages for enterprises. It is substantiated that the priorities of the strategy for increasing the green competitiveness level and the relevant determinants of its implementation should be determined considering the transformation scenarios of its level. This determined the need to improve the scientific and methodological basis for long-term forecasting of the green competitiveness level. Ensuring the green competitive positions of

modern enterprises involves the creation of ecologically oriented strategies for functioning in a competitive environment and ensuring the improvement of production efficiency at the expense of economic, environmental, marketing, social and corporate components of green competitiveness.

To further enhance the green competitiveness of Ukrainian companies, it is imperative for policy-makers to foster a supportive regulatory and financial environment that strongly incentivizes sustainable practices. Governmental policies that offer tax incentives, subsidies, or grants specifically designed for investments in green technologies and sustainable practices are essential. Additionally, the establishment of clear sustainability standards and guidelines would assist industries in making a smooth transition toward greener operations. Training programs are also vital and should be developed to equip workers with the skills necessary for implementing and maintaining green technologies effectively. Moreover, collaborations between the government, research institutions, and private sectors are crucial for driving innovation and development in sustainable technologies. By creating innovation hubs or clusters focused on green technologies, there would be an enabled environment for knowledge sharing and co-development of new solutions that are tailored to the specific needs of Ukraine's strategic industries such as machine building, agriculture, and food production. These hubs could serve as incubators for sustainable ideas and practices, providing a platform for start-ups and established companies to innovate and scale up green technologies.

Additionally, enhancing public awareness and consumer education about the benefits of sustainable practices can further drive the market demand for green products, thus encouraging companies to adopt greener methods. The government could support this through public campaigns, educational programs, and incentives for consumers who choose environmentally friendly products. These comprehensive policy measures and collaborative efforts would not only bolster the green competitiveness of Ukrainian enterprises but also significantly contribute to the broader national goal of sustainable economic development. They would help create a robust ecosystem where economic growth and environmental sustainability go hand in hand, ensuring long-term prosperity and ecological balance.

Despite the valuable findings this study has a few limitations which could be overcome in the further investigations. Thus, future research could enhance our understanding of green competitiveness by integrating more flexible predictive models that employ machine learning to better handle nonlinear relationships and interactions among multiple variables. Broadening the study to include a wider variety of industries and comparing green competitiveness across different economic contexts would also be insightful, helping to determine the generalizability of the findings and identify sector-specific challenges and opportunities. Further investigations could examine the specific impacts of various government policies on green competitiveness, analysing which incentives and support mechanisms are most effective in different contexts. Longitudinal studies would be particularly valuable, tracking changes in green competitiveness over time in response to technological and policy shifts, offering a dynamic perspective on sustainable business practices. Additionally, qualitative research exploring the perceptions and experiences of business leaders and policymakers could provide deeper insights into the motivational factors and challenges influencing the adoption of green technologies and practices.

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Global Financial Crisis from the Institutional Economics Perspective

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Abstract

This study, which aims to determine the institutional dynamics of the 2008 Global Financial Crisis, uses panel data set of OECD countries between the years 1980-2018. The main motivation of this study is to reveal the causes of this great crisis, which deeply affects the whole world, from a different perspective and to develop policy recommendations to prevent similar economic crises in the future. The logit model was used because of its compatibility with the structure of the variables and some of the advantages it provides. Annual change in industrial production, short-term interest rates, annual change in the ratio of public sector debt to GDP, financial institutions development level and financial markets development level, government efficiency are the variables that contribute this crisis more. It seems that government debt and development level of financial institutions are the most important causes of the crisis. Economic freedom does not seem as effective in creation of the crisis. House prices and real exchange rate are the side results of the crisis rather than the causes. Simultaneous estimation of the relations among broad set of financial and macroeconomic variables and crisis by logit model gave clues about how to manage crises, perhaps not how to prevent them.

Key words

financial crises, institutional economics, logit model.

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Introduction

The concept of crisis refers to unexpected shocks that occur outside of routine in many disciplines and disrupt the functioning of the system. There is a similar situation from an economic point of view. Although there are several leading indicators, crises often occur at unexpected times and in unexpected ways. Uncertainty is one of the main features of a crisis. In economic terms, crises, problems in financial markets and most of the time, these problems appear as the effects of the real economy, that is, production and consumption. The instability in the exchange rate and the subsequent collapse of the national currency, domestic and foreign debt, the collapse of asset bubbles, and many other reasons can be effective alone or together in the context of crises such as hyperinflation. Generally, these malfunctions in the financial system result in real problems such as contraction in production, high unemployment and failure to meet consumption needs.

An economic crisis is an unplanned and undesirable process that threatens or totally disables an economy's potential for development. According to the economic sciences, an economic crisis is a time when a nation's economy is developing significantly negatively. Together with this definition, the term "economic crisis" also refers to the presence of negative trends in the primary macroeconomic indicators (capital flows, exports, GDP growth rate, employment rate, and prices, among others) (Hadziahmetovic et al. 2018).

Academics have long occupied the thought world of financial crises. Pioneering studies on this subject have generally focused on the problems experienced in developing countries, which are mainly caused by political failure and inadequate institutional structure (Krugman, 1979; Mishkin, 1990; Mishkin, 2001; Goldstein & Turner, 1996; Kaminsky & Reinhart, 1999).

Despite numerous studies in the area of crisis, it does not seem possible to say that economics has achieved absolute success in preventing the emergence of crises or at least mitigating their possible effects. The self-equilibrium approach put forward by mainstream economics (what is taught in most colleges and universities and is published in most journals) is funded by the most significant research foundation, known as mainstream economics (Dequech, 2007). This suggests a concentration on the US globally. The time frame under examination spans approximately from the late 1970s to at least 2008. Here, institutions are defined as socially accepted sets of norms for conduct or thought, including shared mental models (Dequech, 2017), with a liberal perspective based on a free enterprise constituting a set for regulatory policies and practices to be put forward in this regard. Nevertheless, after every crisis, actions are taken to use the political power of the public and to reorganize the system. In this context, the importance of institutions in the economic situation of countries and citizens is being questioned again in every crisis period. In light of this fact, paying attention to the discourses of alternative economic movements is of great importance in terms of advancing the science of economics, particularly regarding crisis issues. Institutional economics has an important place in terms of creating an alternative to mainstream economics with its comprehensive and dynamic perspective on economic facts. The cultural phenomena and formal-informal patterns that underlie society and human behavior offer logical and effective answers to clarify the sources of many economic problems. When the subject is evaluated for economics, it would not be wrong to say that a similar situation is also valid for economic crises.

Due to the effects of national investment relationships and the integration of the global financial system, the collapse of financial markets—which began in 2007 with financial instability and bankruptcies in the United States and the United Kingdom—was felt abruptly over a large geographic area.

Apart from the advancements in science and technology during the final quarter of the 1900s, the crisis unintentionally halted the long-term moderate growth trajectory. A significant weakening of the US banking sector was noted with the last financial crisis, which resulted from the appearance of an asset bubble in the housing market. Bankruptcies also occurred during this period.

In reaction to unfavourable circumstances following the severe economic downturn, banks raised credit requirements and standards to heights that were previously unheard-of heights. Put differently, even though there were incentives to loosen credit restrictions, financial institutions adopted a restrictive stance toward their operations following the crisis as a result of market uncertainty and pessimism. In other words, it had a significant impact on the real economy by disabling the financial transmission mechanism and disrupting economic activity. The reason for this disruption in financial markets is the inability to supply the cash flow that the economy requires to continue operating. Due to the influence of national banks that hold funds that are traded on foreign exchanges and are referred to as toxic, it has spread to numerous countries despite the lack of common financial issues or asset bubbles. With international trade suffering great damage from these disruptions, a period of global recession has entered. The main motivation of this study is to reveal the causes of this great crisis, which deeply affects the whole world, from a different perspective and to develop policy recommendations to prevent similar economic crises in the future.

In the second section of the study, a literature review is given. The third section covers the theoretical background of the crisis. The methodology is presented in the fourth section. The fifth section consists of the empirical results, while the last section contains conclusions and economic policy implications.

1. Literature review

The scholarly community has long been preoccupied with financial crises. Early research on this topic typically focused on the issues that developing countries face, which are mostly caused by weak institutional frameworks and political failure (Krugman, 1979; Mishkin, 1990; Mishkin, 2001; Goldstein & Turner, 1996; Kaminsky & Reinhart, 1999).

The crisis literature initially focused on the idea that weak economic fundamentals, such as overly expansionary monetary and fiscal policies, were the root cause of crises. However, subsequent crises and the models created in this context have demonstrated that crises can occur even in the absence of major modifications to the underlying policy framework (Insel & Kayıkçı, 2013; Kaminsky et al., 1998). In the United States of America (USA), the last financial crisis, which started with the collapse of the banking sector in 2007 and reached a global dimension in 2008, once again revealed the inadequacy of weak economic fundamentals and weak financial market judgement as a starting point.

Estrella and Mishkin (1996) sought clues for possible future situations by taking into account recessions and crises in the past and concluded that the slopes of the yield curve and stock prices are useful leading indicators. Demirgüç-Kunt and Detragiache (1998) focused on the commonalities between developing and developed countries regarding banking crises and concluded that the weak macroeconomic environment increased the crisis tendency, and high inflation and variable nominal interest rates boosted the risks in the banking sector and made maturity transformation difficult. He also emphasized that the existence of explicit deposit insurance increased systemic banking problems. Kaminsky and Reinhart (1999) focused on the macroeconomic background and causal relationship between the balance of payments and banking crises and concluded that these crises resulted from

weak economic foundations. Weak economic growth, worsening trade conditions, overvaluation of exchange rates and rising credit costs play important roles in the emergence of crises. Following the liberalization of financial markets, banking and currency crises became integrated.

Aka (2006), based on the effect of time on crisis probability, aimed to reveal the probable duration of financial stability and the determinants of this period and concluded that the probability of banking crises occurring approximately every 10 years is high. Bussiere and Fratzscher (2006) drew attention to the distinction between the time of crisis and the aftermath in the early warning system they developed for the prediction of financial crises, and they found that ignoring this distinction would lead to a significant deviation in the forecasting models and therefore weaken the ability of the models to predict financial crises.

Reinhart and Rogoff (2008) highlighted the risks associated with the growing proportion of unregulated or partially regulated financial assets in the financial system as well as the ongoing technological transformation by drawing comparisons between the financial issues that began in the USA in 2007 and previous crises in terms of asset prices, real economic growth, and public debt. The global M1 money supply deficit and the global private credit deficit are the best early warning indicators, according to Alessi and Detken (2009), who developed an early warning system by identifying the leading indicators of crises. They claimed that this is because asset price cycles are primarily global phenomena. Based on the idea that the type of economy and the structure of the banking system influence the likelihood of crises, Barrell et al. (2010) created an early warning system using data from the banking sector. The findings indicate that a high capital adequacy and liquidity ratio in the banking industry helps to lower the likelihood of a crisis.

Baier et al. (2012) focused on the impact of economic freedom on banking crises and revealed the existence of an inverse relationship between the two. The content of the concept of freedom is also important. Restrictions such as the protection of property, prevention of actions that eliminate competition and ensuring the reliability of contracts appear to necessitate freedom. Babecký et al. (2012) carried out an analysis to determine the indicators that will enable the early detection of risks in developed economies and the explanation of economic developments after crises. Chenguel (2014) observed the spillover effect of the crisis that started with payment problems in subprime mortgages in the USA in 2007, and as a result, he determined that the crisis that emerged in American financial markets followed a path first to developed countries and then to developing countries.

Majerová and Pražák (2020) sought to determine how the financial crisis and other structural economic changes affected the prosperity of these advanced economies. Regression analysis was performed to determine whether these indicators were dependent on one another, and observations were made between 2005 and 2016. The linear regression equation makes it clear that, in contrast to the money supply, which has a predominantly positive effect on equity returns, the unemployment rate, exchange rate, and interest rate have a predominantly negative effect. The global financial crisis at the close of 2008 had a negative effect on the ability of the selected linear regression analysis to predict outcomes over the long term in both countries, as confirmed by the Chow test. Abo Saeid (2013) outlined a few issues pertaining to the European financial crisis and how it affected the Arab Spring. The first thesis states that the European financial crisis has spread beyond Europe's borders and now has global implications. Since Europe is the primary trading partner of the Arab world, the economic weakness and decline in demand in Europe have a detrimental effect on the economies of the Arab world. Additionally, the article offered some suggestions for overcoming the effects of the crisis.

In their study, Laina et al. (2015) concentrated on European nations with the goal of determining the leading indicators of banking crises within the context of a more uniform data set. The results show that the most effective leading indicators are increases in the loan/deposit ratio and housing prices. Other helpful leading indicators include growth in mortgaged housing loans, increases in household and private sector debt, and trend deviation. A theoretical analysis of the creation of a traceable macroeconomic model in relation to asset bubbles, banking crises, and the welfare effect was provided by Miao and Wang (2015). In this situation, loss of confidence and shifting expectations are significant factors, even though fundamental shocks have the potential to trigger a financial crisis. By concentrating on the nonlinear relationships between the housing market and the real economy, Huang and Chiang (2017) attempted to identify the presence of a housing bubble and proposed that an effective early warning system could lessen the amount of wealth lost in the event of a collapse. In their analysis, Pedro, Ramalho, and da Silva (2018) found that low GDP growth is the primary cause of banking crises in addition to high bank debt and that bank-based financial systems exhibit greater resilience to crises. From 2004 to 2020, the probability of default for 30 financial institutions from the United States and the European Union (EU) was estimated by Anton et al. (2022). They stated that while default risk increased during the COVID-19 pandemic, it decreased significantly from the time leading up to the 2008 financial crisis.

Since the Great Depression, a great deal of analysis has been performed on the 2008 crisis, which was the second largest global crisis in terms of duration, extent of devastation, and impact area. These explanations, which sometimes overlap with each other, sometimes complement each other, and sometimes contradict each other, are almost a reflection of the assumption frequently emphasized by institutional economists that every researcher is influenced by the environment and world of thought in which the researcher expresses his or her own opinion. Although there are many studies of dominant economic thought systems and schools in the literature examining crises, there is a lack of studies that empirically examine crises from the perspective of institutional economics. This study was designed to fill this gap in the literature. Through this study, not only will studies examining economic crises in the institutional economics literature gain innovation in incorporating empirical features but also, due to the large number of variables and long-term analysis used, the causes of the crisis will be better revealed, and serious policy recommendations will be made to prevent similar crises that are likely to occur in the future.

According to Pan et al. (2023), there is disagreement over whether the European Semester (ES), which was put into place in the wake of the 2007–2008 global financial crisis, was based on a path-dependent or path-changing mechanism for multilateral surveillance and policy coordination. It accomplishes this by laying the theoretical groundwork for historical institutionalism.

Nijkamp et al. (2024) investigated how institutional arrangements might have affected the postcrisis recovery of the economically disadvantaged regions of the European Union in 2008 and how they might have strengthened adaptive mechanisms and encouraged intelligent specialization. Using a combination of econometric techniques, their multidisciplinary study highlights institutional and clever specialization aspects in the core-periphery differentiation of the European Union.

The global financial crisis, austerity, stagnant productivity, wage stagnation, rising inequality, inflation, and environmental and climate breakdown are just a few of the economic crises that have emerged since 2008, according to Jacobs (2024). These crises have proven challenging for mainstream economic theory and policy to address and, in some cases, have made things worse. The primary

reason for this failure is the "ontological individualism" that underpins neoclassical economic theory. According to his "institutional pluralist" view, his paper offers five different types of institutions for different economic domains. This study argues that institutional design should be the basis for economic policy and offers some model recommendations for key policy areas such as corporate investment and climate change.

Jiménez-Rodríguez and Prats (2023) analysed thirteen papers covering a range of important subjects in international finance and economics. The chosen papers provide an intriguing and illuminating collection of data for researching contemporary issues in international economics and finance, particularly in light of the COVID-19 pandemic, the aftermath of the 2008 financial crisis, climate change, and the instability following the invasion of Ukraine in 2022. The papers examine, from various angles, how certain events that have had a significant impact on the global economy's evolution have changed the rules governing international trade, foreign direct investment, and monetary, fiscal, and sectoral policy.

This study aims to determine the institutional dynamics of the 2008 Global Financial Crisis and includes a panel data set of Organization for Economic Cooperation and Development (OECD) countries between 2000 and 2018. This study differs from existing studies in the literature in many aspects and makes various contributions to the literature in this sense. This paper diverges from the current literature with simultaneous estimation of the relationships among a broad set of financial and macroeconomic variables and crises, whereas others generally use several economic or financial variables. In addition, a data set covering the years 1980-2018 will be used to make comparisons with the past years. In this way, this study provides the advantage of better determining the starting point of the crisis and determining where the system begins to deteriorate. Furthermore, even though many studies have examined the crisis, studies about the role of institutions in the literature are scarce. This study not only presents the perspective of institutional economics on crises but also conducts an empirical analysis that is rare in institutional economics. Moreover, generally, no attention has been given to governance, which is very important for financial crises.

2. Methodology

The 2008 crisis rendered many predictions about the health of the economy and the systems intended to identify financial disruptions invalid, forcing us to update our understanding of the structure of the economy. Notably, the crisis originated in developed nations, whose financial systems are regarded as robust and efficient, and it proceeded to spread to developing nations after first reaching developed nations (Chenguel, 2014). In this analysis part of the study, with the help of variables related to institutional elements, the aim is to clarify the aspects of the 2008 crisis that resemble and differentiate it from previous crises.

2.1 Data and Variables

This study, which aims to determine the institutional dynamics of the 2008 Global Financial Crisis, will be carried out on a panel data set of OECD countries between 2000 and 2018. In addition, a data set covering the years 1980-2018 will be used to make comparisons with the past. Panel data have been preferred for analysis because of their advantages, such as allowing more accurate inference of model parameters with their multidimensional structure, having more capacity than a single cross-section or time series of data to capture the complexity of human behavior, and simplifying calculations and

statistical inference (Hsiao, 2007). Since some of the variables included in the model are indices published annually, annual data were used in the analysis.

The 2008 crisis emerged as a crisis in developed countries as its starting point, and as of 2007-2008, 20 of the 24 countries experiencing financial crises were OECD countries. On the other hand, 16 OECD countries did not experience a financial crisis during this period. Considering the countries that did not experience a crisis in this period, a significant proportion of them were affected by the South American and East Asian crises during the 1990s (Laeven and Valencia, 2018). This situation indicates the positive effect of regulations on the financial markets of countries that have recently experienced crises. In addition, it is striking that countries with spatial or socioeconomic characteristics followed a similar path during the crisis period.

In this analysis of the institutional foundations of the 2008 crisis, a total of 25 variables, one dependent variable and 24 independent variables, were used (Table 1). The variables taken into account have often been tested as determinants of crises in the previous analyses put forward in this area. In this study, in addition to determining the similarities and differences with the past by analysing the 2008 crisis in particular, the effect of institutional structures will be revealed.

Table 1. Variables

Variable Name	Variable Definition	Source of Variable
BANK_CRISES	Crisis Dummy Variable (Crisis or Not)	Laeven and Valencia (2018)
REAL_HOUSE_PRICE	Change in Real House Prices	OECD Database, Reidin Real Estate Index (For Turkey)
CON_PRICE	Change in Consumer Prices	OECD Database
SHARE_PRICE	Change in Stock Prices	OECD Database, Trading Economics Database (For Lithuania)
UNEMP_RATE	Change in Unemployment Rate	IMF Database
GDP_PC_CHANGE	Change in GDP Per Capita (by purchasing power parity)	OECD Database
CUR_BAL_GDP	Current Account Balance to GDP Ratio	OECD Database, Trading Economics Database (For Belgium, Ireland, Luxembourg and New Zealand)
INDS_PRO	Change in Industrial Production	OECD Database
SHORT_INT_RATE	Short-Term Interest Rate (Short-Term Borrowing Between Financial Institutions and Short-Term Government Paper)	OECD Database, Chilean Central Bank Annual Reports (For Chilean Short and Long-Term Interest Rates), Knoema Database (For Estonian Long-Term Interest Rates), YCharts (For Luxembourg and Slovenia Long-Term Interest Rates) CBRT Database (For Turkey Short- and Long-Term Interest Rates)
LONG_INT_RATE	Long-Term Interest Rate (Government Bonds Maturing in Ten Years)	OECD Database, Chilean Central Bank Annual Reports (For Chilean Short and Long-Term Interest Rates), Knoema Database (For Estonian Long-Term Interest Rates), YCharts (For Luxembourg and Slovenia Long-Term Interest Rates) CBRT Database (For Turkey Short- and Long-Term Interest Rates)
REAL_EXCHANGE_RATE	Real Exchange Rate	World Bank Database, FRED Database (for Estonia, Lithuania, Slovenia and Turkey)
TERM_TRADE	Terms of Trade	OECD Database
REV_GDP	Public Revenues/GDP Ratio	
EXP_GDP	Public Expenditures/GDP Ratio	IMF Database
GOV_DEBT_GDP	Gross Public Debt/GDP Ratio	
PR_DEBT_GDP	Private Sector Debt/GDP Ratio	IMF Database
FIN_INS_DEV	Financial Institutions Development Index	IMF Database

FIN_MAR_DEV	Financial Markets Development Index	
ECON_FREE	Economic Freedom	Fraser Institute Economic Freedom Index
ACCOUNTABILITY	Voice (Public Participation in Governance), Freedoms and Accountability	
POLITICAL_STABILITY	Political Stability and Absence of Violence/Terrorism	World Bank Database - Worldwide Governance Indicators Project
GOV_EFFECTIVENES	Government Effectiveness	
REG_QUALITY	Regulatory Quality	
LAW_RULES	Rule of Law	
CORRUPTION_CONTROL	Control of Corruption	

Source: Developed by the authors.

2.2 Theoretical background of the model

Price stability has an important place on the basis of a stable economic structure because price stability and market confidence limit uncertainty. The real house price variable, one of the independent variables, was included in the model to determine the effect of the housing market following a different course from the general market trend in the said period on the emergence of the crisis. In addition, the consumer price variable was used to determine the effect of the general price change. The stock price variable is included in the model because it is an important indicator of confidence in the market and allows the process to be followed within the welfare-depression cycle.

Workers, who make up a large part of society and realize a significant part of consumption expenditures, play an important role in ensuring the continuity of demand. Considering the effect of the vicious cycle created by the relationship between demand and employment on economic crises, the unemployment rate variable is included in the model.

The slowdown in growth rates or the disruption of growth is at the center of many economic problems, especially unemployment. The market-centered capitalist economic system necessitates continuous growth. In this framework, the annual rate of change in GDP per capita is included in the model.

The country's constant deficit in commercial and financial transactions with the outside world causes pressure on the national currency, which threatens economic stability and sustainable growth. To determine the relationship between these effects and financial problems, the ratio of the current account balance to the GDP is included in the model.

One of the variables included in the model is the industrial production index. Production also expands due to increased consumption expenditures during the welfare period. However, the fact that increased consumption, such as consumption expenditures fed by mortgage-backed loans, is not based on a healthy basis may create an illusion for production.

After the crises in the 1990s, global savings' search for a safe haven and the effect of the policies implemented by the American authorities for the continuation of growth, interest rates decreased for all maturities. This has had a significant impact on the asset bubble that formed before the 2008 crisis. To see the effect of the movements in interest rates in the period under consideration, short- and long-term interest rate variables are included in the model.

Especially in developing countries, as a result of erroneous policies implemented by governments and monetary authorities, the unsustainability of exchange rates often results in devaluation. In this

context, the real exchange rate variable was included in the model to determine the role of exchange rates in the 2008 crisis.

Foreign trade is an important activity that affects social welfare, and the sustainability of trade and its beneficial effect are directly related to the trade balance. The terms of the trade variable are included in the model, considering that it is one of the main indicators of the direction of trade and the benefit from foreign trade and is an important determinant of the disruptions caused by foreign trade.

The place of the public sector in the economy has been one of the most debated issues throughout the history of economic thought, and there are many evaluations of the role of public policies in the emergence and exit process of crises. In this context, the ratios of public revenues, public expenditures and public debt to GDP variables were included in the model to determine the effect of the public sector during the 2008 crisis.

Before the 2008 crisis, new financial instruments that emerged as a result of financial innovation provided an opportunity to support the consumption of society without a similar increase in income. With low interest rates, this situation reached the level of exuberance, and the crisis became inevitable as the debt became unsustainable. In this framework, the ratio of private sector debt to GDP, which shows the course of private sector debt, is included in the model.

Financial structures play important roles in issues such as growth, development, resource allocation and social welfare, as well as facilitating life, reducing transaction costs and providing a secure exchange environment. The Financial Development Index was developed by the IMF to evaluate financial institutions and financial markets in terms of ease of access, depth and efficiency (IMF, 2021). Financial institutions and financial markets development index variables were included in the model to determine the role of the factors considered to be financial development in the 2008 crisis.

Another variable included in the model, considering its close relationship with growth, development and disruptions in the economic structure, as well as the fact that it contains institutional elements, is economic freedom. The economic freedom data set prepared by the Fraser Institute is an important resource in this regard. The index consists of the size of government, legal system and property rights, sound money, freedom to trade internationally and regulations, and the economic freedom score of the countries is determined by taking the average of all these factors (Fraser Institute, 2021).

One of the most important contributions of institutional economists to economic thought is the contribution of governance to economic efficiency. Worldwide Governance Indicators (World Bank, 2021), which were implemented to determine this contribution, were included in the model within this framework. Voice, freedoms and accountability, political stability and lack of violence and terrorism, government effectiveness, regulatory quality, rule of law, and corruption control are the six dimensions of governance that comprise the set of indicators (Kaufmann et al., 2010). The data reflect the views of public, private and NGO sector experts from around the world surveyed on governance, as well as from available data sources. The crisis dummy variable of whether there was a crisis in the relevant country was used as the dependent variable for the period in the model.

2.3 Empirical Methodology

When the models created for the determination of the causes of crises and the prediction of possible crises are examined, it can be seen that any of the signal approaches, logit or probit models or a few of them are used comparatively. In this analysis, the logit model will be used because of its compatibility with the structure of the variables and some of the advantages it provides.

Linear regression is the basic regression model in which the dependent variable is estimated with the help of one or more independent variables. However, when the dependent variable takes a binary value rather than a continuous one as present (1) or absent (0), the error terms will also take the values of 1 and 0, the variance will not be constant, and the estimated mean values may go out of the range of 0 to 1. These violations make the linear regression model unsuitable for the analysis of binary responses. Logistic regression is one of the leading methods used to model binary responses. Hilbe (2009) stated that although other models can be used in this type of analysis, only logistic regression can be used in estimating the odds ratio for model predictors.

The equation for the linear regression is:

$$Y_i = \sum \beta_k X_{ik} + u_i \quad (1)$$

This equation is the expression of the linear relationship between the change in the independent variables (X_i) and the dependent variable (Y) (Aldrich & Nelson, 1984, p. 11). However, as we mentioned above, linear regression will not yield realistic results when the dependent variable takes a nominal (nominal) value rather than a continuous one, that is, when a dummy variable is used. One of the alternatives that can be used in this case is the logit model. Logit regression equation:

$$\ln \left[\frac{P}{1-P} \right] = \sum \beta_k X_{ik} + u_i \quad (2)$$

The probability value in equation (P) is:

$$\frac{P}{1-P} = e^{\sum \beta_k X_{ik} + u_i} \quad (3)$$

$$P = \frac{e^{\sum \beta_k X_{ik} + u_i}}{1 + e^{\sum \beta_k X_{ik} + u_i}} \quad (4)$$

$$P = \frac{1}{1 + e^{-(\sum \beta_k X_{ik} + u_i)}} \quad (5)$$

$$1 - P = \frac{1}{1 + e^{\sum \beta_k X_{ik} + u_i}} \quad (6)$$

The distribution of errors (u) in the logit model also differs. According to the linear regression assumptions, the mean of the error term is zero, it is normally distributed, and its variance is constant. In the logit model, the error term takes one of two possible values, and its mean is still zero, while its variance is $P(1-P)$. As a result, when the logit model is used in regression analysis, the conditional mean of the regression equation is limited to between 0 and 1, the distribution of errors is defined by this binary structure, and the principles that guide linear regression continue to be valid (Hosmer & Lemeshow, 2000).

In this study, in which the 2008 crisis was centered, OECD country data were preferred because both the crisis affected developed countries to a large extent and it had a relatively homogeneous structure. Despite the possibility that the behavior of some explanatory variables, such as house prices, GDP growth and interest rates, will be affected by the crisis itself (Demirgüç-Kunt & Detragiache, 1998),

postcrisis data are also included in the regression to prevent possible loss of information by considering the existence of a mutual effect. The basis of the internality problem of the variables lies in the fact that the determination of the start and end dates of the crises includes subjective criteria (Barrell et al., 2010). Although this possibility still exists, the fact that the crisis database we used (Laeven & Valencia, 2018) was created based on criteria accepted by the authorities partially eliminates this problem. In the model, the use of annual data due to the publication times of some of the variables weakens the endogeneity problem for countries where the crisis lasts for one year and for countries where the crisis period is considered a process rather than a point. Otherwise, methods such as excluding the postcrisis values of the variables from the model will necessitate handling each crisis individually, which prevents the search for a common cause-effect relationship regarding crises. Similarly, during the observation period, not only the countries that experienced a crisis but also the countries that did not experience it were included in the analysis, and in this way, the aim was to partially disable the parameters that seem to be related to the random crisis but do not actually affect it.

In this study, which we will carry out using the logit model, short-term data in which all variables are included in general, only statistically significant variables are included in the analysis, data between 2000 and 2018 regarding the 2008 crisis are included, and long-term data between 1980 and 2018 are included for comparison. Three models will be used. Explanations of the content of the variables used are provided in the title of the variables. The equations for the models are as follows:

Model 1:

$$E(\text{Bank_Crises}|x) = \ln \left[\frac{p}{1-p} \right] = \beta_0 + \beta_1 \text{Real_House_Price} + \beta_2 \text{Con_Price_Rent} + \beta_3 \text{Share}_{\text{Price}} + \beta_4 \text{Unemp Rate} + \beta_5 \text{GDP_PC_Change} + \beta_6 \text{Cur_Bal_GDP} + \beta_7 \text{Inds_Pro} + \beta_8 \text{Short_Int_Rate} + \beta_9 \text{Long_Int_Rate} + \beta_{10} \text{Real_Exchange_Rate} + \beta_{11} \text{Term_Trade} + \beta_{12} \text{Rev_GDP} + \beta_{13} \text{Exp_GDP} + \beta_{14} \text{Gov_Debt_GDP} + \beta_{15} \text{Pr_Debt_GDP} + \beta_{16} \text{Fin_Ins_Dev} + \beta_{17} \text{Fin_Mar_Dev} + \beta_{18} \text{Econ_Free} + \beta_{19} \text{Accountability} + \beta_{20} \text{Political_Stability} + \beta_{21} \text{Gov_Effectiveness} + \beta_{22} \text{Reg_Quality} + \beta_{23} \text{Law_Rules} + \beta_{22} \text{Corruption_Control} \quad (7)$$

Model 2:

$$E(\text{Bank_Crises}|x) = \ln \left[\frac{p}{1-p} \right] = \beta_0 + \beta_1 \text{Real_House_Price} + \beta_2 \text{Share_Price} + \beta_3 \text{GDP_PC_Change} + \beta_4 \text{Inds_Pro} + \beta_5 \text{Short_Int_Rate} + \beta_6 \text{Real_Exchange_Rate} + \beta_7 \text{Gov_Debt_GDP} + \beta_8 \text{Fin_Ins_Dev} + \beta_8 \text{Fin_Mar_Dev} + \beta_9 \text{Econ_Free} + \beta_{10} \text{Gov_Effectiveness} + \beta_{11} \text{Reg_Quality} \quad (8)$$

Model 3:

$$E(\text{Bank_Crises}|x) = \ln \left[\frac{p}{1-p} \right] = \beta_0 + \beta_1 \text{Real_House_Price} + \beta_2 \text{Share_Price} + \beta_3 \text{GDP_PC_Change} + \beta_4 \text{Inds_Pro} + \beta_5 \text{Real_Exchange_Rate} + \beta_6 \text{Fin_Dev} \quad (9)$$

3. Research results

Before the model estimation, the "stationarity of the series", which is one of the basic statistical assumptions, was tested to make a healthy estimation. At the point of determination of stationarity,

the Levin–Lin–Chu and Im–Persaran–Shin unit root tests, which are the most frequently used methods in panel data analysis, and the Pesaran CADF unit root test, which allows determination of the stationarity of series under cross-sectional dependence, were preferred (Table 2).

Table 2. Stationarity test results

№	Variables	Levin–Lin–Chu		Im–Persaran–Shin		Pesaran CADF	
		t statistic	p value	"Z" "t" Tilde Bar	p value	"Z" "t" Tilde Bar	p value
1	bank_crises			Dummy variable			
2	real_house_price	-	-	-3.7685	0.000***	-3.377	0.000***
3	con_price	-5.2462	0.000***	-13.2257	0.000***	-4.051	0.000***
4	share_price	-	-	-10.0274	0.000***	-9.82	0.000***
5	unemp_rate	-8.7747	0.000***	-7.7282	0.000***	-5.424	0.000***
6	gdp_pc_change	-9.5121	0.000***	-9.4984	0.000***	-8.475	0.000***
7	cur_bal_gdp	-8.1737	0.000***	-11.9443	0.000***	-14.548	0.000***
8	inds_pro	-	-	-12.1164	0.000***	-8.139	0.000***
9	short_int_rate	-	-	-2.5856	0.005***	-7.431	0.000***
10	long_int_rate	-	-	-9.6769	0.000***	-13.817	0.000***
11	real_exchange_rate	-8.0026	0.000***	-10.3199	0.000***	-12.293	0.000***
12	term_trade	-8.7684	0.000***	-12.4797	0.000***	-13.061	0.000***
13	rev_gdp	-	-	-12.1823	0.000***	-15.494	0.000***
14	exp_gdp	-	-	-11.3683	0.000***	-14.06	0.000***
15	gov_debt_gdp	-	-	-7.6877	0.000***	-12.568	0.000***
16	pr_debt_gdp	-4.804	0.000***	-7.4621	0.000***	-9.326	0.000***
17	fin_ins_dev	-7.2624	0.000***	-1.6915	0.045**	-3.987	0.000***
18	fin_mar_dev	-5.7151	0.000***	-4.2942	0.000***	-3.402	0.000***
19	econ_free	-5.7603	0.000***	-5.2085	0.000***	-4.406	0.000***
20	accountability	-11.351	0.000***	-11.5147	0.000***	-14.525	0.000***
21	political_stability	-9.1935	0.000***	-12.3636	0.000***	-15.345	0.000***
22	gov_effectiveness	-10.0865	0.000***	-13.0102	0.000***	-16.034	0.000***
23	reg_quality	-11.17	0.000***	-12.6819	0.000***	-16.19	0.000***
24	law_rules	-12.8454	0.000***	-11.7595	0.000***	-15.502	0.000***
25	corruption_control	-1	0.000***	-11.9611	0.000***	-13.937	0.000***

Notes: ***Significant at the 1% level, **significant at the 5% level, *significant at the 10% level.

Sources: developed by the authors

According to the test results, 16 out of 25 variables were found to be significant at the 1% level in the Levin–Lin–Chu (2002) test. In the Im–Persaran–Shin (2003) test, on the other hand, 23 of the variables are significant at the 1% and 1% levels at the 5% level. According to the Pesaran (2007) CADF test, all variables are significant at the 1% level. According to the Levin–Lin–Chu test, no results could be obtained due to missing data for 9 variables. Within the framework of these results, the analysis continued with the assumption that the series were stationary.

In the next step, is the model "under fixed effects?" or "under random influences?" The Hausman Specification Test was applied to determine which estimation would be more appropriate (Table 3).

Table 3. Hausman Specification Test

Chi ²	2.01
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Prob> Chi ²	0.9913
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Sources: developed by the authors

To determine the model to be used with this test, the alternative hypothesis of a consistent but asymptotically inefficient estimator is tested, as opposed to the null hypothesis of an asymptotically efficient estimator (Hausman, 1978). With the Hausman Specification Test, the "H0" hypothesis, in which there are random effects, versus the "H1" hypothesis, in which there is a fixed effect, is tested to determine whether a fixed or random effect is preferred in the analysis. According to the test results, the H0 hypothesis is valid, and it would be appropriate to estimate the model under random effects. In this framework, the model was estimated by continuing to work under random effects (Table 4).

Table 4. Model 1 – Logit Model Random Effects Results (for all variables)

Variables	Coefficients	P> z
bank_crises	-22.29199	0.094
real_house_price	4.51E-14	1.000
con_price	-18.91949	0.000
share_price	-0.1559556	0.965
unemp_rate	-1.479981	0.001
gdp_pc_change	-0.176433	0.089
cur_bal_gdp	31.92891	0.046
inds_pro	1.271907	0.000
short_int_rate	0.1597309	0.793
long_int_rate	-36.22258	0.001
real_exchange_rate	-31.59521	0.186
term_trade	20.39837	0.259
rev_gdp	-10.6288	0.485
exp_gdp	20.56205	0.000
gov_debt_gdp	-16.68566	0.118
pr_debt_gdp	46.15728	0.000
fin_ins_dev	5.706254	0.003
fin_mar_dev	-112.7227	0.000
econ_free	-0.0739559	0.935
Accountability	-0.0122353	0.957
political_stability	6.115605	0.000
gov_effectiveness	-7.8095	0.090
reg_quality	4.810094	0.513
law_rules	-1.935362	0.566
corruption_control	234.7112	0.000

Sources: developed by the authors

The final model was obtained by eliminating the variables that were not statistically significant as a result of the estimation (Table 5).

Table 5. Model 2 – Logit Model Random Effects Results (2000-2018) (for significant variables only)

Variables	coefficients	P> z
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real_house_price	-47.6927	0.004***
share_price	-29.5456	0.000***
gdp_pc_change	-1.88173	0.000***
inds_pro	58.58101	0.002***
short_int_rate	1.745688	0.000***
real_exchange_rate	-64.3292	0.000***
gov_debt_gdp	33.97006	0.000***
fin_ins_dev	55.6395	0.000***
fin_mar_dev	13.5382	0.000***
econ_free	-193.711	0.000***
gov_effectiveness	13.29426	0.000***
reg_quality	-9.74852	0.024**
Cons	400.877	0.000***
Wald chi ² (16)	142.16	
Log likelihood	-81.5209	
Probability > chi ²	0,0000	
Likelihood-ratio test of rho=0: chibar ² (01) = 114.93 Prob ≥ chibar ² = 0.000		

Notes: *** Significant at the 1% level, significant at the 5% level, *significant at the 10% level.

Sources: developed by the authors

In the final model we obtained for the years 2000-2018, there are 12 independent variables based on 571 observations from 36 countries. All variables in the final model are individually significant. The test results for the overall model show that the variables in the model are also significant overall. According to these results, half of the independent variables included in the model (annual change in industrial production, short-term interest rates, annual change in the ratio of public sector debt to GDP, financial institution development level, financial market development level, and government efficiency) are in the same direction as the other variables. Half of them (annual change in real house prices, annual change in stock prices, annual change in per capita GDP, annual change in real exchange rates, economic freedoms and the quality of regulations) have the opposite effect. From these coefficients, we can conclude that the variables that contributed to this crisis were annual change in industrial production, short-term interest rates, annual change in the ratio of public sector debt to GDP, financial institution development level, financial market development level, and government efficiency. It seems that government debt and the development level of financial institutions are the most important causes of the crisis. Surprisingly, economic freedom does not seem to be effective in creating the crisis. Housing prices and the real exchange rate are the side results of the crisis rather than the causes.

In the next stage, to compare the 2008 crisis and the previous crises, a model was created by using the data of 36 OECD countries between 1980 and 2018. The results obtained from this model are as follows (Table 6).

Table 6. Model 3 – Logit Model Random Effects Results (1980-2018) (for significant variables only)

variables	coefficients	P> z
-----------	--------------	------

real_house_price	-18.8568	0.000***
share_price	-5.7095	0.000***
gdp_pc_change	-0.3242	0.004***
inds_pro	14.0086	0.004***
real_exchange_rate	8.4294	0.013***
fin_dev	3.0473	0.000***
Cons	-1.2584	0.034**
Wald chi ² (16)	83.60	
Log likelihood	-197.7118	
Probability > chi ²	0,0000	
Likelihood-ratio test of rho=0: chibar ² (01) = 37.11 Prob ≥ chibar ² = 0.000		

Notes: *** Significant at the 1% level, significant at the 5% level, *significant at the 10% level.

Sources: developed by the authors

In the final model we obtained for the period 1980-2018, there are 6 independent variables based on 938 observations from 36 countries. All the variables in this model are also individually significant, and the model appears to be significant overall. Due to the lack of data for the relevant period, some variables could not be included in the analysis between 1980 and 2018. The financial development index was included in the model as a single variable in the long run since the financial institutions and financial markets development indexes did not yield significant results depending on the convergence in the long run. The findings indicate that the 1980-2018 results are in parallel with the 2000-2018 results. The contribution and roles of the variables for the crisis, whether they are the main causes or not, seem very similar to the Model 2 results except for the condition for real exchange.

Discussion and policy implications

According to the evaluations, the political tradition of the countries and the legal legislation shaped on this basis also play important roles in terms of economic crises. It has been argued that economic success and failure are a reflection of the institutional tradition rather than the macro policies implemented and that institutional heritage is also the basis of weak macroeconomic performance and inconsistent policies.

Stock prices, one of the variables whose relationship with the crisis has been revealed many times in past analyses (Estrella & Mishkin, 1996; Babecký et al., 2012), have a negative relationship with the crisis, similar to real house prices, according to both our short- and long-term analyses. was found to show a relationship. The share sales method, whose purpose is to provide long-term resources to the company through the transfer of company shares, has become a highly liquid investment tool in today's practice with the development of technology and increased accessibility to financial systems. This situation, in addition to its efficiency-enhancing results such as the redistribution of resources and the conversion of small savings into investments, may also have deepening effects on the crisis due to panic sales similar to those of the housing market during crisis periods.

Another variable that has been among the determinants of crises in past analyses (Demirgüç-Kunt & Detragiache, 1998; Pedro et al., 2018) is GDP growth. In these studies, low GDP growth or economic contraction are shown to be leading indicators of crises. Our analysis revealed that there is a negative relationship between economic growth and crises in both the short and long term.

According to our estimation results, short-term interest rates for the 2000-2018 period were found to have a positive relationship with the crisis, in line with the literature (Demirgüç-Kunt & De-tragiache, 1998; Kaminsky & Reinhart, 1998). Prior to the 2008 crisis, interest rates began to rise in response to growing risks. These rates had been low for many years as a result of both external influences and policies put in place to ensure that growth would continue. The cycle of trying to convert existing debts into new loans has become unsustainable in a system where borrowing costs have increased.

According to the analysis results, it has been determined that there is a unidirectional relationship between the crisis and public sector debt. In this context, it is possible to say that the increasing public debt burden makes countries more fragile and reduces the power of intervention in the case of any disruption. Minsky suggested that a strong state and a strong central bank are important in the prevention of crises and in the process of escaping crises (Minsky, 2013).

It has been observed that the economic freedom variable also exhibits a negative relationship with the crisis, in line with the literature (Baier et al., 2012). However, it should not be forgotten that the concept of freedom here is a controlled freedom that is legally secured and strengthened with effective control mechanisms rather than unlimited freedom. It is thought that freedom and uncontrolled financial innovations in financial markets were quite effective in the 2008 crisis (King, 2017).

Using the results of this study, not only will studies examining economic crises in the institutional economics literature gain innovation in incorporating empirical features but also, due to the large number of variables and long-term analysis used, the causes of the crisis will be better revealed, and serious policy recommendations will be made to prevent similar crises that are likely to occur in the future. However, there are also some limitations of this study. This study was conducted for OECD countries, considering that it would reflect the crisis better, but the crisis affected almost all open countries in the world to a greater or lesser extent. Additionally, there are some data deficiencies regarding the countries, although they are not at a level that would affect the results. In future studies, the empirical model of this study can be used for other country groups around the world. As in the institutional economics perspective in this study, the crisis can be examined from the perspective of other schools of economic theory in new studies. In addition, the variables used in this study and whose relationship with the crisis is explained both theoretically and empirically may guide other studies.

The evidence of the claim in question, the will of politicians in the face of the recent global epidemic, can also be seen within the framework of policies that differ from country to country. The path dependence created by the policies shaped in the axis of the political and institutional tradition followed by the governments during the epidemic and the consequences dragged the countries have revealed the importance of the governance issue in terms of economic analysis. This process provides insight into how to manage crises, perhaps not how to prevent them.

Conclusions

The phenomenon of crisis contains great uncertainty behind it and makes an absolute explanation impossible. The final models that emerged within the framework of our analysis are also under the influence of this basic fact. The results show that the model parameters, especially the macroeconomic indicators, are compatible with the literature.

The asset bubble that emerged in the housing market was the trigger of the 2008 crisis. According to the results of the analysis, there is an inverse relationship between real housing prices and crises both in the short and long term. The rise in prices, either by chance or as a result of interventions, causing an asset bubble and the ensuing collapse plays an important role in the occurrence and deepening of crises. The expansion of credit is caused by an increase in the value of assets pledged as collateral during welfare periods. A growing loan volume is produced by using money secured by hazy collateral for new purchases and then using those same purchases as collateral for another loan. As a result, prices rise due to rising effective demand. Rising borrowing costs are a result of a more uncertain society and the perception that prices will never increase. In certain cases, borrowing costs are greater than the value of collateral, particularly when debts are being settled through repeated borrowing. In this instance, there is less demand for investment loans, and there is an increased risk of existing loans defaulting.

It has been determined that stock prices have an inverse relationship with the crisis in both our short- and long-term analyses. The moral hazard and principal-agent problem that arises in modern companies through the transfer of capital's management rights can have much more devastating effects in the financial sector. The problems caused by the actions of fund managers, such as prioritizing their personal interests, have a domino effect on the financial market, and the resulting tendency toward selling has an accelerating effect on the collapse.

Our analysis revealed that there is an inverse relationship between economic growth and crises in both the short and long term. In addition to the increase in demand during the welfare period, the costs of new investments also cause an increase in prices, and increasing prices cause a lack of demand after a while creating downwards pressure on prices. Pessimistic expectations and increased risk aggravate loan costs and loan conditions, leading to a deepening of the crisis. Limited credit facilities, decreasing demand and profitability cause growth to slow or even stop.

Another variable found in both our short- and long-term models is the industrial production index. Our estimation results show the existence of a positive relationship between industrial production and the crisis, contrary to per capita GDP growth. It is estimated that this may be because the volume of industrial production, which expanded as a result of consumption and growth supported by credit before the crisis, did not decrease simultaneously with the crisis.

In the past, the real exchange rate variable, which was shown among the reasons for crises in analyses aimed at explaining currency crises, especially in developing countries, was also statistically significant for both the short and long term in our final forecasting model. The real exchange rate variable, which has an inverse relationship with crises, reveals the possible impact of unsustainable policies implemented to protect the value of the national currency.

Our estimation results show that, in keeping with the literature, there is a positive correlation between short-term interest rates and the crisis during the 2000–2018 period. Before the 2008 crisis, interest rates began to rise in response to growing risks. Prior to this, rates had been low for many years because of both foreign influences and policies put in place to ensure that growth would continue. The cycle of trying to refinance existing debt with new loans has become unsustainable due to rising borrowing costs in the system. The fact that the ease of financing in welfare periods erodes the margins of safety and increases uncertainty and risks ultimately aggravates financing costs and conditions.

The public sector debt-to-GDP variable is also statistically significant for our model, which covers only the 2000–2018 period. It has been determined that there is a same-sided relationship between the crisis and public sector debt. In this context, it is possible to say that the increasing public debt burden makes countries more fragile and reduces the power of intervention in the case of any disruption. A strong state and a strong central bank play important roles in the exit process from the crisis as well as in the prevention of the crisis.

Rather than being the root cause of the crisis, the dynamics that preceded it have a common influence on fluctuations in variables such as public sector debt, growth and industrial production, exchange rates, housing and stock prices, and interest rates. In fact, they acquire a quality that influences one another as a result of the crisis they go through. Nonetheless, it would not be incorrect to argue that the economic system and institutional tradition are the two most crucial aspects of the crisis. Robust institutional design, efficient legal frameworks, and robust banking regulation and supervision are critical for a nation's capacity to successfully pursue financial liberalization.

According to the estimation results, the financial development title is also related to the crisis in both the short and long term. The results regarding financial institutions and financial markets for the period 2000–2018 were evaluated separately. For the 1980–2018 period, financial development was considered a single variable because the values for the mentioned variables converged and affected each other. The most striking results in our final model are those related to financial development. Within the framework of model outputs, there is a same-sided relationship between crises and some elements considered financial development in both the short and long term. The results show that the factors considered financial development can also pose risks for the system. The results related to financial development give us clues that our strengths can sometimes create weaknesses and show that the features that we consider development may need to be reconsidered.

Another variable included in our final model covering the period 2000–2018 is within the scope of the economic freedom index prepared by the Fraser Institute. Our analysis revealed that the economic freedom variable yielded statistically significant results and showed an inverse relationship with the crisis, which is in line with the literature. However, it should not be forgotten that the concept of freedom is more than unlimited freedom; it is a controlled freedom that is legally guaranteed and strengthened by effective control mechanisms. From this perspective, the analyses of developing countries revealed that crises emerged following financial liberalization and that liberalization and uncontrolled financial innovations in financial markets were effective during the 2008 crisis.

The last statistically significant variables for the period 2000–2018 are the efficiency of government and the quality of regulations within the scope of the Worldwide Governance Indicators Project. Governance indicators were also not included in the long-term model since they started to be published after 1996. According to the estimation results, the government regulations that allow and encourage the development of the private sector reduce the probability of a crisis, while the situation in which the economic impact of the public is high and bureaucracy and politics are dominant may have a negative effect.

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Testing the Reliability of Technical Analysis Models for Short-term Prediction of Prices on the Financial Markets

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Abstract

The issue of successful investment has been addressed since the beginning of the financial markets. For investors and the academic community, there is a strong motivation to test the reliability of models for predicting the development of prices on these markets. Our goal is to determine which models are optimal for short-term predictions during periods of high market volatility, and what their reliability is. A number of studies indicate that methods of technical analysis are a suitable approach for their ability to be as effective as modern methods, user-friendliness, and their ability to be applied by basic software. The price prediction reliability for the first two weeks of March 2022 is tested on the case of copper based on three conventional forecasting strategies: a) linear regression, b) naive forecasting, and c) exponential smoothing, with the frequencies of data being the daily prices of the preceding month, the daily prices of the preceding three months, and the annual average monthly prices of the preceding 13 months. The results show that linear regression is the most suitable model with the frequency distribution of daily historical prices for the period of three months (MAPE = 4.16%) and average monthly data from the preceding year (MAPE = 4.37%). Predictions based on the daily frequency of data from the period of one previous month achieved the worst predictive results for all the models. The outcomes of this study, reflecting conditions of high market uncertainty, can help investors minimise risks and maximise returns. They demonstrate which method of technical analysis is suitable in terms of predictive power and the choice of data frequency under high market volatility.

Key words

financial market; copper price; volatility; prediction; technical analysis.

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Introduction

Achieving maximum profit or outperforming the market have been investors' goals since the beginning of the financial markets. For this reason, predictive modelling is gaining increasing interest in the scientific community, especially among investors and analysts (Devriendt et al., 2021). Testing the predictive abilities of models is necessary for many reasons, such as verifying the reliability of the model, identifying the optimal model, or optimising investment decision-making strategies (Biecek & Burzykowski, 2021). From the perspective of rational decision-making by market participants, such testing is a strategic topic for educational institutions (Pietronudo et al., 2022).

Verifying the reliability of models becomes particularly important during periods of high market volatility. As an example of a volatile market from recent times, let us consider the period of the COVID-19 pandemic, which profoundly affected the global economy, especially investment activities (Kwilinski et al., 2023). The cause was a significant increase in uncertainty from external factors. In addition to uncertainty in the development of domestic and foreign markets, factors such as the possibility of lockdowns, inflation, interest rates, and consumer sentiment contributed to the uncertainty (Chernii et al., 2022). Another catalyst for volatility in capital markets was the Russia-Ukraine conflict, which inflated international energy prices, leading to an increase in commodity prices in importing countries' industries, affecting their economic outlook and increasing capital market volatility (Huang et al., 2023). It is evident that Russia, European financial markets, and global commodity markets are dynamically interconnected during times of conflict, with European stocks and Russian bonds acting as shock absorbers, and the conflict affecting yields and volatility between them in terms of short-term and long-term frequencies (Umar et al., 2022). The imposition of restrictions on access to SWIFT by some Russian banks resulted in a significant spillover of volatility from the rouble to other markets, with this effect diminishing after investors realised that the war would persist for a longer period (Lin & Wang, 2024).

Commodities are a prominent feature of the global economy. They constitute a significant component of income and prosperity, which is highly dependent on their prices both in the countries that produce them and in the countries that consume them. The price development of commodities is inseparably linked to transient shocks. Generally, the behaviour of asset prices in capital markets is uncertain and difficult to predict, especially during turbulent periods. At the same time, commodity price prediction is an important and challenging process, particularly in volatile markets.

Increased volatility presents a clear challenge to accurate forecasting due to the unpredictability and instability of the market environment, leading to research and the quest for the most effective predictive model that generates forecasts with the lowest percentage of errors (Gaytan et al., 2022).

A number of cited studies indicate that technical analysis might be such a model. Technical analysis includes the search for repetitive and predictable stock price patterns (Mustafa et al., 2022). Many studies have concluded that technical analysis is not a suitable tool for prediction (Goutte et al., 2023). On the other hand, a number of studies have suggested that technical analysis may not be a reliable tool for prediction (Thakkar & Chaudhari, 2021). There is also evidence supporting the effectiveness of simpler forms of technical analysis in generating predictive insights (Gradojevic et al., 2023). This has been confirmed by many researchers based on practical applications, such as Jin (2021), Anghel (2021), and Hudson and Urquhart (2019).

At the market level, the dominance of technical analysis is evident – the major real-time financial information agencies operating in the market such as Thomson Reuters consistently offer reliable,

comprehensive, and up-to-date information based on technical analysis (Picasso et al., 2019). Nti et al. (2020) prepared a systematic overview of 122 studies on the topic of forecasting the stock market that were published in academic journals between 2007 and 2018. The methods were divided into three categories – technical, fundamental and combined analysis. The results show that 66% of the studies were based on technical analysis, 23% on fundamental analysis, and 11% on combined analysis.

In addition to the question of choosing the proper technical analysis method, there is the question of selecting the amount and frequency of input data. How does this aspect affect the quality of prediction? In this context, we address two interrelated problems:

1. What basic model / models for modelling time series data are optimal for short-term predictions in the periods of high market volatility and what is their reliability?
2. Is the accuracy of the model influenced by the choice of frequency and the amount of data used?

From these perspectives, we test methods of technical analysis often used in practice, namely linear regression, naive forecast, and exponential smoothing, in terms of their ability to make short-term financial market predictions.

Tests of selected prediction models are carried out in the short-term view for the copper price development in the turbulent period of 1. – 14. March 2022, i.e. shortly after the outbreak of the Russian-Ukrainian conflict, which was preceded by the Covid-19 pandemic. Copper is among the precious metals, the price of which is strongly influenced by the uncertainty in world economic policy (Raza et al., 2023).

Model predictions of the copper price are carried out on the basis of historical data of three different frequency selections with the aim to confront the prediction with reality and, based on this comparison, to identify an adequate technical analysis model and such a frequency of data that can be generally used under specific conditions of high volatility in the precious metals market.

The outcomes of this study, reflecting conditions of high market uncertainty, can help investors minimize risks and maximize returns. They will demonstrate which technical analysis method is suitable in terms of predictive power and the choice of data frequency under high market volatility.

1. Literature review

What is the predicted development of a specific stock, ETF, currency, or derivative in the following minutes, hours or days? Is the so-called timing of the market possible? These are some of the most important current economic questions, which are addressed in practice by businesspeople, investors, and banks, and theoretically by current economic research.

Rouf et al., 2021 argue that forecasting short-term price development of stock and other marketable assets have undergone a revolution in recent years, which is related to the growing market capitalization of traded companies, technological development, and relatively easy access to the market. The authors thus claim that many analysts are developing new tools and techniques to forecast the future price movement and help with investment decisions. One of them is Vo-Van et al. (2022), who use Naive Bayesian classifier for short-term trading. The classifier is used for transforming daily time series of stock prices into a data frame using posterior probability functions. Inaba (2020) also points out the importance of specific region, type of the market and degree of globalization. Based on the analysis of data from 37 markets, the author correlates these determinants, emphasizing that the

forecasting methods must consider whether it is a developed or developing country. The influence of globalized markets within extensive research of the Tokyo stock market trading is confirmed by Yamamoto (2022), who examines the importance of technical analysis for foreign investors. While private and qualified domestic investors often opt for long-term investments based on fundamental analysis, foreign traders prefer using technical analysis for short-term trading. In terms of short-term trading, the influence of short-term interest rates is equally logical. Ysmailov (2021) confirms that high-interest rates in general are connected with the increasing temporary investments and declining cash volume. The dividend policy, which is theoretically important rather for long-term investors also plays a role in short-term speculations, although it might seem paradoxical. Driver et al. (2020) point out the investors' intense short-term pressure on companies regardless of long-term investment opportunities.

One of the highly topical areas of short-term investment research is the impact of social media sentiment. Li et al. (2021) use Granger causality test to quantify the impact of the social sentiment of Twitter and the volume of results generated by Google in order to forecast the development stock and cryptocurrency prices. According to the authors, the optimal model is a combination of the results provided by both networks. Khan et al. (2021) achieve 80.53% accuracy within Twitter. However, the authors point out to the importance of developing such algorithms, which would enable both effective work with large data volumes and removing the so-called social spam.

Another current area of short-term trading research is the effort to prevent stationary data. One of the possibilities is a relatively common use of neural networks and deep learning (Tashiro et al., 2019). This is not a new method, as the first attempts to use new technologies combined with artificial intelligence date back to the 1980s. Vachhani et al. (2020) provide an overview of machine learning algorithms; however, they are aware of the problems related to constant development of new methods. A similar comprehensive overview of the most frequently utilized machine learning methods is presented by Jiang (2021), who points to the rapid development of techniques, which is driven mainly by technological progress, as well as the necessity to consider new factors and growing volume of investments. According to Zhang (2022), the most efficient one is Extreme Learning Machine (ELM), a modified feedforward neural network with one hidden layer, with significantly increased learning speed. The author recommends using this method especially in a volatile period, when it shows high performance in the period of the so-called fluctuation. remarkable learning speed is suitable for high-volatility periods. Similarly, Nabipour et al. (2020) assess the efficiency of predictive models based on methods such as Random Forrest, Adaboost, XGBoost and other artificial neural networks. According to the authors, the best performance is achieved by the model based on Long short-term memory (LSTM) network. Most of the authors (Nabipour et al., 2020) further develop this research, analysing ten methods and complementing the LSTM network with recurrent neural network. This combination is considered highly efficient. They can base their assumptions on the research conducted by Lee et al. (2019), who conclude that these methods are more effective in times of shar market fluctuations, especially during financial crises, when they are able to detect effectively resistance levels. Wang et al. (2021) and Srivastava et al. (2021) propose a different machine learning model for analysing and forecasting financial time series based on the daily analysis of the performance of the international stock indexes. The authors also compare the outputs of machine learning and technical analysis to predict price movement in financial and capital markets.

In general, machine learning methods demonstrate relatively high levels of prediction accuracy, particularly when the appropriate network and data smoothing method are chosen. Hewmalage et al. (2021) note that there is a problem of a persisting relatively low application of these models in financial practice. According to the authors, for short-term trading, entrepreneurs need easily-applicable models established in the business platforms. Ayala et al. (2021) try to solve this problem by suggesting the use of both techniques - machine learning and technical analysis, combining a Linear model (LM), Artificial Neural Networks (ANN), Random Forrest, and support vector regression with technical analysis using the Triple Exponential Moving Average (TEMA) and Moving Average Convergence Divergence (MACD). Within the short-term investments Hašková et al. (2023) presents the predictive capabilities of a fuzzy multi-criteria evaluation system that operates on the basis of a non-fuzzy neural approach, but also one that is capable of implementing a learning paradigm and working with vague.

Despite the intensive efforts to apply new predictive methods based both on social networks sentiment analysis, neural networks and machine learning, technical analysis still holds the pre-eminent position in research and financial practice (Jin, 2021). It predominates within short-term trading, is robust, and forms the basis of short-term business strategies (Sermpinis et al., 2021). Technical indicators are better predictors than the fundamental indicators in the case of active intensive trading; their prediction performance is not affected by problematic data selection and processing and time changes (Wang et al., 2020). Predictions of stock return provided by technical indicators are statistically and economically significant; however, it is possible and feasible to further innovate and improve them (Dai et al., 2021). The authors form their opinion based on the examination of novel technical indicators in their research (Dai et al., 2020), combined with a two-phase probabilistic model defined by economic limitations.

Nevertheless, according to researchers, technical analysis has a lot of limitations. Hassanniakalager et al. (2021) correlate the method on the example of short-term currency trading with other predictive models, such as Vector Machine and dynamic Bayesian model averaging, which outperform technical analysis. At the same time, it is clear that technical analysis is not always suitable; according to Tan et al. (2020), its effectiveness depends on the area of research and type of business. The authors also point to the growth of transaction costs in short-term investments based on technical analysis and recommend combining with the Sentiment-Threshold method. Jin (2022) achieved similar results, analyzing the possibility of short-term five-minute cycle trading (intra-day) with gold as a commodity in the Shanghai Futures Exchange market. The author did not prove the effectiveness of this method compared to other business strategies. Strategies of short-term (spot) trading with other commodity (oil) is addressed by Nonejad (2021), who points to the instability of parameters and model uncertainty in the Bayesian approach. The author states that the statistical approach shows the highest effectiveness in short-term trading. In general, it is possible to use the method of commodity channels in the case of trading with oil or precious metals, although they are not always evaluated positively. Brogaard et al. (2019) criticized the methods for distorting prices, which impedes the companies to make decisions. However, according to Wena et al. (2019), channels can be used in selected markets. The authors highlight the substantial non-linear causality that exists between oil prices and the Chinese stock market.

Despite various studies on short-term business strategies based on machine learning or social network sentiment, technical analysis, supplemented by new indicators, such as tackling the problem of volatility (León-Castro et al., 2019) or static data, largely dominates the market. This problem was

addressed by Nonejad (2021) in another study on the function of dynamic averaging, declaring its effectiveness in economic predictive models.

The issue of Moving Average method (MA) draws the attention of many researchers. Ma, Yang and Su (2021) deal also with the appropriate application of this model in various situations, proving its highest effectiveness in volatile stock markets. The authors also point to the method's decreasing performance over time, warning about its detrimental effect when used for longer period. Similarly, Huang and Huang (2020) indeed, it has been confirmed that moving average (MA) strategies tend to experience diminished profitability when implemented through ETFs compared to when applied directly to the underlying indexes. The authors also test an investment horizon, declaring that the strategy is less effective in the long run than, for example, a buy-and-hold approach. Lin et al. (2021), who deal with an extensive comparison of both strategies, disagree with the above statement, claiming that the timing the momentum by incorporating the signals of the Moving Average enables achieving better performance by the application of the "buy and hold" strategy, including the often-discussed consideration of higher transaction costs in the case of the first variant. Almost the same conclusion was made by Hung and Lai (2022), who compare the efficiency of portfolios composed using Moving Average and "buy-and-hold" strategies. Aliu et al. (2022) used Vector Error Correction Model firstly to detect the effect that electricity prices maintain on the PX Index, secondaly to estimate forecasts using Facebook Prophet and Auto ARIMA Model.

High-frequency algorithmic trading is a unique method used for short-term trading in financial and capital markets. According to Vezeris et al. (2020), the financial practice uses mainly three dominant methods - MACD (oscillator), SMA (moving average) and PIVOT points (price transition), with the optimization of their setting being the key point. For this, the authors recommend ad-Backtest model, which appears to be the most efficient in terms of back testing. The variants method of autoregressive moving average (ARIMA) is also a subject to analyses in terms of this short-term trading; out of these variants, the most efficient one is DT-ARIMA (Zheng et al., 2021). Therefore, Huang et al. (2021) create more than 100 directed weighted stock exchange networks, in which they search for key nodes using the LeaderRank algorithm. The authors argue that an average clustering coefficient and global effectiveness rise sharply before and during a financial crisis and sharply decline after it, with only three largest shares having the major impact in the selected Chinese market. The current comparison of trading strategies based on technical analysis and PEGR indicator (Price to Earnings to Growth Ratio) is also surprisingly unique. While the technical approach dominates in the case of short-term investments, the Price to Earnings to Growth Ratio outperforms stochastic methods in the long run (Wang et al., 2020).

Short-term trading in financial and capital markets concerns stock, currencies, ETF and other instruments. Cryptocurrencies, which draw the attention of both businesspeople and economists, are also very popular, as Cohen (2021) points out. The author searches for optimal technical analysis using the comparison of three tools – relative strength index, moving average convergence divergence (MACD) and pivot reversals (PR), concluding that using MACD and PR methods in short-term trading significantly outperforms the "buy-and-hold" strategies; however, the relative strength index did not achieve the expected results. Yamani (2021) analyses the effectiveness of moving average, momentum and relative strength index, but through the prism of the economic crisis in 2008. The author concludes that such an important event causes a significant time deviation, which is reflected in the long run in the effectiveness of business strategies based on technical analysis. Zhang et al.

(2021) innovate the stochastic methods within trading with financial derivatives. They modify the oscillator using the probability approach, i.e., the second moment of risk-neutral variance implied by option prices to achieve higher prediction accuracy. Siddiqi (2019) improves stochastic stock predictive Black-Scholes, Heston, and Bates models for reliance on the fixed starting point. Hu and Jacobs (2020) further confirm the cross-sectional theory of stock option returns using a complex business model. The authors state that call option returns decrease (grow) with the volatility of underlying assets, despite the existence of option risk premium connected with the volatility and jump risk. Guo and Lin (2020) further verified these findings using the asymmetry property of S&P 500 index distribution.

Islam and Nguyen (2020) describe the current state of short-term business strategies research, favoring “newer” methods based on neural networks focused on static data processing. The authors create and correlate complex forecasting models using historical data on the stock gathered from Yahoo Finance. Comparisons of the autoregressive integrated moving average, artificial neural network and a stochastic geometric Brownian motion suggest higher efficiency of both static stochastic approaches. Ni et al. (2021) also use the stochastic oscillator to predict the asset development, but compare its performance with the effectiveness of business management. The authors further suggest using the fluctuations as a management quality indicator. Lin et al. (2020) propose a different correlation integrating the revaluation of intangible assets with stochastic technological limits in a dynamic stock model. They point out the risks consisting in the necessity to increase capital costs of new technologies.

Logically, researchers also verify the effectiveness of combined technical models, often based on the probability approach (Gavurova et al., 2017). In short-term trading, Lai et al. (2016) recommend the integration of averaging techniques and Bollinger Bands indicator, which are effectively used as the indicators of market entry and exit control, achieving better results than when using only one of the above methods. Huang and Martin (2018) applied Bollinger Bands to short-term leverage currency trading, declaring that USD Bollinger Bands optimized by the profit factor outperformed other strategies and generated the highest annual rate of return per risk unit with 68% prediction accuracy. They thus confirmed the results achieved by Coakley et al. (2016), who conducted complex empirical research on the profitability of technical analysis of foreign currency trading between 1996 and 2015. They confirmed the effectiveness of these forecasting methods, choosing Bollinger Bands supplemented by the relative strength index, which show the best performance. Gurrib et al. (2022) used a different combination based on Fibonacci retracement combined with price conflux strategies. They compare the model in various segments of short-term trading, stating that Fibonacci retracement captures the changes in energetic stock prices much better than the changes in the cryptocurrency exchange rates.

2. Methodology

This contribution evaluates the accuracy of commodity price prediction using three conventional forecasting strategies based on a) linear regression, b) naive forecasting, and c) exponential smoothing. The choice of these methods was influenced by these circumstances; these simple models are widely used in practice (Svetunkov et al., 2023), these simple practices have the ability to be as effective as advanced methods such as machine learning (Paldino et al., 2021; Funde & Damani, 2023), these simple practices are user-friendly and can be modeled in basic software (Ilic et al., 2021).

While linear regression, naive forecast, and simple exponential smoothing offer a comprehensive approach to forecasting in volatile market conditions, there are certainly other alternative methods available like Time series Decomposition, Machine learning models or State space Model and others (Jiménez-Navarro et al., 2023). Some alternative methods are more complex and require additional computational resources and expertise to implement effectively (Gill et al., 2022). In contrast, the chosen methods are relatively simple and easy to understand, making them more accessible and straightforward for analysis. Linear regression, naive forecast, and simple exponential smoothing offer clear and interpretable results, making it easier to understand the underlying drivers of the forecasts and communicate findings to stakeholders (Poongodi et al., 2020). Implementing and maintaining alternative approaches require additional resources, such as specialized software or computational power (Gill et al., 2024). The chosen methods are relatively resource-efficient and can be implemented with standard statistical software packages, minimizing the burden on resources. Thus, the decision to use specific forecasting methods involves a trade-off between complexity, performance, interpretability, and resource requirements.

Linear regression models are extensively utilized for price prediction of financial instruments and commodities in the field of finance (Sharaf et al., 2021). The method models the relationship between the variables and linear predictor functions in which the dataset estimates the parameters (Thamarai & Malarvizhi, 2020). The prerequisite for the model application is the existence of causality between the variables. Simple linear regression is suitable for modelling trends for data evenly distributed along the line (Apanovych & Prágr, 2023). It is described by the equation of the line (1):

$$Y = a + bX \quad (1)$$

In the context of linear regression, the dependent variable is denoted as Y, the independent variable as X, and the slope of the line as b.

A native model is one of the simplest predictive models. It assumes that future values will be the same as the most recent observed value, making it straightforward to implement and interpret. A naïve model serves as a baseline model against which the performance of more sophisticated methods can be compared (Vijh et al., 2020). This model assumes that the expected change in all forecasting points is zero and the last known value of the variable is thus used for the whole prediction horizon (Burghauserová et.al., 2023). For the time series with the linear trend, the model with proportional change (2) can be used:

$$F_{t+1} = X_t + p(X_{t+1} - X_t) \quad (2)$$

where p is a constant from the interval (0;1), F_{t+1} is the prediction for the period t+1, and X_t is the last known time series value (Díaz et al., 2020). The empirical research showed that the naïve model is applicable for many economic and financial time series (Atkins et al., 2018, Monahan, 2018).

The exponential smoothing model uses historical averages of the variable in the monitored period for predicting future behaviour of the given variable. It has ability to capture short-term fluctuations and smooth out random noise in the data. This method assigns exponentially decreasing weights to past observations, giving more weight to recent data points while still considering the entire historical

series. The main goal is to reduce fluctuations and identify the trend, which is otherwise imperceptible (Barrow et al., 2020). For non-seasonal models (3) it applies:

$$lt = \alpha yt + (1 - \alpha)lt - 1 \quad (3)$$

where yt represents the value of the series at a specific point in time (t), and lt represents a component related to the level of the series. The smoothing coefficient α takes a value from the interval 0, 1 (Smyl, 2020).

To evaluate the accuracy of the models' predictions, methods of absolute error, or respectively mean absolute error (Abs Error), and Mean Absolute Percentage Error (MAPE) are used (Chicco et al., 2021). The Abs Error metric measures the average absolute value of the difference between the actual value and the predicted value for each point in the time series or for each observed value (4):

$$Abs\ Error = \frac{1}{n} \sum_{i=1}^n |x_i - \hat{x}| \quad (4)$$

where, the actual value of the quantity is denoted as x_i , for $i = 1 \dots n$, and its measured value is denoted as $\hat{x}$. If the absolute error is close to zero, the model has good predictive accuracy; conversely, the further the absolute error value, the lower the model accuracy.

MAPE is the most common metric used to evaluate the accuracy of a predictive model. It is especially useful in cases with outliers, as it does not penalize large errors in prediction as strongly (Koutsandreas et al., 2022). It measures the average percentage difference between actual and predicted values (5):

$$MAPE = \frac{1}{n} \sum_{i=1}^n \left| \frac{x_i - \hat{x}}{x_i} \right| \quad (5)$$

Models with a MAPE value below 10 % are considered very good, between 10 % and 20 % are good, between 20 % and 50 % are conditionally acceptable, and models with a MAPE value higher than 50 % are classified as falsely predicted (Kumar et al., 2020).

3. Data

Almost all predictive models need to specify the volume and frequency of the input data necessary for predicting future prices. The objective is to attain the highest level of accuracy achievable for an extended time horizon, emphasizing the importance of sustained predictive performance. In terms of the volume and frequency of the input data, commodity prices will be predicted from three perspectives: prediction based on the daily prices of the preceding month (22 input values), prediction on the basis of daily prices from the preceding three months (66 input values), and prediction on the basis of annual average monthly prices (13 input values). The methods will be applied for the given volume and frequency of data for a short-term 14-day price prediction in 1. – 14. March 2022, and their results will be compared with the actual real prices.

Price prediction will be tested on the case of copper, which was chosen for its specific properties used in industry and reflected by stock market investors. Unlike most other metals, copper is traded on both the London Metal Exchange (LME) and the New York Mercantile Exchange (NYMEX). While

the LME prices serve as a benchmark for over-the-counter (OTC) contracts, any deviations in price on the NYMEX are typically minimal. The demand for copper is experiencing rapid growth due to the expanding economies of China and India. These thriving economies require substantial amounts of copper to sustain their development, leading to an increase in prices (Ge & Tang, 2020).

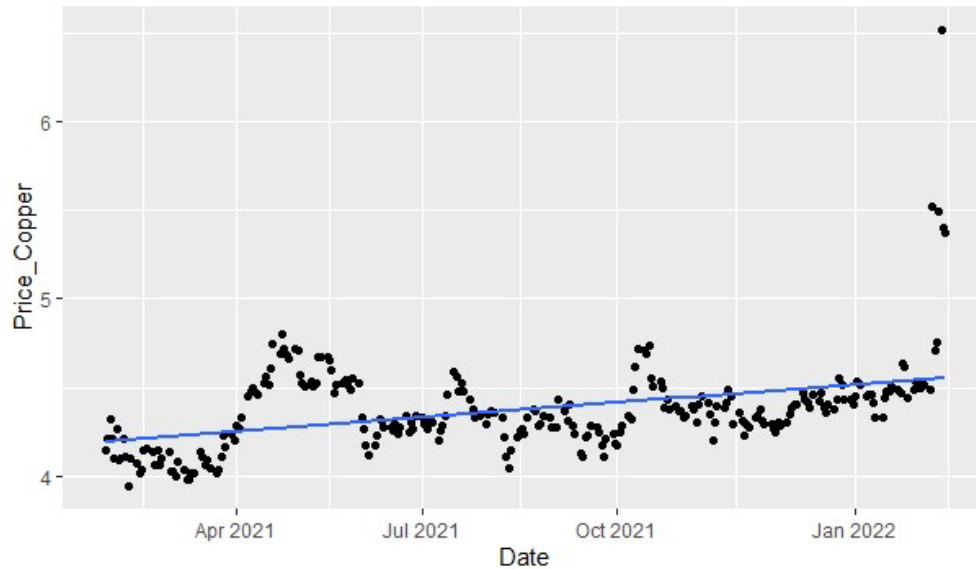


Figure 1. Daily closing prices of copper in USD/lb from 22/02/2021 – 28/02/2022

Source: Nasdaq (March, 2022), own processing in Rstudio using package „readxl”

Figure 1 shows the development of daily copper prices (in USD/lb) in the period 2/22/2021 - 2/28/2022. The data series shows a slightly increasing trend in the monitored period. Significant volatility in copper prices is recorded across the period February 2021 – December 2021 as part of the wave of the Covid-19 pandemic. The volatility during this period may stem from its status as a publicly traded commodity that is susceptible to rapid market reactions and sentiment (Xu, 2024). Regarding the development of copper prices after the outbreak of the Russian-Ukrainian conflict on February 24, 2022, a significant deviation from the counterfactual predictions was shown. Copper prices were consistently higher than expected (Khurshid et al., 2023).

Table 1. Descriptive statistics of the daily copper prices for the period 22 February 2021 – 28 February 2022

Variable	n	Mean	Sd	Median	Min	Max	Range	Skew	Kurtosis
Price Copper	273	4,37	0,25	4,34	3,94	6,52	2,57	3,19	20,7

Source: Own. Calculated in RStudio using package “psych”

Table 1 contains descriptive statistics of the daily copper price variable in USD/lb for the period 2/22/2021 to 2/28/2022. The variable contains 273 observations. The average value is \$4.37/lb with a price range of 2.57. The difference confirms the outliers in the data set that occur to the right of the

mean (Skew = 3.19); a positive kurtosis of 20.7 indicates a higher concentration of values around the mean than for a normal distribution.

The data was sourced from the Nasdaq (March, 2022). The copper prices prediction analyses for the dates 1 – 14 March 2022 is divided into three parts utilizing the data based on different frequencies. Table 2 contains the copper daily closing prices in USD/lb of the preceding month (1 – 28 February 2022 – 22 input values).

Table 2. Descriptive statistics of the copper prices for the period 1. February – 28. February 2022

Variable	n	Mean	Sd	Median	Min	Max	Range	Skew	Kurtosis
Price_Copper	22	4,79	0,53	4,53	4,44	6,52	2,08	1,79	2,54

Source: Own. Calculated in RStudio using package “psych”.

Table 3 contains the information on the copper daily closing prices in USD/lb of the preceding three months (1 December 2021 – 28 February 2022, 66 input values).

Table 3. Descriptive statistics of the copper prices for the period 1 December 2021 – 28 February 2022

Variable	n	Mean	Sd	Median	Min	Max	Range	Skew	Kurtosis
Price_Copper	66	4,52	0,36	4,44	4,23	6,52	2,29	3,44	13,3

Source: Own. Calculated in RStudio using package “psych”.

Table 4 contains the information on the copper annual average monthly prices in USD/lb of the preceding year (February 2021 – February 2022 13 input values).

Table 4. Descriptive statistics of the copper prices for the period February 2021 – February 2022

Variable	n	Mean	Sd	Median	Min	Max	Range	Skew	Kurtosis
Price_Copper	13	4,34	0,2	4,34	3,96	4,73	0,77	0,08	-0,32

Source: Own. Calculated in RStudio using package “psych”.

The variables include 22, 66 and 13 observations in total. The mean values are close to or equal to the median, suggesting that the datasets do not contain significantly outlier values; this is supported by the standard deviation values. Skewness greater than 1 in all cases indicates that the distribution is asymmetrical, slightly deviating from a normal distribution. The kurtosis of the distribution takes positive and negative values. A negative value indicates a flat distribution, while a positive value signals a narrow distribution with an elongated peak.

4. Research results

The prediction of copper price for 14 days in March 2022 using linear regression, naïve model, and simple exponential smoothing will be made from three perspectives in terms of the volume and frequency of the input data: 1) monthly prices from February 2022 (30 values), 2) monthly prices for three months, from December 2021 to February 2022 (90 values) and 3) data for one year from 12 average monthly prices from March 2021 to February 2022 (12 input values).

Results of a 14-day prediction for March 2022 based on daily values from 1 – 28 February 2022 are shown in Table 5. The method with the least % error of the day prediction is highlighted.

Table 5. Results of a 14-day forecast for March 2022 from daily prices of the preceding month February 2022

Day	Price March	Linear regression				Naive forecast				Exponential smoothing			
		Coefficient	ABS error	Error2	% Error	Coefficient	ABS error	Error2	% Error	Coefficient	ABS error	Error2	% Error
01.03.2022	4,587	5,281	0,695	0,483	15,15%	5,374	0,787	0,620	17,16%	5,581	0,995	0,989	21,69%
02.03.2022	4,656	5,319	0,664	0,440	14,25%	5,374	0,718	0,516	15,43%	5,626	0,970	0,941	20,84%
03.03.2022	4,772	5,357	0,586	0,343	12,27%	5,374	0,602	0,363	12,62%	5,670	0,899	0,808	18,83%
04.03.2022	4,929	5,395	0,466	0,217	9,46%	5,374	0,445	0,198	9,02%	5,715	0,786	0,617	15,94%
05.03.2022	4,892	5,433	0,541	0,293	11,06%	5,374	0,482	0,232	9,84%	5,759	0,867	0,752	17,72%
06.03.2022	4,868	5,471	0,603	0,363	12,38%	5,374	0,505	0,255	10,38%	5,804	0,935	0,875	19,21%
07.03.2022	4,731	5,509	0,778	0,605	16,44%	5,374	0,643	0,413	13,58%	5,848	1,117	1,248	23,61%
08.03.2022	4,710	5,547	0,837	0,701	17,77%	5,374	0,664	0,440	14,09%	5,893	1,183	1,399	25,11%
09.03.2022	4,573	5,585	1,012	1,025	22,14%	5,374	0,801	0,642	17,52%	5,937	1,365	1,862	29,85%
10.03.2022	4,640	5,623	0,983	0,967	21,20%	5,374	0,734	0,539	15,82%	5,982	1,342	1,802	28,93%
11.03.2022	4,626	5,661	1,035	1,072	22,38%	5,374	0,748	0,560	16,17%	6,026	1,401	1,962	30,28%
12.03.2022	4,597	5,699	1,102	1,215	23,97%	5,374	0,777	0,603	16,90%	6,071	1,474	2,172	32,06%
13.03.2022	4,578	5,737	1,159	1,344	25,33%	5,374	0,796	0,634	17,39%	6,115	1,538	2,365	33,59%
14.03.2022	4,525	5,775	1,250	1,562	27,62%	5,374	0,849	0,720	18,75%	6,160	1,635	2,672	36,13%
Average	4,691	5,528	0,837	0,759	17,96%	5,374	0,682	0,481	14,62%	5,870	1,179	1,462	25,27%

Source: Own.

Results of a 14-day prediction for March 2022 using monthly values from a period of three months from December 2021 to February 2022 (66 values) are shown in Table 6. The method with the least % error of the day prediction is highlighted.

Table 6. Results of a 14-day prediction for March 2022 from daily prices of the preceding months from December 2021 to February 2022

Day	Price March	Linear regression				Naive forecast				Exponential smoothing			
		Coefficient	ABS error	Error2	% Error	Coefficient	ABS error	Error2	% Error	Coefficient	ABS error	Error2	% Error
01.03.2022	4,587	4,815	0,229	0,052	4,99%	5,374	0,787	0,620	17,16%	5,820	1,233	1,521	26,892%
02.03.2022	4,656	4,822	0,167	0,028	3,58%	5,374	0,718	0,516	15,43%	5,950	1,295	1,676	27,81%
03.03.2022	4,772	4,829	0,058	0,003	1,22%	5,374	0,602	0,363	12,62%	6,080	1,309	1,713	27,43%
04.03.2022	4,929	4,837	0,092	0,009	1,88%	5,374	0,445	0,198	9,02%	6,211	1,282	1,642	26,00%
05.03.2022	4,892	4,844	0,048	0,002	0,99%	5,374	0,482	0,232	9,84%	6,341	1,449	2,098	29,61%
06.03.2022	4,868	4,851	0,018	0,000	0,36%	5,374	0,505	0,255	10,38%	6,471	1,603	2,568	32,92%
07.03.2022	4,731	4,858	0,127	0,016	2,68%	5,374	0,643	0,413	13,58%	6,601	1,870	3,498	39,53%
08.03.2022	4,710	4,865	0,155	0,024	3,29%	5,374	0,664	0,440	14,09%	6,731	2,021	4,086	42,92%
09.03.2022	4,573	4,872	0,299	0,090	6,55%	5,374	0,801	0,642	17,52%	6,862	2,289	5,240	50,06%
10.03.2022	4,640	4,879	0,240	0,057	5,16%	5,374	0,734	0,539	15,82%	6,992	2,352	5,533	50,70%
11.03.2022	4,626	4,886	0,261	0,068	5,63%	5,374	0,748	0,560	16,17%	7,122	2,497	6,233	53,97%
12.03.2022	4,597	4,893	0,296	0,088	6,45%	5,374	0,777	0,603	16,90%	7,252	2,655	7,051	57,77%
13.03.2022	4,578	4,900	0,323	0,104	7,05%	5,374	0,796	0,634	17,39%	7,382	2,805	7,867	61,28%
14.03.2022	4,525	4,907	0,382	0,146	8,45%	5,374	0,849	0,720	18,75%	7,513	2,988	8,926	66,02%
Average	4,691	4,861	0,193	0,049	4,16%	5,374	0,682	0,481	14,62%	6,666	1,975	4,261	42,35%

Source: Own.

Results of a 14-day prediction for March 2022 using one-year values with 13 average monthly prices from February 2021 to February 2022 (13 input values) are shown in Table 7. The method with the least % error of the day prediction is highlighted.

Table 7. Results of a 14-day prediction for March 2022 from average monthly prices from February 2021 to February 2022

Day	Price March	Linear regression				Naive forecast				Exponential smoothing			
		Coefficient	ABS error	Error2	% Error	Coefficient	ABS error	Error2	% Error	Coefficient	ABS error	Error2	% Error
01.03.2022	4,587	4,417	0,170	0,029	3,70%	5,374	0,787	0,620	17,16%	4,379	-0,208	0,043	-4,53%
02.03.2022	4,656	4,428	0,228	0,052	4,89%	5,374	0,718	0,516	15,43%	4,373	-0,283	0,080	-6,08%
03.03.2022	4,772	4,439	0,333	0,111	6,98%	5,374	0,602	0,363	12,62%	4,366	-0,405	0,164	-8,49%
04.03.2022	4,929	4,449	0,480	0,230	9,73%	5,374	0,445	0,198	9,02%	4,366	-0,563	0,317	-11,41%
05.03.2022	4,892	4,460	0,432	0,186	8,83%	5,374	0,482	0,232	9,84%	4,354	-0,538	0,289	-10,99%
06.03.2022	4,868	4,471	0,397	0,158	8,16%	5,374	0,505	0,255	10,38%	4,348	-0,520	0,271	-10,68%
07.03.2022	4,731	4,482	0,249	0,062	5,26%	5,374	0,643	0,413	13,58%	4,342	-0,389	0,151	-8,22%
08.03.2022	4,710	4,493	0,217	0,047	4,61%	5,374	0,664	0,440	14,09%	4,336	-0,374	0,140	-7,94%
09.03.2022	4,573	4,504	0,069	0,005	1,50%	5,374	0,801	0,642	17,52%	4,330	-0,243	0,059	-5,30%
10.03.2022	4,640	4,515	0,125	0,016	2,69%	5,374	0,734	0,539	15,82%	4,324	-0,316	0,100	-6,80%
11.03.2022	4,626	4,525	0,100	0,010	2,16%	5,374	0,748	0,560	16,17%	4,318	-0,308	0,095	-6,65%
12.03.2022	4,597	4,536	0,060	0,004	1,32%	5,374	0,777	0,603	16,90%	4,312	-0,285	0,081	-6,20%
13.03.2022	4,578	4,547	0,030	0,001	0,66%	5,374	0,796	0,634	17,39%	4,306	-0,272	0,074	-5,94%
14.03.2022	4,525	4,558	0,033	0,001	0,73%	5,374	0,849	0,720	18,75%	4,300	-0,225	0,051	-4,98%
Average	4,691	4,487	0,209	0,065	4,37%	5,374	0,682	0,481	14,62%	4,340	-0,352	0,137	-7,45%

Source: Own.

The first model prediction accuracy based on daily data from February 2022 significantly prefers the naïve model, with the MAPE value of 14.62% (Table 5). The second test of model prediction accuracy based on daily data from three months (December 2021 to February 2022) favors linear regression with the MAPE being 4.16% (Table 6). The third test based on the average monthly data from March 2021 to February 2022 favors linear regression with the MAPE of 4.37% (Table 7).

All models were used in a basic version and their extension would be possible using more sophisticated statistical models, however, this was not the goal of this research. For example, the naïve method was used because the article only focused on one commodity. However, we realize that if an investor decides among several investment possibilities, it is more appropriate to use other, more robust models.

5. Discussion

The copper price prediction accuracy test was deliberately set in the turbulent period of March 2022. To understand the behavior of metal prices the insights into the economic consequences of the Covid-19 pandemic and the Russia-Ukraine war is helpful. The metal markets play a key role in the economic activities of countries, regions, companies or individuals. For that reason, measuring the volatility is the key interest for investors. Related to this is the choice of a suitable model to capture time series data and the choice of frequency data used. In this context, we examined questions:

1. What basic model / models for modelling time series data are optimal for short-term predictions in the periods of high market volatility and what their reliability is.

The paper tested the prediction ability of the most commonly applied models in practice - linear regression, exponential smoothing and naïve model. The prediction was analyzed using various frequency data that were compared with the reality, based on which we identified the optimal model applicable in the conditions of high market volatility for short-term copper price prediction. In the case of our research the simple linear regression with the frequency of daily historical prices of immediately preceding three months used for predicting 14-day prices for March 2022 is the most

suitable approach for predicting the copper prices. The linear regression model also proved to be applicable for the prediction using the frequency of average monthly data from the preceding year.

The similar view is held by Sagheer & Kotb (2019), who reminded that linear statistical methods have been solving the problem of prediction based on historical data for many years. Several models of non-linear time series have also been proposed, e.g. bilinear model or autoregressive conditional heteroscedastic model, which, however, compared to linear time series, are still in their infancy from the point of view of applicability in practice.

2. Is the model accuracy influenced by the choice of frequency and amount of data used?

Our results indicate a strong relationship between the prediction reliability and the frequency of the input data used. In other words, the accuracy of the predictions is significantly influenced by the amount of data available and how frequently it is collected. The quarterly framework of the daily data (the highest frequency and amount) and the 10 years framework of the average yearly data (the highest data amount) showed the best results when linear regression was applied. The worst predictive results within all models were measured when using monthly framework of the daily data (the lowest data amount).

This finding aligns with the conclusions drawn in previous studies conducted by Lyocsa et al. (2021), who statistically tested two data sets (low-frequency and high-frequency) to verify the prediction accuracy. They found that high-frequency data can make accurate short-term predictions for the maximum of one following month.

Linear regression is often identified as an optimal model for predicting prices in periods of high market volatility (Uras et al., 2020). Despite its simplicity, linear regression can be robust, especially when there is a linear relationship between the predictor variables and the target variable, a condition that often holds true for many financial time series data, particularly over short-term horizons (Wang et al., 2020). In periods of high volatility, simpler models may perform better than more complex ones because they are less prone to overfitting noisy data (Megaritis et al., 2021).

Generally, we can thus state that linear regression can predict the short-term future direction of precious metals' price development in turbulent environments. However, it is important to note that it may not always be the best model for all situations. In some cases, more sophisticated techniques such as machine learning algorithms or time series models may be necessary to capture the nonlinearities and complex dynamics present in volatile markets (Masini et al., 2021).

Conclusions

The issue of how to successfully invest in times of financial crises caused by war conflicts or the Covid-19 pandemic, has been addressed by investors and theoreticians since the beginning of financial markets. These periods bring about fundamental changes and significant capital spillovers, prompting the exploration of optimal approaches and models for short-term predictions amidst high market volatility. A number of cited studies indicate that technical analysis can be the right solution. Its advantages and disadvantages are summarized in the literary research, along with the overview of other most commonly used predictive methods and approaches, which are discussed as a better or equivalent alternative to technical analysis. Research based on testing the reliability of technical analysis results demonstrates its applicability for selected time series.

In line with the research objectives, a period of high market volatility and uncertainty, stemming from the Covid-19 pandemic and the Russian-Ukrainian war conflict in March 2022, was selected for analysis.

The paper employs commonly applied time series models – linear regression, exponential smoothing, and naïve model. The predictions of these models were analyzed using various frequency data and compared with actual outcomes to identify the optimal technical analysis model applicable in conditions of high market volatility.

The findings reveal that linear regression with daily historical prices for three months used for predicting 14-day prices for March 2022 yielded the most favorable results, with a Mean Absolute Percentage Error (MAPE) of 4.16%. Additionally, the model proved applicable for prediction using average monthly data from the preceding year, with a MAPE of 4.37%. However, predictions based on daily data from the preceding month were unsuccessful in all models, as the MAPE values were excessively high.

One significant feature of technical analysis is its widespread use in both research and practice within capital markets on a daily basis. The results of the study validate the appropriateness and effectiveness of employing this method for specific time series, supporting the conclusion that utilizing technical analysis is reasonably accurate and suitable.

The outcomes of this study, reflecting conditions of high market uncertainty, can be applied by investors to minimize risks and maximize returns. They will demonstrate which technical analysis method is suitable in terms of predictive power and the choice of data frequency under high market volatility, demonstrating the potential method and data frequency dominance. The results of the study can be generalized at least to cases where external factors cause volatility in the rare metals market.

It is crucial to acknowledge the limitations inherent in this study. Firstly, the research focuses primarily on the applicability of technical analysis within a specific timeframe and under specific market conditions, namely, the Covid-19 pandemic and the Russian-Ukrainian war conflict in March 2022. Therefore, the generalizability of the findings to other contexts may be limited. Additionally, the study utilizes selected time series models, and while these models are commonly applied in practice, there may be other approaches not explored in this research that could yield valuable insights.

Future research in this area could explore several avenues to enhance our understanding of the effectiveness of technical analysis and other predictive methods during periods of high market volatility. Firstly, investigating the robustness of the findings across different market conditions and timeframes could provide valuable insights into the generalizability of the results. Additionally, exploring the integration of multiple predictive methods, including technical analysis, fundamental analysis, and sentiment analysis, could lead to more accurate predictions and a comprehensive understanding of market dynamics.

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Digital Transformation Processes in Tourism

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Abstract

Consumer behaviour and decision-making in tourism are increasingly based on digital information. Content created by users on social networks, the opinions of travel-oriented bloggers and vloggers, and the content and focus of new media are becoming the standard, and it is anticipated that these tendencies will continue to gain momentum. For the supply side, knowledge of consumer preferences for forms of marketing communication is crucial. The aim is to examine the preferences of contemporary tourists in relation to the use of new media in the tourism sector in the Slovak environment, based on the individual phases of travel as well as demographic characteristics. A quantitative study was conducted on 1208 respondents using inferential statistics. The specifics of the Slovak market were identified: websites, as a more traditional digital medium, play a direct role in all purchase phases of travel, while social networks, reviews, and discount portals are also essential. Though newer forms of digital communication, such as digital games or virtual or augmented reality, are certainly in the minds of tourists, the intensity of their use remains low. In terms of demographic characteristics, it was found that women use new media significantly more both during and after a trip than men. Men prefer using entertainment-related media, most often digital games. The findings of this study will serve as a useful basis for formulating strategies of public and private organisations for the digital transformation of tourism.

Key words

digital marketing communication, new media, e-tourism.

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Introduction

In the tourism industry, terminology such as digital tourism, intelligent tourism, e-tourism, e-tourist, tourism 4.0, smart tourism, and the like is used in connection with digitalisation (Stankov & Gretzel, 2020; Ozdemir et al., 2023; Baggio et al., 2020). Digitalisation is the process by which technology and data-driven management change social and economic systems and consumer behaviour. The pressure to adopt digital technologies is driven by the convergence of advanced technologies and the growing social and economic connectivity that has developed during globalisation (OECD, 2021; Madleňák et al., 2021).

An indisputable benefit of digitalisation is, among other things, that all destinations or businesses in tourism (small, lesser known, or completely new) have an impact on the world tourist through

intelligent tourism (Albrecht & Raymond, 2023). Working with Big Data and data analyses are essential for the purpose of making important business decisions (Yallop, 2023), and data collection makes it possible to summarise knowledge about consumers, trends, and the business environment. Data and its collection and interpretation are generally a source of value creation for companies. New media enables interaction and communication with destinations and businesses in tourism (Pencarelli, 2020) as well as the possibility of time setting, which allows the problem of the seasonality of the industry to be solved.

The digitalisation of tourism is intensively projected in the sphere of marketing communication, as traditional marketing techniques are no longer valid. Consumers are becoming fully digital tourists – they use new communication channels and IT devices, which today are almost a necessity. Tourist destinations and businesses in the sector are undergoing a digital transformation (Madzík et al., 2023; Matušíková et al., 2023) in an effort to stay competitive; they are leading a predominantly digital battle to attract potential visitors. At the centre of digital marketing communication is the desire for the offer to reach tourists through various digital platforms (Orden-Mejía & Huertas, 2022).

1. Literature review

Studies that attempt to predict the future development of tourism suggest that information and communication technologies can, and in all probability will, fundamentally change the way that tourists and their experiences can be managed (Buhalis et al., 2023; Carvalho & Ivanov, 2023; Hughes & Moscardo, 2019; Elmahdy, 2017; UNWTO, 2019; WEF, 2019; OECD, 2021). These technologies are irreversibly ubiquitous, and connectivity in all phases of travel punctuates this fact (Dadić et al., 2022; Lončarić et al., 2019; Štefancová et al., 2023). Information technologies enhance the tourist experience (Neuhofer et al., 2014) and the newest can even create an experience in tourism.

Several studies have been conducted that deal with the relationship between digital information and media and services in tourism or destinations (A-khateeb & Al-khateeb, 2020; Bieger & Laesser, 2004; Choi et al., 2018). One recent study (Fernán-dez-Cavia et al., 2020) dealt more deeply with research on the sources of information that tourists use during the individual phases of a trip. The authors of the study divided travel into four phases. Aside from the usual three phases of “before the trip, during the trip and after the trip,” they also considered a fourth phase, “choosing the destination.”

Unlike the traditional tourist, the digital tourist is more demanding, actively searching for and sharing information in a new way, and is more independent of intermediaries (Buhalis & Law, 2008; Pencarelli, 2019). Marketing communication is thus transformed into a digital form. It becomes a process of using various digital instruments and channels to communicate with the target group (Strauss & Frost, 2020; Kotler, 2017): websites, social media, e-mails, mobile applications, online forums and reviews, augmented and virtual reality, digital games, etc. (Blštáková, 2020). Digital marketing communication, unlike traditional communication, is primarily interactive, targeted, measurable, flexible, and offers multimedia possibilities (Chaffey & Smith, 2017).

Digital information and content are an inseparable part of travel for today's tourists as they enable access to up-to-date information sources, the possibility of constant communication (even during the trip itself) and the sharing of experiences with others. What's more, tourists perceive digital information as enjoyable and convenient, user friendly and useful (Mathew & Soliman, 2020). Tourists use digital information and transactions at every stage of the value chain of a tourism product or service. Digital information is especially important in such a market, where there is more international traffic

(Fernández-Cavia et al., 2013). Authors dealing with consumer behavior in tourism most often distinguish three phases of purchasing behavior (Horner & Swarbrooke 2011; Llodrà-Riera et al., 2015), and one study by Fernández-Cavia et al. (2020) lists four phases of travel (the phase of choosing a place of future vacation is considered as a separate phase) (Table 1).

Table 1. The phases of travel and searched content

Phase of travel	Before traveling		While traveling	After traveling	
	Inspiration	Planning	Booking	Use of time	Sharing of experiences
Activities and content	Searching: a) inspiration, b) information, b) comparing destinations and opinions of other travelers. Forming of preferences. Seeking recommendations.	Planning: a) trips, b) spending time during a stay (trips, cultural monuments, attractions and etc.).	Use of instruments: a) booking a stay, b) reservations of unplanned attractions.	Utilization: a) previously-booked services, b) unplanned decisions on a purchase (attractions, events, food, etc.), c) sharing of experiences.	In the case of satisfaction/dissatisfaction: a) desire to repeat the visit, b) recommendations c) discussion and consultation.

Source: developed by the authors.

In terms of the volume of sales of products and services via the Internet the tourism sector has gradually become one of the largest sectors in both the world and in Europe (Statista, 2023; Jin & Hu, 2022, Pojkarová & Gottwald, 2020; Spieß et al., 2022; Uçar et al., 2022). Digital tourism services are among the main industries of online sales (UNWTO, 2019). There are several reasons why: high Internet penetration (over 80% in advanced economies), rapidly developing digitalization and smart systems, and the popularity of new distribution networks (Clement, 2020; Nuenen & Scarles, 2021). European tourists use e-tourism platforms to a great extent when selecting a destination, and in the e-tourism ecosystem the following are predominant: Facebook, TripAdvisor, Google and Booking (David-Negre et al., 2018; Watkins et al., 2018). Differences do exist, however, in the mutual relationship of information sources and their perception among shoppers according to EU countries, based on the economic development and national culture of individual nations (Korneliussen & Greenacre, 2018).

Research on how tourists perceive the use of the latest new media in the sector and the use of artificial intelligence is still in its infancy (Nannelli et al., 2023). The results of a study on the perception of augmented reality in various areas of use in tourism (Schein & Rauschnabel, 2023) show that it is usefully valued by tourists, and the most popular AR applications include virtual guides and applications with historical content. Demographic characteristics are not an important factor with their use. The first research question (RQ1) thus follows from this: What media are most used in individual phases – before travel, during travel and after travel? With regard to the published study (David-Negre et al., 2018), we can assume that social networks, websites and IT applications will be the most used even in the Slovak Republic.

Destinations and tourism industry businesses have embarked on the trajectory of digital technologies. Their rapid development, however, is creating inequality between tourists and businesses in the tourism industry. Empirical experience points to hazards and barriers to their effective use arise. The rate of their adoption determines the use of technological innovations on both the supply and demand

side. In the case of tourists, this is in particular the limited ability of user control (Stankov & Gretzel, 2000), and age categorization is not crucial (Carlisle et al., 2021). On the supply side, differences are found between the digital skills of tourism workers and the competencies needed (Parsons et al., 2023).

Varying opinions on the connection between the use of IT and the age of tourists follow from published findings. A Eurostat report (2017) indicates that there is a decreasing tendency of their use among older tourists (the use of online booking of accommodation and transport was investigated). However, the results of an unpublished study (Schein et al., 2023) which examined the use of the latest technologies in tourism (virtual and augmented reality) and attitudes towards them based on the age of their users show that there are no significant differences in their use in terms of age. Similarly, the results of the study by Pesonen et al. (2015) report that there is no special marketing or website design that older travelers prefer or require, and there is even a new breed of senior tourists who are avid technology users and independent travelers. The study further determined that older travelers even prefer using the Internet to search for information and to book vacations, that they are also creators of e-WOM and are generally open to using technology. Therefore, we ask the second research question (RQ2): What demographic attributes does the use of individual media depend upon? And our assumption, based on the results, is that (Carlisle et al., 2021) Slovak users in all age categories use the selected media in the same way during the various travel phases. That is, the use of individual media is not affected by the age of the traveler.

From the viewpoint of the dependence of IT use and gender (Goswami & Dutta, 2016), it has been shown that gender plays an important role in several contexts: men are more technologically competent and more easily adopt new technology, though there are cases in which it is not possible to differentiate gender differences: the use of e-banking, online shopping, and social networks. Women dominate in creating existing relationships (most often through social networks) and in the use of customer reviews. Gender differences in digital skills and the use of digital devices are gradually narrowing, particularly among young people (European Institute for Gender Equality, 2021). Given the orientation of women and men with regard to information technology, this creates another assumption: Men use technically progressive media (virtual reality, digital games, augmented reality) significantly more often than women.

The aim of the study is to identify the rate of transformation of tourism to the digital era in the circumstances of Slovakia. The demographic associations and differences linked with the use of digital media of tourism between various types of tourists at individual phases of a trip are investigated: before travel, during travel and after travel.

2. Methodology

The aim of the study was to identify the demographic context associated with the use of digital tourism media among Slovak users. The rate of transformation of tourism to the digital era in the circumstances of Slovakia was analyzed with a focus on the differences in the use of technology between different types of tourists based on demographic attributes such as gender and age at different phases of a journey: before travel – occurs before the trip and includes inspirations, product and service booking and travel planning, during travel (use) – this is the time of consumption of a tourism product/services, which can be planned in advance – only partially or completely, after traveling (sharing) – this occurs along the way, most commonly referred to as “e-word of mouth” (eWOM).

The identification of preferred information technologies by tourists is closely associated with the marketing communication of products, services and destinations in tourism and the management of information content. Together they create an increasingly complex system, and a compatible connection is crucial for creating the design of future tourism management strategies.

2.1 Data collection

The questionnaire survey was conducted in the spring of 2023 (March – May 2023) in order to achieve the proposed aims. A structured questionnaire was compiled and distributed, and 1208 respondents filled it in. The target population of this study was tourists aged 15 and older. Based on the fact that travel is at present considered a so-called social given, all those who were already participants in the tourism industry were included in the research. The research aim was explained to the respondents by the interviewers, and the questionnaire was subsequently filled out individually. The interviewers were selected from among the students of the UCM Institute of Management in Trnava and subsequently trained. They were made familiar with the issues of new media and their importance in the tourism sector and received instructions on how to correctly address the respondents. A total of 113 interviewers participated, and each interviewer collected an average of 10.7 answers. The interviewers questioned respondents mainly from western and northern Slovakia (Trnava, Bratislava, Nitra, Trenčín and Žilina regions) with regard to all age categories (proportionately). The administration took place using a combined method: through a web application for collecting answers from Google, and personal administration was conducted mainly in the case of seniors. So-called closed questions and verbal rating scales were used. Questions were asked with the aim of determining the experience and use of digital media at different phases of travel: before travel, during travel and after travel. A question on the use of traditional tools and distribution channels was used to verify the responses.

The definition of the term “new media” can appear problematic; in general a) they are categorized as quaternary technologies, although this is a set of diverse media technologies that share the same technological platform as lower stages of development, and b) this is a very numerous and dynamically developing group (Macek, 2011; Coleman, 2018). New media includes a number of technologies: infrastructure, hardware, software, network protocols and web services. When classifying new media in the context of tourism, as reflected in the construction of the questionnaire (Table 2), we were started mainly from works by the authors: Clement (2020); Nuenen and Scarles (2021), David-Negre et al. (2018); Watkins et al. (2018); Nannelli et al. (2023); Ivanov and Soliman (2023), Huang et al. (2023) and Schein et al. (2023).

Table 2. Characteristics of new media in the tourism sector

New Media	Characteristic	Trip phase	Dynamism
E-mail	System for sending messages electronically, especially from one computer to another using the Internet or a message sent electronically.	Pre-trip In-trip	Static/ Dynamic
Website	A set of pages of information on the Internet about a particular subject, that has been published by the same person, company, or organization, and often contains pictures, video, and sound.	Pre-trip In-trip	Static/ Dynamic
SMS message	Short message service: a system for sending written messages from one mobile phone to another.	In-trip	Dynamic

Chat and video platforms (WhatsApp, Viber)	To have a conversation with a person/people on the Internet, when you a) write down what you want to say and can see immediately what the other person or other people are writing or b) online call.	In-trip	Static/ Dynamic
IT travel application (e.g. Maps, Timetable, Eather, other)	The content of the applications is helpful tourist information.	Pre-trip In-trip	Static/ Dynamic
Social media (Facebook, Instagram, TikTok)	Forms of media that allow people to communicate and share information using the Internet or mobile phones.	Pre-trip In-trip Post-trip	Dynamic
Online discussion forum	An online space for people to share and talk about knowledge, opinions, impressions, etc.	Pre-trip Post-trip	Dynamic
Webinar	An occasion when a group of people go online at the same time to study or discuss something.	-	Static/ Dynamic
Augmented reality	Images produced by a computer and used together with a view of the real world.	Pre-trip In-trip	Static/ Dynamic
Virtual reality	A set of images and sounds produced by a computer, which create a place or a situation that a person can take part in.	Pre-trip In-trip	Static/ Dynamic
QR code	A pattern of black-and-white squares that is printed on something and that can be read by some types of mobile phone to give information to the user of the phone.	Pre-trip In-trip	Static
Blog	A record of news, people's opinions, photos, and videos about a particular subject that someone puts on the Internet and adds information, pictures, etc. to regularly.	Pre-trip Post-trip	Static
Influencer	In the context of marketing, following a person or group that has the ability to influence the behavior or opinions of others.	Pre-trip	Static
Podcast	An audio recorded program that can be downloaded from the Internet and listened to on an MP3 player.	Pre-trip	Static
Digital game	A digital game is any game that is played with the assistance of a computer or other electronic device.	In-trip	Static
YouTube	The name of a website that allows people to show videos they have made.	Pre-trip	Static
Streaming platforms	The act of sending sound or video to a computer, mobile phone, etc. directly from the Internet so that it does not need to be downloaded and saved first.	Pre-trip	Static

Source: developed by the authors.

The characteristics of the terms come from the Cambridge Dictionary. The table also included a) types of tourism information channels according to trip phase (the pre-trip phase, in-trip phase and post-trip phase) and b) media according to their dynamism (static and dynamic), which were processed in the study of Benckendorff et al. (2014). Travelers need information at different times and different places and prefer it in different forms. To a large extent, these information needs can be derived from the type of tourist: for example, adventurous or impulsive travelers will need little or no information before the trip, while risk-averse travelers plan for the long term and will need a lot of information before the trip.

2.2 Formulation of the research questions and hypotheses

Based on the survey of published knowledge, it was possible to formulate two research questions and research assumptions formulated on them as research hypotheses.

The first research question (RQ1) was: What media are most used in individual phases – before travel, during travel and after travel?

Research hypothesis RH1: Social networks, websites and IT applications will be the most used media in all phases of travel, even among Slovak users.

The second research question (RQ2): What demographic attributes does the use of individual media depend upon?

Research hypothesis RH2: Slovak users in all age categories use the selected media equally during the different phases of travel.

Research hypothesis RH3: Men use technically progressive media (virtual reality, digital games, augmented reality) significantly more often than women.

2.2 The research set and analysis of obtained data

The research set is made up of 1207 correctly completed questionnaires from Slovak media users within the monitored phases of travel. The more detailed structure of the respondents forming the research set is presented in Table 3.

Table 3. Structure of the research set

Structure of respondent		Gender		
		Row N %		Column N %
		female	male	Total
Age	< 25	55.6%	44.4%	29.5%
	26–40	53.2%	46.8%	21.0%
	41–55	63.1%	36.9%	23.5%
	55 >	60.5%	39.5%	25.9%
	Pensioner	62.4%	37.6%	21.8%
Social status	Unemployed	70.0%	30.0%	2.5%
	Entrepreneur	36.9%	63.1%	9.2%
	Employed part-time/on agreement	62.7%	37.3%	11.8%
	Employed full-time	59.2%	40.8%	40.2%
	Student without own income	56.3%	43.8%	14.6%
Form of housing	Single	48.2%	51.8%	18.4%
	Common household with children/parent	62.9%	37.1%	41.3%
	Common household with life partner	57.7%	42.3%	40.3%
	Total	58.1%	48.9%	100.0%

Source: developed by the authors.

Groups of media in the individual phases of travel were subjected to McDonald's Omega test. The result for the selection and planning phase is 0.917 (n=19), for the during-travel phase is 0.861 (n=14) and for the post-travel phase 0.865 (n=14). These Omega values indicate an acceptable level of reliability. The data were analyzed using basic descriptive statistics (absolute and relative frequency, standard deviation, arithmetic mean) and inferential statistics (Student's t-test for comparison of two independent groups, the anova test) at the 1% and 5% significance levels. The substantive significance of the detected differences was expressed on the basis of Cohen's d and eta squared.

3. Research results

Digital technologies and content play a major role in all phases of travel, significantly influencing the way that people are inspired, how they travel, and how they share and preserve their travel

experiences. The demands for the implementation of information technologies change dynamically over time: some technologies may already be seen as outdated, while the use of others, in contrast, appear to be too ambitious. Designing effective communication strategies is one of the promotional tasks of managers at tourist destinations. Research on the perceptions of the usefulness of IT that is linked to the period of recovery of tourism after the pandemic period in Central Europe, is lacking. What's more, the pandemic had a significant impact on the dynamism of IT use in all spheres. This research paper looks at the question of the use of media by Slovaks in the individual phases of travel as well as their use depending on gender and age. For the purpose of clarity, the results will be divided based on the individual phases of travel.

3.1 Phase of selecting and planning a trip

The results of the use of media in the first phase of travel (that is, before travel) are presented in Figure 1. A total of 19 media were monitored, and the respondents had the chance to answer on a scale from 1 to 3 (1 – I do not know, 2 – I know but do not use, and 3 – I do use). Websites are the most used (average 2.6), followed by social networks – Facebook (2.41) together with IT applications (2.39). These are followed by Instagram (2.26), email (2.25), Chat and video platforms (2.22), SMS messages (2.14), and YouTube channels (2.14). Although on average respondents often know other media, they practically do not use them in the context of tourism: influencers (1.97), streaming platforms, Tik-Tok (1.91), podcasts (1.88) and QR codes (1.83). Other media are relatively unknown to the average user (traveler).

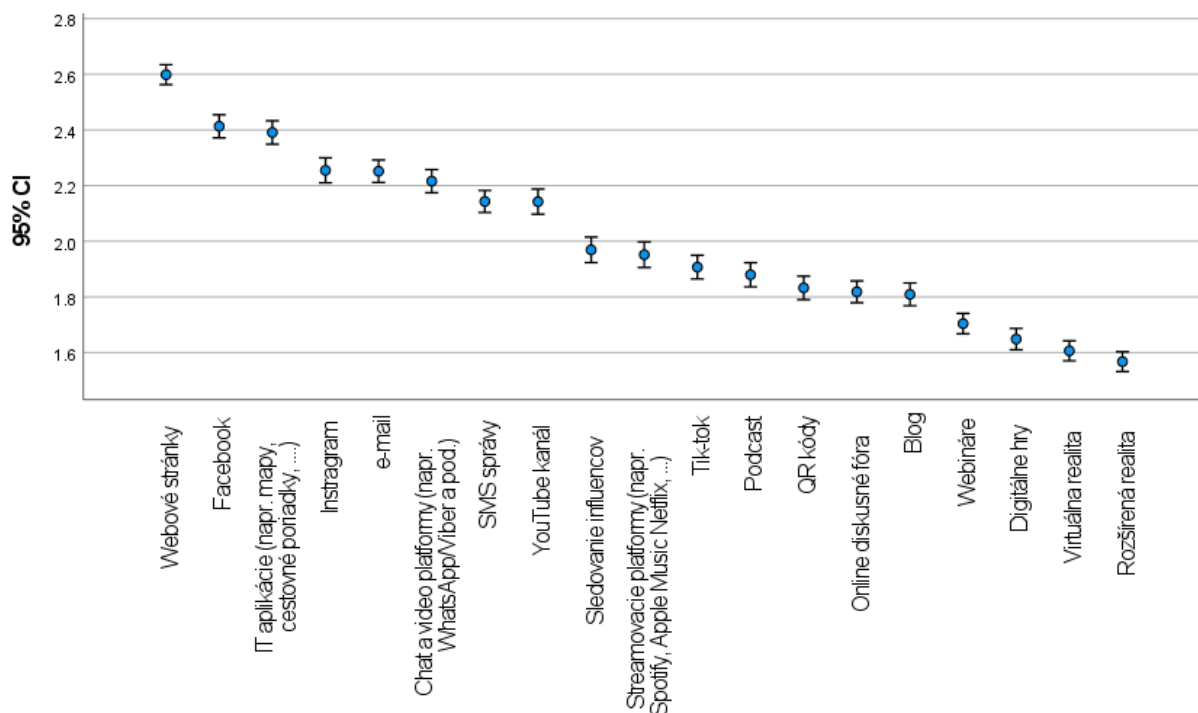


Figure 1. Experience with digital media in Phase I. of travel

Source: developed by the authors.

The following Table 4 shows the difference in the use of media in terms of gender. The results of the T-test indicate significant differences in the use of email, websites, SMS messages, Facebook, and digital games in the first phase. Given the small effect of the identified differences in the use of media by

gender, it is appropriate to investigate in more detail whether this difference is not only in certain age categories, since according to the European Institute for Gender Equality (2021), the gender difference in working with new technologies among young generations is narrowing. For the youngest category – those under 25 years of age – gender differences were found using the T-test, though not all were shown in the summary overview, namely in the use of websites ($p=0.008$, $d=0.286$), chat ($p=0.035$, $d=0.226$), Instagram ($p<0.001$, $d=0.411$), Tik-Tok ($p<0.001$, $d=0.467$), influencers ($p<0.001$, $d=0.492$), augmented reality ($p=0.043$, $d=-0.218$) and digital games ($p=0.012$, $d=-0.270$), while in the case of Instagram, Tik-Tok and influencers, the substantive significance approaches a moderate effect. In the other age categories, differences with a small to minimal effect are identified, which shows that the assumption of minimizing the erasure of gender differences of the young generation in the use of new technologies was not confirmed in the first phase.

Table 4. T-test results for media use depending on gender

Media	Gender			T- test	Cohen's d
	female	male	Total	p-value of T-test	
E-mail	2.31	2.17	2.25	0.001	0.203
Website	2.64	2.54	2.60	0.004	0.167
SMS message	2.21	2.05	2.14	0.000	0.228
Chat and video platforms (WhatsApp, Viber)	2.25	2.17	2.22	0.053	0.113
IT application (e. g. Maps, Timetable, Eather, other)	2.43	2.34	2.39	0.062	0.109
Facebook	2.46	2.34	2.41	0.005	0.164
Instagram	2.27	2.23	2.26	0.336	0.056
Tik-tok	1.93	1.88	1.91	0.215	0.072
Online discuss forum	1.83	1.80	1.82	0.490	0.040
Webinar	1.70	1.70	1.70	0.976	0.002
Augmented reality	1.54	1.60	1.57	0.120	-0.091
Virtual reality	1.59	1.63	1.61	0.262	-0.065
QR code	1.81	1.86	1.83	0.323	-0.058
Blog	1.81	1.80	1.81	0.773	0.017
Iinfluencer	2.00	1.92	1.97	0.079	0.103
Podcast	1.88	1.88	1.88	0.952	-0.003
Digital game	1.61	1.70	1.65	0.041	-0.119
YouTube	2.13	2.16	2.14	0.615	-0.029
Streaming platforms	1.93	1.99	1.95	0.190	-0.077

Source: developed by the authors.

The results of differences in the use of selected media in the first phase of travel are presented in Table 5. Aside from the arithmetic averages on a scale from 1–3 (1 – I do not know, 2 – I know but do not use and 3 – I do use), the results of testing the agreement of the mean values via an anova test on the level of 5% significance are also presented here. The results show a statistically significant difference in the use of media according to the age of the user, and except for the first six items, the use of media decreases linearly with age (test of linearity). With websites, SMS, chat and video platforms, IT apps and Facebook, the highest use of these media is among the category of 41 – 55-year-olds. However, only with email was the linear dependence on age not statistically confirmed. From the viewpoint of substantive significance, the biggest differences in the use of media were identified (based on eta squared – Tab. 5) in the case of Instagram, following influencers, Tik-Tok, streaming platforms, podcasts, blogs, QR codes, YouTube channels and virtual reality.

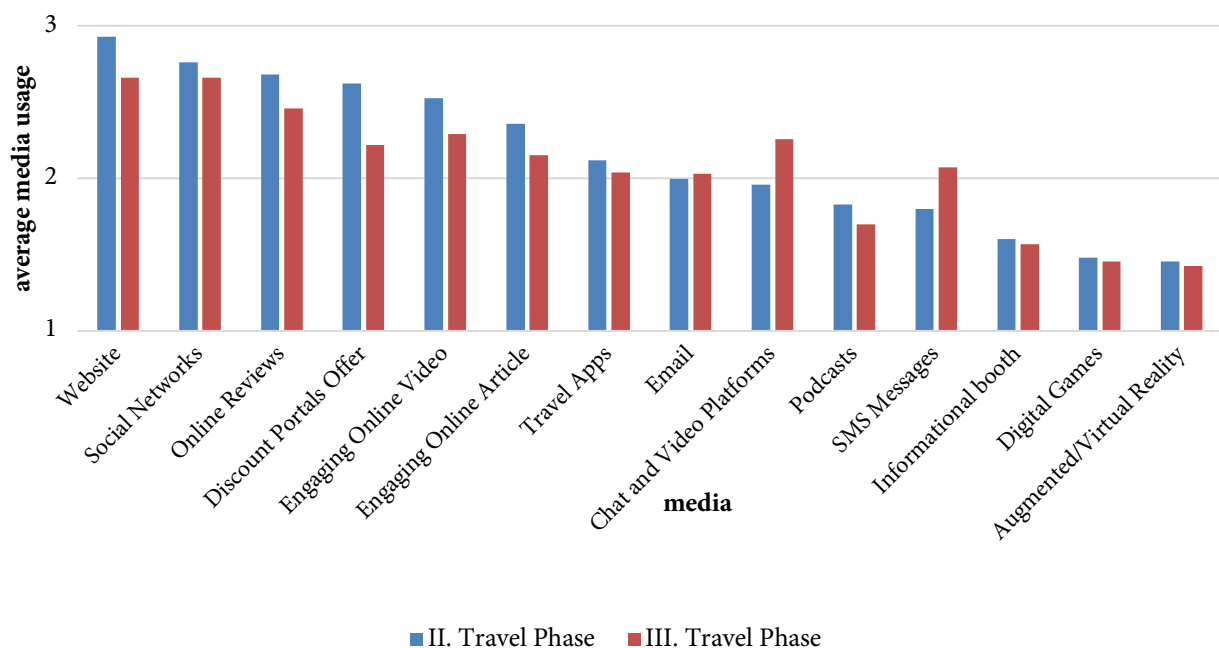
Table 5. Differences in media use by age in the first phase of travel

Media	Age				Anova test	Test of linearity (anova)	Eta squared
	< 25	26-40	41-55	55 >	p-value	p-value	
E-mail	2.16	2.27	2.55	2.08	<0.001	0.790	0.060
Website	2.69	2.64	2.75	2.32	<0.001	<0.001	0.069
SMS message	2.00	2.10	2.22	2.28	<0.001	<0.001	0.026
Chat and video platforms (WhatsApp, Viber)	2.30	2.30	2.44	1.86	<0.001	<0.001	0.091
IT travel application (e. g. Maps, Timetable, Eather, other)	2.51	2.48	2.59	2.01	<0.001	<0.001	0.093
Facebook	2.51	2.56	2.54	2.06	<0.001	<0.001	0.081
Instagram	2.75	2.54	2.19	1.53	<0.001	<0.001	0.357
Tik-tok	2.32	2.13	1.79	1.36	<0.001	<0.001	0.253
Online discussion forum	1.90	2.00	1.92	1.50	<0.001	<0.001	0.079
Webinar	1.82	1.85	1.79	1.38	<0.001	<0.001	0.089
Augmented reality	1.77	1.68	1.59	1.24	<0.001	<0.001	0.105
Virtual reality	1.82	1.71	1.64	1.26	<0.001	<0.001	0.120
QR code	2.06	1.96	1.95	1.36	<0.001	<0.001	0.141
Blog	2.04	2.02	1.83	1.36	<0.001	<0.001	0.149
Influencer	2.45	2.24	1.85	1.32	<0.001	<0.001	0.300
Podcast	2.26	2.07	1.83	1.35	<0.001	<0.001	0.211
Digital game	1.89	1.76	1.61	1.32	<0.001	<0.001	0.105
YouTube	2.44	2.28	2.19	1.66	<0.001	<0.001	0.143
Streaming platforms	2.32	2.17	1.98	1.34	<0.001	<0.001	0.221

Source: developed by the authors.

3.2 The phase during travel and after travel

The same media were monitored in the second and third phases of travel; therefore, it is possible to present the use of media in these phases on a common graph (Figure 2). The data are presented in the graph in the form of arithmetic averages of the respondent's answers on a scale of 1–4, where 1 is not at all and 4 is the most.

**Figure 2.** Use of new media in the second and third phases of travel

Source: developed by the authors.

Subsequently, we were interested in the difference in the use of these media based on gender. In terms of gender, the difference for the second phase of travel is presented in Table 6. From the results of the T-test, it is clear that there are differences in usage in terms of gender in both phases: women use significantly more websites, discount portal offers, social networks, and reviews on the Internet (with great substantive significance, which acquires approx. 0.1 higher Cohen's d values in the 3rd phase of travel). In contrast, men use digital games significantly more in both phases of travel (with medium substantive significance).

Table 6. Differences in the use of media in the second and third phases of travel by gender

Phase travel/ Media		Gender		t-test		
		female	male	Total	p-value	Cohen's d
II. Phase travel	Website	3.04	2.77	2.93	0.000	1.051
	E-mail	2.03	1.96	2.00	0.214	0.925
	SMS message	1.80	1.80	1.80	0.879	0.914
	Chat and video platf. (WhatsApp, Viber)	1.98	1.92	1.96	0.283	0.979
	Discount Portal	2.70	2.51	2.62	0.001	1.022
	Social media	2.87	2.60	2.76	0.000	1.071
	YouTube	2.57	2.47	2.53	0.108	1.096
	Blog	2.41	2.29	2.36	0.070	1.047
	Discussion forum – consumer reviews	2.74	2.59	2.68	0.018	1.061
	IT travel application	2.12	2.11	2.12	0.907	1.054
	Podcast	1.81	1.86	1.83	0.301	0.954
	Digital game	1.41	1.57	1.48	0.001	0.804
	Augmented/virtual reality	1.43	1.50	1.46	0.107	0.775
	III. Phase travel	Website	2.74	2.55	2.66	0.000
E-mail		2.05	2.00	2.03	0.214	0.051
SMS message		2.11	2.02	2.07	0.879	0.090
Chat and video platf. (WhatsApp, Viber)		2.31	2.18	2.26	0.283	0.115
Discount Portal		2.28	2.14	2.22	0.001	0.131
Social media		2.75	2.53	2.66	0.000	0.194
YouTube		2.27	2.32	2.29	0.108	-0.045
Blog		2.18	2.11	2.15	0.070	0.059
Discussion forum - consumer reviews		2.50	2.40	2.46	0.018	0.102
IT travel application		2.07	2.00	2.04	0.907	0.070
Podcast		1.68	1.72	1.70	0.301	-0.043
Digital game		1.40	1.53	1.45	0.001	-0.169
Augmented/virtual reality		1.39	1.48	1.43	0.107	-0.120

Source: developed by the authors.

The last part of the results is an analysis of differences in the second and third phases of travel based on age. Table 7 presents the results of the anova test at the significance level of 1% with substantive significance presented by the eta squared values. From the results it is evident that in the case of all media, information booths and SMS messages excepted, the rate of use of these media is linearly dependent on age. From the fourth item, their use increases linearly with decreasing age. In the case of information booths, no difference is identified in use in both phases depending on age, and in the case of SMS messages, no linear dependence on age is seen. From the viewpoint of substantive significance, the use of social networks (eta squared in the fourth phase 0.165 and third phase 0.189), attractive videos, reviews on the Internet and podcasts (in the third phase also in the use of websites) differs the most.

Table 7. Differences in the second and third phases of travel by age

Phase / Media	Age				Anova test	Test of linearity (anova)	Eta squared	
	< 25	26-40	41-55	55 >	p-value	p-value		
I. Phase of travelling	Website	3.00	3.05	3.22	2.50	0.000	0.000	0.064
	E-mail	1.84	2.04	2.23	1.93	0.000	0.044	0.025
	SMS message	1.62	1.85	1.85	1.91	0.000	0.000	0.017
	Chat and video platforms	1.95	2.15	2.13	1.65	0.000	0.000	0.041
	Discount Portal	2.68	2.81	2.66	2.35	0.000	0.000	0.026
	Social media	3.13	3.06	2.82	2.05	0.000	0.000	0.165
	YouTube	2.87	2.75	2.59	1.90	0.000	0.000	0.123
	Blog	2.60	2.56	2.49	1.80	0.000	0.000	0.102
	Discussion forum – consumer reviews	2.89	2.90	2.91	2.07	0.000	0.000	0.117
	IT travel application	2.29	2.35	2.22	1.64	0.000	0.000	0.073
	Podcast	2.07	2.13	1.83	1.32	0.000	0.000	0.113
	Digital game	1.62	1.61	1.49	1.21	0.000	0.000	0.045
	Augmented/virtual reality	1.59	1.55	1.50	1.19	0.000	0.000	0.042
	Website	2.76	2.85	2.97	2.12	0.000	0.000	0.089
III. Phase of travelling	E-mail	1.90	2.15	2.26	1.87	0.000	0.759	0.028
	SMS message	1.85	2.12	2.18	2.17	0.000	0.000	0.020
	Chat and video platforms	2.32	2.44	2.46	1.85	0.000	0.000	0.051
	Discount Portal	2.31	2.42	2.30	1.88	0.000	0.000	0.039
	Social media	3.12	2.94	2.66	1.89	0.000	0.000	0.189
	YouTube	2.68	2.49	2.26	1.73	0.000	0.000	0.115
	Blog	2.36	2.41	2.19	1.67	0.000	0.000	0.080
	Discussion forum – consumer reviews	2.62	2.73	2.57	1.96	0.000	0.000	0.079
	IT travel application	2.17	2.25	2.14	1.63	0.000	0.000	0.057
	Podcast	1.93	1.91	1.67	1.29	0.000	0.000	0.084
	Digital game	1.56	1.60	1.43	1.25	0.000	0.000	0.032
	Augmented/virtual reality	1.51	1.54	1.43	1.23	0.000	0.000	0.026

Source: developed by the authors.

Discussion

Setting up an effective digital communication strategy assumes knowledge of consumer behavior. Travelers today base their decision-making process on relevant and trustworthy tourism information. In this regard new media is the driving force of this sector. The research was oriented on a study of attitudes and habits in the use of new media in the context of tourism. The research was conducted on Slovak travellers. Specifically, it examined habits in the use of new media based on individual phases of travel and demographic characteristics.

The subject of the study in the first research question was to determine what new media are most often used in tourism in the individual phases of travel in the circumstances of Slovakia. It can be stated that the intensity of the use of new media varies according to individual phases of travel. In the first phase, when travelers are seeking inspiration and making decisions about what destination to visit, websites, social networks (Facebook, Instagram) and travel IT applications are used most intensively, though e-mail communication, chat and video platforms (including SMS) as well as watching YouTube channels are also significant. The nature of these media is mainly oriented on the presentation of text, images or video content. For Slovak travelers, however, e-mail communication remains important, even though it is now a traditional digital tool. It can be assumed, however, that it is the most often used in the process of booking services. In the second phase of travel (i.e. at the time of using services), websites and social networks are still the most intensively used, but unlike in the first phase, we recorded an increasing intensity of use of online reviews, discussion portals or inspirational

articles. This fact indicates that at the travel destination (that is, while enjoying the vacation), travelers will very intensively look for information, on the basis of which they make decisions about what other attractions to visit or products to buy. The mentioned media are a form of digital word-of-mouth (Babić Rosario et al. 2019). Although today's tourists travel with information prepared in advance and have a pre-travel itinerary already planned, these results point to the fact that the use of services, such as attractions, excursions, trips, dining, etc., belong to unplanned decisions and they seek information about them at the site itself. At this moment, tourism management organizations can play an important role, as they can use digital tools and thus take part in the decisions of travelers during the second phase of travel (enjoying a vacation). Consumer behavior among Slovak travelers opens up space for destination management organizations to connect digital media and monitor the steps tourists take during their stay. In the third phase of travel, the use of media such as chat, video platforms and SMS increases in intensity. These results are testimony to the fact that while the search for information predominates in the second phase of travel, in the third phase, tourists move on to the active creation of content through the sharing of text messages and videos. The results of the typology of digital media use do not vary much from the standard European tourist, though a slight deviation can be found in the use of social media. These are considered a dynamic information channel and their consumption is generally more significant in the third phase of travel (Oliveira et al. 2020). Their use among Slovak travelers is slightly more intensively even in the second phase of travel.

Compared to the results of studies at the pan-European level (David-Negre et al. 2018; Watkins et al., 2018), certain specificities can be identified in the Slovak market: websites, as a more traditional digital medium, play a direct role in all purchase phases of travel. Social networks as well as online reviews and discount portals play a significant role, in line with the European average. Newer forms of digital communication, such as podcasts, digital games, virtual or augmented reality, are well known among Slovak travelers, but the intensity of their use is the lowest among the monitored media. Whether and to what extent organizations operating in tourism use these tools, or whether Slovak tourists encounter them at all, is a debatable question.

The results of our research were also aimed at the second research question: examining the demographic attributes of contemporary Slovak travelers in relation to their use of new media in the tourism industry. Here we looked for connections related to the use of the latest media in the context of a) the age of the travelers and b) the gender of the travelers.

From the point of view of researching new media and age, we especially observed consumer behavior in the first phase of travel and together in the second and third phases of travel. We found that when travelers form preferences, when they seek inspiration they summarize and evaluate information (that is, in the first phase of travel) new media can be categorized as those that are 1) intensively used across age groups (these include: e-mail communication, websites, SMS, Chat and video platforms, IT travel apps, social networks such as Facebook and Instagram, online discussion forums and webinars) and those that are 2) of a newer character, and that their use decreases with the increasing age of travelers (others, see Tab. 7). An interesting finding is the fact that the age group of travelers from 41 – 55 is the group with the most intensive use of media as such in the first phase of travel. This fact may be connected to the fact that this is the group of most active travelers with the highest economic power. These findings correlate with published studies that show that age categorization is not crucial when using new media (Carlisle et al. 2021), but the ability and measure of user control is decisive (Stankov & Gretzel 2000).

Our findings point to differences in the use of new media in tourism by gender. Differences between the sexes can be seen in the use of these media: e-mail, websites, SMS, Facebook and digital games in the first phase of travel, when these are more intensively used by women, with the exception of digital games, whose use is more intensive among men. However, it needs to be noted that the differences found represent only a low rate, so they are less significant, and that no significant differences were noted in the case of the other researched media. In the second and third phases of travel, women use media significantly more during and after their trip than men. The nature of the media used by women in the second and third phases indicates that their use is connected more with search or by sharing information (websites, discount portals, reviews and social networks) related to travel. Men in the second and third travel phases use media related to entertainment (digital games) more intensively.

A previously published study by Goswami and Dutta (2016) states that men are in general more technologically savvy but recognizes that there are areas where there are no differences: e-banking, online shopping, and the use of media where interaction takes place – especially social networks and consumer reviews. Newer research (European Institute for Gender Equality, 2021) shows a blurring of gender differences, predominately among the younger generation. It turns out that in the conditions of Slovakia, men slightly dominate among the youngest travelers, but taking the whole population into consideration, similar consumer behavior can be found in the tourism segment in Slovakia.

Based on the above-presented results, the research hypotheses can be checked. Research hypothesis (RH1) was confirmed in all the monitored phases of travel. At the same time, it was shown that the newest new media (virtual and augmented reality) are used to a small extent in Slovakia – in all phases of travel. RH2 was not confirmed at the 1% significance level, because the difference in use was not determined for the information booths. RH3 was also not confirmed, as a significant gender difference was only confirmed for digital games at the 5% significance level across all phases of travel.

Conclusions

This research is a source of data that specifies the use of new media in tourism by Slovak travelers. Their number and development dynamics are constantly changing, and it is sometimes difficult for tourism sector enterprises to identify which new media to use in relation to the offered service or product and how to target the content. The analysis of the use of new media is founded on three phases of travel (Neuhofer et al. 2014): before purchase, during purchase and after purchase of tourism products and services. Demographic characteristics related to the use of these media are also discussed in more detail.

In the context of future developments in the tourism sector, a certain difference in the interval of use of new forms of communication can be anticipated between the younger and older generations in favor of the older one. We also assume an increase in the intensity of use of the latest media, such as virtual or augmented reality, digital games, etc., which have the potential to complement the image of destinations. In the first phase of travel, when destinations fight intensively for the visitor, they can rebuild an important tool to strengthen competitiveness.

The presented results of the study on digital marketing communication and the use of new media in tourism will serve to fill the knowledge gap and also as a basis for the orientation of the public sector, business practice and the professional public in strengthening professional competences in this area.

The limitation of the study to selected regions in the Slovak Republic which we can consider to be economically stronger and which results in higher purchasing power, as well as tourism products and services, can be considered a limitation of the research (Statistical Yearbook of the Regions of Slovakia 2022). Another limitation can be the fact that in the case of respondents in the age group over 41 years old there is a slight preponderance of women over men (around 60%). In terms of gender differences, this difference may have slightly distorted the results within these two age categories.

As a subject of further research in the context of digital marketing communication and new media in tourism it would be useful to compare the acquired knowledge with the results of research on the rate of use of new technologies by business entities in the tourism industry from the segment of small and medium-sized enterprises, since these predominate in the tourism sector. Special attention in research could also be devoted to the public sector – destination management organizations, especially in relation to the knowledge and use of the latest technologies: augmented and virtual reality or digital games and their implementation in individual phases of travel. This finding can help to identify a) organizations for which their use will be most useful as well as b) the needs and interests of travelers with the goal of transforming marketing communication into digital forms.

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Tax Revenue Decentralisation and Corruption in the Context of Civil Liberties: A Cross-Country Study

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Abstract

In studies on the functioning of the public sector there are surveys examining the determinants of corruption, including the level of fiscal decentralisation in the light of economic and social development. However, there is a dearth of survey data presenting the impact of the revenue side of this decentralisation in the context of civil liberties. Thus, the aim of the paper is to examine the influence of tax revenue decentralisation and civil liberties on corruption based on the OECD countries, taking into account the impacts of a country's size, scope of the public sector and public procurements, macroeconomic uncertainty, and interactions between tax revenue decentralisation and civil liberties on the phenomenon under study. The empirical study concerns 38 OECD countries in the period 2012–2022. Therefore, longitudinal data models were estimated, namely the fixed effects model and panel quantile regression with fixed effects using the method of moments. The survey showed that an increase in tax revenue decentralisation causes a decrease in corruption. In addition, civil liberties and their interaction with aforementioned decentralisation may determine corruption; however, this is heterogeneous throughout the distribution of corruption level. In addition, the scope of the public sector and macroeconomic uncertainty stimulate rent-seeking behaviour, which weakens the institutional foundations to counteract corruption. Thus, policymakers should be aware that the growing scope of the public sector, government fragmentation, and the functioning of bottlenecks in the performance of official duties at sub-national level might lead to a decrease in the efficiency of anti-corruption policy or programmes. Based on the findings, it is crucial to ensure price stability to reduce the analysed dysfunction.

Key words

corruption, decentralisation, tax revenue decentralisation, civil liberties, government size, public procurements.

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Introduction

The processes of fiscal decentralisation and corruption determine the quality of government (Kyrriacou & Roca-Sagalés, 2011). This quality can be perceived through the perspective of efficiency in the sphere of economy, finance, the proper functioning of democracy, human rights, or the rule of law (Rothstein & Teorell, 2008). Simultaneously, corruption interacts and coevolves along with governance (Kwilinski, 2023), economic, social, political (Kwilinski et al., 2022), and culture development (Gouvea et al., 2019; Valdovinos-Hernandez et al., 2019). Moreover, corruption is driven by market failures (Contreras, 2014), democratisation, or media freedom (Bhattacharyya & Hodler, 2015). These factors are grouped into certain broad categories, i.e. (1) economic and demographic; (2) political; (3) judicial and bureaucratic; and (4) geographical and cultural (Aidt, 2011). It is worth adding that civil liberties are elements of democracy and its indexes; thus, their effects on corruption might be conditional on economic and social factors (Oueghlissi & Derbali, 2023). In the group of corruption factors,

the impact of fiscal decentralisation is also examined, taking into consideration its revenue and expenditure side. These dimensions might affect corruption (Bojanic, 2023) and other issues of the local economy differently.

In the context of the complexity of corruption, Treisman (2000) indicates that this phenomenon is difficult to investigate empirically due to a number of probable determinants being interconnected in complex ways. This, in turn, requires in-depth analysis (Prabowo, 2019). Similarly, the fiscal autonomy of public institutions is affected by various quantitative and qualitative factors. Although there are numerous studies concerning fiscal decentralisation, it is crucial, according to Martinez-Vazquez et al. (2017), to apply more sophisticated econometric methods and pay more attention to replication analysis. This results from the fact that certain diverging findings are likely to be the result of inadequate estimation methods. Moreover, there are fewer studies dealing with corruption in relation to revenues rather than expenditure (Guillamón et al., 2021). Therefore, in this article, in-depth analysis in the sphere of the nexus between tax revenue decentralisation and corruption in the context of civil liberties was implemented. Longitudinal data models with the interaction term and the quantile panel regression were applied, which allows the estimation of relations that are heterogeneous throughout the distribution of the dependent variable.

As a consequence, the aim of the paper is to examine the influence of tax revenue decentralisation and civil liberties on corruption based on the OECD countries, taking into account the impacts of a country's size, scope of the public sector and public procurements, macroeconomic uncertainty, and interactions between tax revenue decentralisation and civil liberties on the phenomenon under study. To attain the purpose of the research study, the following hypotheses were formulated:

Hypothesis 1 (H1): An increase in tax revenue decentralisation causes a decrease in the level of corruption.

Hypothesis 2 (H2): Higher civil liberties affect the degree of corruption; however, this is heterogeneous throughout the distribution of corruption level.

Hypothesis 3 (H3): There is a statistically significant interaction between tax revenue decentralisation and civil liberties in terms of the impact on corruption.

Hypothesis 4 (H4): Both the size of government and the scope of public procurements affect corruption, especially in highly corrupt countries.

Identification of the potential relationships between tax revenue decentralization, civil liberties, and corruption may contribute to the formulation of policy assumptions for tax power devolution in the country to increase efficacy of the actions. There is a view in the research literature that in countries with low levels of corruption, implementing further measures to reduce corruption may have no effect, despite the involvement of significant funds (Pluskota, 2020).

The novelty of this study is the examination of the impact of an interaction between tax revenue decentralization and civil liberties on corruption, as well as including the aspects of the size of the government, scope of public procurements and macroeconomic uncertainty, proxied by inflation rate (Gründler, 2017; Bouis, 2019; Ahmed & Islam, 2010), which affects fiscal health of local governments by altering the economic conditions, the fiscal structure and the interactions between these issues (Martell, 2024). The empirical estimation tries to reveal the potential influence of the civil liberties on the impact of deepening fiscal decentralization on corruption and the impact of different dimensions of the public sector and economic condition on the studied phenomenon. The literature

review and the empirical research also show the complexity of the relationships between the studied variables, and their potential ambiguity.

The originality of the article is also the application of the panel quantile regression, which allows for the estimation of relationships across the distribution of the level of corruption in OECD countries. This enables the formulation of more precise anti-corruption policies in individual countries in the light of tax revenues devolution, or fiscal, social and macroeconomic situation.

1. Literature review

In the subject literature scientists indicate that both corruption and decentralization are multi-dimensional issues (Choudhury, 2015; Pal, 2013). Thus, it is difficult to clearly identify their level and determinants. In the case of fiscal decentralization, on the one hand, it can be assumed as an explained variable (Bojanic, 2020). On the other hand, this is considered as a predictor of various issues, e.g. local government indebtedness (Galinski, 2023b) or debt risk (Ouyang & Li, 2021), environmental federalism (Galiński, 2023a), access to education and health, school quality, life satisfaction, natural disaster death rates, citizens' trust in government, party system nationalization or infant mortality rate (Martinez-Vazquez et al., 2017). In the second type of research, scholars also examine the nexus between fiscal decentralization and corruption. Choudhury (2015) emphasizes that examining an influence of decentralization on direct corruption experiences has become crucial, whereas empirical estimations have been unable to credibly verify the causal relation between decentralization and corruption experiences.

Dell'Anno and Teobaldelli (2015) revealed that decentralization is significantly associated with lower corruption, both theoretically and empirically. Decentralization may be conducive to reduce corruption due to enhanced accountability and competition among local governments or higher levels of information and transparency at the sub-national level (Martinez-Vazquez et al., 2017). Similarly, Arikan (2004) displayed that corruption may be lower in countries with higher extent of fiscal decentralization due to bureaucrats in a fiscally decentralized economy are less able to engage in rent-seeking behaviour. Hence, corruption and rent-seeking are state system failures indicating institutional weaknesses, determining negative economic effects (Dincă et al., 2021), causing redistribution of resources and malfeasance (Ali & Hodan, 2003) since the rent-seeking is unproductive, destroys value by wasting valuable resources (Tollison, 2012) and is associated with the inflation processes in the economy (Åslund, 1999). High inflation, in turn, leads to uncertainty (Atkinson, 1998), which is conducive to corruption (OECD, 2015). Therefore, in some surveys rent-seeking is perceived through the level of the corruption (Fofana, 2022), as the rent-seeking activities can take the form of corruption (Starosta de Waldemar, 2010; Svensson, 2000). Thus, corruption affects quality of institutions (Lyulyov et al., 2023). In addition, a low revenue collection in the region in relation to others might partly result from this dysfunction (Yohou, 2023). Government officials are empowered to create bottlenecks in performance of their duties, which might be encountered in greater government fragmentation (Goel & Nelson, 2011). According to the survey of Gurgul and Shah (2014) the lack of service orientation in the public sector, weak democratic institutions, economic isolation, colonial past, internal bureaucratic controls, and centralized decision-making are perceived as the major drivers of corruption. As a results, local politicians have incentives to behave honestly exercising power, lest they would not be elected (Shrestha et al., 2023). Kuhn and Pardos-Prado (2021) add that central-level corruption

directly affects decentralization, and indirectly enhances support for decentralization and self-determination through dissatisfaction towards the national government.

However, Prud'homme (1995) indicates that local tier favours corruption more than the central level, since local politicians and bureaucrats are likely to be more subject to pressing demands from local interest groups, e.g. in the field of taxation. In turn, monitoring and auditing aspects are usually better developed at the national than sub-national level. Hence, decentralization may counteract corruption in countries with high degrees of press freedom, whereas countries without effective monitoring institutions suffer from decentralization (Lessmann & Markwardt, 2010). Therefore, there are findings which show that decentralization can contribute to corruption due to a lack of coordination resulted from greater dispersion of government decision-making powers or higher number of public officials increases potential for bribery (Shrestha et al., 2023). Furthermore, corrupt bureaucrats may support processes of decentralization since it is more conducive to extract gain (rent) during an interaction with the society at the local level (Choudhury, 2015). Campbell and Saha (2013) show that a democratic transformation: (a) initially affects a decrease of corruption, (b) at intermediate stages of democracy increases corruption, (c) at mature levels of democracy, substantially reduces corruption. Thus, in the economy the relationship between democracy and corruption does not have to be monotonic.

As far as potential relationships between corruption and human rights (including the civil liberties and rights (Lewczuk, 2021) are concerned, they are analysed by Ngugi (2010). Corruption decreases the ability of the government to respect, protect, and fulfil its human rights obligations. Therefore, higher levels of corruption are strongly associated with breaches of civil liberties (Transparency International, 2022). Corruption affects a decrease of revenues available to the government and the capacity of the government to fund basic services or to meet adequate standards of living and counteract social exclusion. Thus, corruption exacerbates other human rights violations, and finally is an obstacle to development (Spyromitros & Panagiotidis, 2022). The findings of Lewczuk (2021) show the importance of civil liberties for the economic development and the existence of various channels of interrelationship between these categories. Similarly, Pritchett and Kaufmann (1998) argue that civil liberties are conducive to improving a country's economic performance and designing the mechanisms for delivering public services.

On the other side, decentralization infuses more resources to the local community and thereby made available more venues and broader infrastructure for human capital development. However, decentralization also introduces possibilities of larger disparities amongst municipalities, and may affect social exclusion (Thede, 2009). Nevertheless, an increase of expenditure side of fiscal decentralization improved the governance in regions, which should be accompanied by the promotion of citizen participation through civil society organizations in local development, including their participation in planning, execution and supervision of actions and policies (de Mello & Barenstein, 2001). Thus, fiscal decentralization can become a driver for greater political and civil liberties (Bojanic, 2018a), which, in addition, may foster economic growth (Bojanic, 2018b).

2. Methodology

The starting point of the empirical research was the survey of: (1) Fisman and Gatti (2002), and (2) Karlström (2015). In the first study the authors proposed the basic specification of the regression (Fisman & Gatti, 2002), in which corruption (corruption index) was determined by: (a) decentralization

(total expenditure of subnational, i.e. state and local governments over total spending by all levels, i.e. state, local, and central); (b) GDP per capita (natural logarithm); (c) civil liberties (Gastil index of civil liberties); (d) population (natural logarithm); (e) government size (total government expenditure in relation to GDP). In contrast, Karlström (2015) specified a basic equation for the model, which examined the influence of: (a) democracy (democracy index); (b) decentralization; (c) interaction term by multiplying democracy with decentralization (its various forms, i.e. fiscal and administrative, political) on corruption (perceived through Transparency International's Corruption Perception Index). In Karlström's estimation, fiscal decentralization was measured as revenue share of sub-central governments (local and state) in total (local, state, and central) public revenues.

Taking into consideration the aforementioned studies and the application of panel data this article examines an influence of tax revenue decentralization, civil liberties, interaction between tax revenue decentralization and civil liberties and other factors on corruption, using the data of 38 OECD countries for the period 2012-2022.

In the survey, both panel data models with fixed effects (FE) and random effects (RE), were initially considered. However, the outcomes of the Wald test, the Breusch-Pagan test, and the Hausman test resulted in the final estimation of FE models (Gruszczyński, 2020), which take a form (Brooks 2019):

$$Y_{it} = \alpha + X'_{it}\beta + u_i + v_{it}, \quad (1)$$

where Y_{it} is the dependent variable (corruption) for i country in t period; α represents the intercept term; X'_{it} is a $k \times 1$ vector of independent variables, i.e. tax revenue decentralization, civil liberties, interaction between tax revenue decentralization and civil liberties, government size, GDP per capita, population, population per region, inflation, public procurements observed for i country in t period; β is a $k \times 1$ vector of the parameters to be measured on the independent variables; u_i is an individual specific effect, and v_{it} is the 'remainder disturbance'.

Due to the detected presence of the heteroscedasticity (verified by means of the Modified Wald test for groupwise heteroskedasticity) and the autocorrelation (verified by means of the Bias-corrected Born and Breitung $Q(p)$ -test) the clustered standard errors were applied (Hill et al., 2018; Wursten, 2018). In addition, for FE models 'Within R2' and 'R2' were presented as a goodness of fit measures and outcomes of F test.

To deepen the research on the nexus between corruption, tax revenue decentralization, civil liberties and the aforementioned interaction term, as well as to verify the stability of the results (robustness check), a panel quantile regression with fixed effects using the method of moments, i.e., method of moments-quantile regression (MM-QR) (Machado & Santos Silva 2019), was estimated. The use of the MM-QR approach was to check the statistical significance of the variables, considering the distribution of the dependent variable, i.e. corruption (CPI). In this regression, it is estimated the conditional τ -th quantiles $Q_Y(\tau|X)$ for location-scale model, which takes a form (Machado & Santos Silva, 2019):

$$Y_{it} = \alpha_i + X'_{it}\beta + (\delta_i + Z'_{it}\zeta)U_{it}, \quad (2)$$

with $P\{\delta_i + Z'_{it}\zeta > 0\} = 1$. In the MM-QR model the parameters (α_i, δ_i) , $i = 1, \dots, n$, capture the individual i fixed effects; U is an unobserved random variable; and Z is a $k \times 1$ vector of known

differentiable (with probability 1) transformations of the components of X with element l given by $Z_l = Z_l(X)$, $l = 1, \dots, k$; ζ is a $k \times 1$ vector of other parameters. For MM-QR models there was presented the Wald test to show the overall significance of the regression (Fuinhas et al. 2021).

In the study, the specification of the applied variables is follows:

Dependent variable: ‘Corruption’, measured using the Transparency International’s Corruption Perceptions Index (CPI) from Transparency International (2024), which ranges from 0 to 100, with higher values indicating less corruption. This index might be applied to proxy the rent-seeking behaviour (Wong et al., 2022).

Independent variables:

- ‘Tax Revenues Decentralization’ (TRD), as sub-national tax revenues to total general government tax revenues $\times 100$ (Afonso et al., 2023), natural logarithm, extracted from OECD (2023).
- ‘Civil Liberties’ (CL), measured using Civil Liberties Index (ranges from 0 - low to 10 - high), which indicates the extent to which citizens enjoy civil liberties. Index extracted from ‘Our World in Data’ (2023). Introduction of this kind of variable also enables to control the level of economic development (Fisman & Gatti, 2002).
- ‘Tax Revenues Decentralization $\times$ Civil Liberties Index’ (TRD $\times$ CL), as an interaction term. Kyriacou and Roca-Sagalés (2011) introduced interaction between democratic maturity and fiscal decentralization in the study on government quality, whereas Karlström (2015) verified the significance of an interaction between fiscal decentralization and democracy. Obeng (2021) underlines that the aim of every decentralization is an increase of direct participation of citizens and civil society.
- ‘Government Size’ (GS), as general government expenditures to GDP (%). Ali and Isse (2003) found that an increase of the size of government is associated with an increase in the level of corruption. Fisman and Gatti (2002) indicate that introduction of this ratio could also control for the fact that larger countries might adopt more decentralized fiscal systems to better fulfil the diverse preferences of the society together with the appearance of the economies of scale in the process of counteracting corruption. Variable extracted from OECD (2024) and Turkish Statistical Institute (2023, for TUR for 2021 and 2022).
- ‘Gross Domestic Product (GDP) per capita’ (GDP per capita, US dollars, constant prices, constant PPPs, reference year 2015) extracted from OECD (2024), which is perceived as a ‘standard’ determinant of corruption (Aidt, 2011).
- ‘Population’, natural logarithm, using the World Bank (2023), as a control variable (Fisman & Gatti, 2002; Karlström, 2015) of the country’s size, which is applied in surveys on corruption (Aidt, 2011). According to the economies of scale larger countries have more efficient bureaucracy and regulations along with their implementation, an adequate quality of public institutions that reduce corrupt among politicians and bureaucrats. Opposite views suggest that small countries need to be better managed to maintain sound finances and economic competitiveness, which result in less corruption in these states (Amin & Soh, 2019). Knack and Azfar (2003) argue that population-corruption relationship is an artifact of sample selection bias.
- ‘Population per region’, natural logarithm, using the World Bank (2023) and the number of regions (first-tier subnational governments) based on OECD (2021, 3) and Lecuna (2012). Total population divided by total number of regional governments (first-tier subnational unit) was used by

Lecuna (2012), who found that countries with more population per regional government had better corruption ratings (higher CPI).

- ‘Inflation’, measured as consumer prices (annual %) using World Bank (2023). Oueghlissi and Derbali (2023) applied inflation rate as control variable for macroeconomic uncertainty. They emphasize that an increase of inflation signals real wage deterioration which is positively correlated with the development of rent-seeking behaviours.
- ‘Public Procurement’, measured as general government procurement spendings to total general government expenditures (%), extracted from OECD (2024), not available data for CHL. Well-managed public procurements can play a major role in strengthening public sector performance, enhancing citizen confidence (OECD, 2015), and an increase of the spending efficiency due to competition on the market (Borowiec et al., 2017).

Tu sum up, this study examines tax revenue decentralization, civil liberties, interaction between tax revenue decentralization and civil liberties as potential causes of corruption, also taking into account the scope of the public sector (government) and the control of the size and development of countries (regions), which is consistent with the observation of Aidt (2011) as well as the aspects of macroeconomic uncertainty and procurement spendings.

3. Research results

The descriptive statistics show that in the OECD countries there are differences in the field of tax revenue decentralization, and the Corruption Perceptions Index or Civil Liberties Index (Table 1). These countries also differ in the field of the size of government, and economic development, population of the state and per first tier sub-national government. There are also disparate shares of procurement spendings in the national budgets and the level of price stability.

Table 1. Descriptive statistics and the codes for the analysed OECD countries

Variable	Nº	Mean	Sd.	Min	Max
Corruption Perceptions Index	418	66.8971	15.4613	28.0000	92.0000
Tax Revenue Decentralization	416	14.3890	12.2003	0.6225	50.0953
Government Size	413	43.1487	8.1421	21.2500	63.2300
Civil Liberties Index	418	8.7171	1.3571	2.0600	10.0000
GDP per capita (natural logarithm)	418	10.5544	0.4026	9.4423	11.6331
Population (natural logarithm)	418	16.3897	1.5139	12.6783	19.6245
Population per region (natural logarithm)	418	14.2350	0.9547	12.5405	16.9228
Inflation	418	2.6606	4.6744	-1.7359	72.3088
Public Procurement	401	29.7884	6.6029	14.8800	46.9800
Country codes					
AUS, AUT, BEL, CAN, CHL, COL, CRI, CZE, DNK, EST, FIN, FRA, DEU, GRC, HUN, ISL, IRL, ITA, ISR, JPN, KOR, LVA, LTU, LUX, MEX, NLD, NZL, NOR, POL, PRT, SVK, SVN, ESP, SWE, CHE, TUR, GBR, USA					

Sources: developed by the author.

The outcomes of the estimated FE models show that an increase of the tax revenue decentralization affected a growth of the Corruption Perceptions Index (lower corruption) (Table 2). This extends the study of Fisman and Gatti (2002, 332) who found that countries with more decentralized expenditure had better corruption ratings. However, the larger size of government resulted in increased corruption. Thus, the expansion of the public sector leads to greater corruption, what was also found by Ali and Isse (2003, 460). Hence, the state’s active involvement in production of economic goods, forces public

institutions to resolve claims between various interests (Gerring & Thacker, 2005), which encourages the larger corruption. In addition, the MM-QR models (Table 3) indicate that an impact of tax revenue decentralization and size of government is greater the higher level of corruption in the country. Against the background of these results, it is worth adding the findings of Qiao, Ding, and Liu (2019) that fiscal decentralization is negatively associated with government size, supporting decentralization as an instrument to promote local competition, especially within mobile tax bases, thus constraining expansion of public sector growth.

Table 2. Estimation results for FE models characterizing factors affecting corruption in the OECD countries in the period 2012-2022

Variable	Model 1	Model 2	Model 3	Model 4
Tax Revenue Decentralization	16.0048*** (5.6095)	6.0201*** (2.1212)	15.3152** (5.7232)	4.4469** (1.8785)
Civil Liberties	1.3109 (1.7560)	-	1.5584 (1.6783)	-
TRD×CL	-1.0447* (0.5949)	-	-1.0314* (0.5901)	-
Government Size	-0.1446** (0.0704)	-0.1741** (0.0666)	-	-
GDP per capita	2.7324 (5.3564)	-	3.9577 (5.4229)	-
Population	-	29.0423*** (7.6767)	-	-
Population per region	-	-	-	24.5775*** (8.0730)
Inflation	-	-	-	-0.1502* (0.0825)
Public Procurement	-	-	-	0.2112 (0.1353)
Intercept	17.7356 (67.7269)	-414.5563*** (126.4493)	-2.4457 (67.5464)	-298.8539** (113.3898)
Obs	412	412	416	400
Within R^2	0.1226	0.1785	0.0941	0.1642
R^2	0.9768	0.9783	0.9760	0.9790
F test	[<0.01]	[<0.01]	[<0.01]	[<0.01]

Note: 1) ***, ** and * denotes statistical significance at 1%, 5% and 10% levels respectively; 2) cluster standard errors in parentheses (...); 3) p-value in brackets [...]

Sources: developed by the author.

Regarding civil liberties (CL) and the interaction between civil liberties and tax revenue decentralization (TRD×CL), the FE models did not show the statistical significance of CL. However, Model 5 (MM-QR) displayed that an impact of civil liberties on corruption is not significant in the countries with low level of corruption. Thus, promoting civil liberties as a part of anti-corruption policies might be effective in the economies, where corruption is perceived as a real problem. The regressions (Table 2, Table 3) also revealed a statistically significant impact of the interaction between civil liberties and tax revenue decentralization on the level of corruption. In consequence, an increase in tax revenue decentralization reduces corruption, but this impact is smaller the greater the civil liberties in the country. An influence of this interaction might not be evident in states with low levels of corruption, probably due to properly functioning civil liberties.

Table 3. Estimation results for MM-QR models characterizing factors affecting corruption in the OECD countries in the period 2012-2022

Variable/Test	Model 5 Quantiles			Model 6 Quantiles		
	25 th	50 th	75 th	25 th	50 th	75 th
Tax Revenue De-centralization	19.4288*** (4.5463)	15.6474** (3.4261)	11.1286 (4.6877)	7.8700*** (1.7801)	5.9006*** (1.3216)	3.9967** (1.6758)
Civil Liberties	2.4784** (1.2652)	1.6327* (0.9500)	0.6220 (1.3043)	-	-	-
TRD×CL	-1.3173*** (0.4973)	-1.0545*** (0.3722)	-0.7404 (0.5126)	-	-	-
Government Size	-	-	-	-0.2084*** (0.0626)	-0.1719*** (0.0458)	-0.1367** (0.0590)
GDP per capita	4.2847 (3.4050)	3.9841 (2.5361)	3.6249 (3.5088)	-	-	-
Population	-	-	-	26.8640*** (4.8193)	29.1830*** (3.5155)	31.4250*** (4.5436)
Obs	416	416	416	412	412	412
Wald test	[<0.01]	[<0.01]	[<0.01]	[<0.01]	[<0.01]	[<0.01]
Variable/Test	Model 7 Quantiles			Model 8 Quantiles		
	25 th	50 th	75 th	25 th	50 th	75 th
Tax Revenue De-centralization	7.1377*** (1.7332)	5.1150*** (1.2338)	3.3432** (1.5599)	5.2468*** (1.5781)	4.4016*** (1.3047)	3.6678* (1.9668)
Population	21.4177*** (5.1209)	22.6153*** (3.6054)	23.6644*** (4.6196)	24.7376*** (5.6254)	24.5684*** (4.6413)	24.4216*** (7.0137)
Inflation	-	-	-	-0.2613** (0.1020)	-0.1439* (0.0852)	-0.0420 (0.1269)
Public Procurement	0.2375* (0.1280)	0.2072** (0.0902)	0.1807 (0.1155)	0.2184* (0.1327)	0.2108* (0.1094)	0.2042 (0.1654)
Obs	400	400	400	400	400	400
Wald test	[<0.01]	[<0.01]	[<0.01]	[<0.01]	[<0.01]	[<0.01]

Note: 1) ***, ** and * denotes statistical significance at 1%, 5% and 10% levels respectively; 2) standard errors in parentheses (...); 3) p-value in brackets [...]

Sources: developed by the author.

The estimated models did not confirm the impact of the country's level of GDP per capita on corruption, whereas this nexus might be included in the other factor, i.e. civil liberties, as it was mentioned by Fisman and Gatti (2002). Nevertheless, an increase of inflation affects an increase of corruption (lower CPI), especially in the countries with low CPI (Model 8), which are vulnerable for rent-seeking behaviour. Hence, a deterioration of macroeconomic uncertainty results in a growth of corruption. This extends the findings of Valdovinos et al. (2019) that uncertainty avoidance (extent to which a society relies on social norms, and legal procedures to mitigate the unpredictability of future events) is a predictor of corruption levels. In addition, the regressions show that an increase of population or population per region affected a decrease of corruption (higher CPI). In the second case (i.e. population per region), this coincides with the findings of Lecuna (2012), who also identified that countries with more first-tier subnational governments relative to their population are more corrupt. Thus, an increase in corruption with greater government fragmentation may result from more rent-seeking opportunities (Goel & Nelson, 2011). Therefore, the public procurements should be promoted as a method of public spendings, including strengthening the quality of the procurement system.

According to the study of Ghossein et al. (2018) there is an inverse relationship between good procurement and corruption faced by the business sector. According to the estimation of Fazekas et al. (2016) there are certain dysfunctional techniques leading to higher corruption risk (rent-seeking opportunities) within public procurement, e.g.: not publishing the call for tenders officially, non-open procedure type, short submission period, expensive tender documents, annulling and re-launching procedures, increasing contract length and its modification. In addition, the MM-QR models (Table 3) show that an increase in general government procurement spendings as a share of total general government expenditures results in a decrease of corruption (lower CPI) in the states with the low corruption perceptions index.

Conclusions

In the research literature, there are examined numerous factors determining corruption. In certain studies, the findings lead to different conclusions, especially in the field of the impact of population as a proxy of unit's size. Distinct research outcomes result from the use of various variables to the phenomenon under study, different samples, and research methods. In addition, in most of the surveys the expenditure side of this decentralization is considered, since the spending autonomy leads to greater accountability and transparency. This study confirms that also an increase of tax revenue decentralization results in a decrease of corruption in the country. Thus, the hypothesis 1 (H1) was positively verified. However, this impact is lower whether the country is at the lower level of corruption. Nevertheless, the growing scope of the public sector or a government fragmentation and the functioning of the bottlenecks in the performance of official duties at sub-national level might hamper the efficiency of the anti-corruption policy and actions. The remedy for these phenomena should be regulations consisting in strengthening and promoting of public procurements as a method of government spendings, especially in the states, where corruption is rampant. The findings proved that both the size of government and the scope of public procurements affect corruption, especially in the highly corrupt countries. Then, the hypothesis 4 (H4) was positively verified. Strengthening regulations and standards within public procurement should be aimed at decreasing rent-seeking opportunities and increasing savings in public expenditures.

Regarding the impact of civil liberties on corruption, this is not homogeneous throughout the distribution of corruption level. An increase of the civil liberties reduces corruption in countries with higher levels of corruption, whereas in countries with low corruption this relationship is not statistically significant. Hence, this confirms the hypothesis 2 (H2). Simultaneously, the level of civil liberties may be affected by the fiscal decentralization, determine the economic development, and mechanisms of public service delivery. Corruption, in contrast, affects a lower capacity of public institutions to promote civil liberties. Therefore, in the scientific research, it is important to take into account inter-relationship relating to the spheres of corruption, fiscal decentralization, and civil liberties.

The study also shows that an increase of civil liberties decreases an impact of an increase of tax revenue decentralization on corruption, which leads to the positive verification of hypothesis 3 (H3). This interaction is not statistically significant in the countries with low levels of corruption. In these type of states civil liberties are not abridged in practice. In consequence, the implementation of monitoring and auditing instruments as part of ongoing fiscal decentralization and promotion of civil liberties should be adjusted to the level of corruption in the country, and potential interactions between these issues. Highly corrupt countries should also avoid increasing inflation, which determines greater

macroeconomic uncertainty and rent-seeking behaviour as a dysfunctional practice in the public sector. This relates to the findings of scholars that uncertainty avoidance affects corruption.

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The Influence of Competition on Turnover Intention among Co-operative Bank Employees: The Moderating Role of Training and Organisational Size

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Abstract

Co-operative banks (CBs) in many countries have recently been experiencing increased competitive pressure. Although studies have analysed how competitive intensity affects the stability of CBs, research dedicated to its impact on employee attitudes is extremely scarce. Furthermore, it is unknown how human resource management (HRM) practices modify these relationships. To fill this gap, this article examines the influence of competitive intensity on turnover intention in CBs and assesses the moderating role of training and company size in this relationship. Several hypotheses are formulated on the basis of human capital theory and social exchange theory, which are then verified with data from a nationwide survey covering the responses of 1707 employees from 43 CBs in Poland. The results of multilevel modelling confirm that competitive intensity increases employee turnover intention. Moreover, this influence is much weaker when employees receive intensive training. Finally, adding company size to the analysis has a marginal impact on the interaction between competitive intensity and training. The article contributes to the literature on co-operative banks by analysing what shapes CB employees' attitudes in the current dynamic environment. It also adds to HRM research by exploring how contextual variables (competition, company size) affect turnover intention and interact with HRM practices (in particular, training).

Key words

competition, co-operative banks, turnover intention, training, company size, human capital theory, social exchange theory.

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Introduction

Organisations are currently experiencing a variety of changes in their environment, with the intensity of the competition being one of the most challenging among them (Jung and Takeuchi, 2019; Leclerc et al., 2020; Le, 2023). This intensity is particularly noticeable in the co-operative banking sector – a crucial sector of the economies of many European countries (Jones and Kalmi, 2012; Fiordelisi and Mare, 2014; Clark et al., 2018; Jackowicz et al., 2020), especially among the segment of customers who have low income and small to medium-sized companies (Kil and Miklaszewska, 2017). Although for many years a significant number of co-operative banks (CBs) operated in local markets with

relatively low levels of competition, in recent times many of them have experienced fierce competition for customers (Balina et al., 2014; Kil and Miklaszewska, 2017; Coccoresse and Ferri, 2019). This is partly due to the entry of new players into markets hitherto dominated by local credit institutions, but also to the ambition of the CBs themselves, which are growing to the size of commercial banks and adopting similar strategies (Ory et al., 2006; Balina et al., 2014).

Competition is of particular importance for the financial sector, as it affects the stability of banks (Fiordelisi and Mare, 2014; Clark et al., 2018). In the case of CBs, it also has an influence on the number of members, as Jones et al. (2016) have shown. Moreover, competition increases the pressure on employers to cut costs (Kaufman, 2015), which can be difficult to reconcile with, for example, the long-term perspective of investing in employee competence development specific to CBs (Jones et al., 2012) and creates tensions in relations with employees. Competition also makes it easier for employees to access information about alternative jobs (Trevor, 2001), which is particularly important in the limited rural labour markets that are CBs' main areas of activity (Fiordelisi and Mare, 2014; Jones et al., 2012; Piasecki, 2021a). Resulting turnover intention is a key employee attitude from the perspective of managers since it is related to lateness and absenteeism (Griffeth et al., 2000; Holtom et al., 2008) and is strongly correlated with actual turnover (Griffeth et al., 2000; Flint et al., 2013). Voluntary turnover is costly for companies as it is associated with lower firm performance (Holtom et al., 2008; Hom et al., 2017), leads to losses in organisational social capital (Holtom et al., 2008), and sometimes decreases workforce diversity (Hom et al., 2017). Finally, turnover is of special importance to CBs due to the customer-specific knowledge of employees which is difficult to restore when the employee leaves (Jones et al., 2012). However, little is known about the impact of competition on CB employees since issues related to employees and human resource management (HRM) are under-researched in financial co-operatives (Leclerc et al., 2020; Voigt and von der Oelsnitz, 2024). The few exceptions include the work of Kaźmierczyk and Zajdler (2020), who compared the stress levels of employees of commercial and co-operative banks in Poland and explained the more unfavourable results in the case of the former by, among other things, greater performance pressure associated with the high level of competition in the banking market. Additionally, Ramu (2008) pointed to the impact of competitive pressure on CB managers' increased focus on labour costs and productivity in India, but did not address this issue more extensively. Leclerc et al. (2020), giving the example of Canadian financial service co-operatives, emphasised how competition affects HRM practices, but without a broader exploration of the effects on employee attitudes. It seems that there is a lack of research not only on the direct impact of competition on the attitudes of CB employees, but in particular on the role of additional factors (moderators) that could modify its effect.

This article aims to fill this gap. Specifically, we will focus on the impact of competition on the turnover intention in Polish CBs. CBs in Poland are a good example, considering the analysed topic, because although they have a stable position on the market resulting from a long history (Kil and Miklaszewska, 2017), they have recently experienced increasing competition not only between banks, but also new organisations such as FinTechs (Kil and Miklaszewska, 2017; BANK.pl, 2023). Competitive pressure translates into increased stress for Polish bank employees, which prompts them to leave their jobs (Kaźmierczyk and Zajdler, 2020). We will consider two moderators in our analysis – training and the size of CBs. Many organisations are seeking ways to mitigate the adverse impact of competition through, among other strategies, a variety of HRM practices. Among the wide range of HRM practices currently in use in the banking industry, this article focuses on training since it is one of the

key areas of HRM and has potential to reduce turnover intention (e.g. Chiang et al., 2005; Cooke et al., 2011; Ju and Li, 2019). For example, training may be perceived by employees as an expression of the employer's concern and arouse the desire to reciprocate through commitment to the organisation (Martini et al., 2023a). Moreover, training in CBs is especially important as it helps employees deal with changes in the complexity of financial products (Jones et al., 2012) and helps build local institutional trust (Bossler and Schild, 2016). Therefore, CB employees should particularly appreciate training. Surprisingly, however, scant scientific research exists on training in CBs (Piasecki, 2021b).

In addition to training, the second moderating factor considered in this study is the size of the bank, as competition may impact employees differently depending on the size of the company in which they work (Patel and Cardon, 2010). CBs are heterogeneous in terms of size and this is particularly evident in the Polish co-operative banking sector (Kil and Miklaszewska, 2017). The size of co-operative financial institutions is crucial since it affects management (Kil and Miklaszewska, 2017; Coccoresse and Ferri, 2019) and also has an impact on the effects of implemented HRM practices (Piasecki et al., 2022). Moreover, many authors have indicated that the growing size of CBs is leading to a move away from co-operative principles towards management similar to commercial banks (see Jones and Kalmi, 2012; Kil and Miklaszewska, 2017; Coccoresse and Ferri, 2019). All in all, the aim of this study is to examine the influence of competitive intensity on turnover intention in CBs and to assess the moderating role of training and company size on this relationship.

The contribution of this article is twofold. First, it contributes to the co-operative literature by analysing what shapes CBs employees' attitudes in the current dynamic environment. As mentioned above, to date, research on co-operative bank employees is scarce and studies of the impact of competition on employee attitudes are virtually non-existent. Second, examining the relationship between competition, training and turnover intention contributes to the development of HRM. As Kaufman (2015) has highlighted, despite various studies devoted to the relationship between competition and HRM, we still know too little about their interdependencies. This study helps to explore how contextual variables (competition, company size) affect turnover intention and interact with HRM practices (in particular, training). It thus meets the recent call for a broader consideration of context in HRM research (Kaufman, 2015; Cooke, 2018; Mayrhofer et al., 2019), including more attention to the factors that influence turnover (Hom et al., 2017).

1. Literature review

Competitive intensity is usually conceptualised in terms of the number of competitors and their growth potential (Hoang et al., 2023; Le, 2023). Its influence on employee turnover intention can be analysed using various theoretical approaches; however, in this study two theories will be employed: human capital theory (HCT) and social exchange theory (SET). The choice of these theories is based on several factors. First, both fit the specificity of employee relations in CBs. These companies usually offer stable employment and invest heavily in employee development (Jones et al., 2012), enabling employees to take a long-term view of their development, which aligns with the perspective of HCT. Moreover, SET provides a suitable theoretical basis for analysing the internal organisation of co-operatives, which, by definition, are based on the commonality of interests and interdependence of various co-operative actors (Jussila et al., 2012). CBs also base their activities, at least in principle, on co-operative values and principles, such as democracy and equity (International Co-operative Alliance, 2015), which are reflected in employer-employee relationships that are governed not only by economic

factors but also by social exchange. Second, both theories are used to explain the impact of training on employee attitudes (Benson, 2006; Koster et al., 2011). Finally, these theories might be perceived as complementary; hence, some authors use them simultaneously in their turnover research (Renaud et al., 2015; Martini et al., 2023a). An example of their concurrent use in research on CBs can be found in the work of Piasecki (2021b).

According to HCT, employees are rational actors seeking the maximum return on their human capital (Flamholtz and Lacey, 1981). They compare the benefits which might be gained in alternative workplaces with those expected in the current job and use this information to decide whether to stay or switch organisations (Huang et al., 2006). The high competitive intensity within the industry increases the number of alternative jobs available (Banker and Mashruwala, 2007). Moreover, competitors compete not only for sales but also for the acquisition of valuable human capital (Renaud et al., 2015); thus, they try to reach potential candidates with information that will persuade them to switch employers. Providing access to information about alternatives saves time and effort for the employee, which translates into a higher likelihood of the employee finding a suitable position and, ultimately, a greater willingness to leave. SET, a complementary theory to HCT, emphasises the exchange relationship between the employer and the employee (Cropanzano and Mitchell, 2005). The employer offers the employee resources that go beyond the employment contract, such as an interest in the development of employee competencies or a concern for the employee's general well-being, and the employee reciprocates with greater commitment to work and loyalty (Pajo et al., 2010; Quenneville et al., 2010; Jung and Takeuchi, 2019). Competition is usually associated with increased employer demands on employees (Patel and Cardon, 2010; Forastieri, 2016; Guo et al., 2023), which, when coupled with the pressure to minimise costs (including wages) (Kaufman, 2015), can distort the level of social exchange previously established between the employer and the employee. This may result in greater stress and psychological uncertainty (Forastieri, 2016), which are predictors of turnover intention (Holtom et al., 2008). Moreover, employers facing intense competition are more focused on company (and employee) performance (Pulignano et al., 2020); hence, concerns about an adequate level of social exchange with employees may become relatively unimportant. Finally, with greater competition, some employers become more fearful of employees leaving and therefore reduce long-term investment in their human capital (Kaufman, 2015). Paradoxically, the negative effects on long-term social exchange may further increase the turnover rate. It follows that from the perspective of HCT and SET theories, increased competition experienced by CBs can be expected to lead to an increase in turnover intention, as the first hypothesis states:

H1: Competitive intensity is positively correlated with turnover intention.

Many authors believe that high competitive intensity is related to greater investments in the human capital of employees as these investments allow companies to maintain a competitive advantage (e.g. Martini et al., 2023b). However, Kaufman (2015) indicates that strong competition will in many cases lead to cost cutting and lower expenditure on HRM practices. In CBs, the level of training intensity experienced by a given employee depends on a number of factors unrelated to the market situation, such as the orientation of the organisation's management towards co-operative principles explicitly referring to investment in employee development or the employee's shareholder status (Piasecki, 2021b). It follows that the level of training intensity will vary for any given level of competitive pressure. For this reason, training can be conceptualized as a moderator (rather than a mediator) of the relationship between competition and employee attitudes.

According to HCT, an important aspect of training is that it has different levels of specificity. Stated otherwise, the knowledge and skills acquired from workplace training have different degrees of applicability in other workplaces. In the classic HCT view, training with a high level of specificity is not associated with a high employee propensity to leave, as employees have limited opportunities to use their acquired knowledge with other employers (Becker, 1962). Moreover, specific training may increase perceived internal employability, thus strengthening employees' belief that their current workplace will provide them with ample career opportunities (Martini et al., 2023a). This belief can be an asset to a company when it has a high level of competition whereby employees have easy access to information about other employers, as described earlier. Training in CBs is often characterised by a relatively high level of specificity resulting from being tailored to the local economic and social conditions of the bank (Bossler and Schild, 2016). Correspondingly, when employees evaluate the overall benefits offered in the workplace and compare them to alternatives, their workplace training and its concomitant development opportunities may be an important element in deciding whether or not to look for a new employer (Flamholtz and Lacey, 1981). From these observations, it follows that in cases where there is high competition, significant differences will be observable in the attitudes of employees who have participated in many training sessions and those with limited or no training.

From the SET perspective, training is perceived by employees as an expression of managerial concern for their development (Pajo et al., 2010; Martini et al., 2023a). Employees who receive training thus reciprocate by presenting more positive attitudes towards work, such as greater involvement and a decreased willingness to leave (Benson, 2006; Pajo et al., 2010). These attitudes are particularly important when there is high competition that correlates with greater demands from customers (Banker and Mashruwala, 2007; Guo et al., 2023). When employees do not feel supported by their employer in dealing with demanding clients, they tend to feel frustrated, and as their frustration escalates some start looking for other jobs where they expect to receive more support (Guo et al., 2023). In organisations experiencing less intense competition, training may not play as important a role in retaining employees due to the decreased pressure from both management and customers. The foregoing observations lead to the second research hypothesis:

H2: The positive correlation between competitive intensity and turnover intention is weaker among employees who participate in more intensive training than others.

Company size influences turnover intention in several ways, and the HCT and SET theories explain this influence differently. Since company size is related to the number and variety of positions that employees can take up (Pajo et al., 2010), if, according to HCT perspective, employees are thinking long-term about their development and the return on the investment they make in human capital (Flamholtz and Lacey, 1981), they will value the opportunities offered in a large organisation more than those in a small company. In a highly competitive environment where there are many alternative jobs, training may be ineffective in reducing turnover intention in small companies where there are a lack of suitable career prospects. Moreover, small companies, on average, pay less than large ones (Pajo et al., 2010); thus, in a situation of high competition they generally face more difficulties in retaining employees. Offering greater opportunities to develop competences may be insufficient to convince employees to stay since profit-oriented (as described by HCT) employees compare the overall benefits obtained from different employers (Renaud et al., 2015). From the SET perspective, the effectiveness of training in reducing the negative impact of competition depends on the type of bond between the employer and the employees. If the relationship is mainly based on economic exchange (i.e.

appropriate pay in exchange for high performance (Jung and Takeuchi, 2019), training will probably be less effective than if the employer places more emphasis on social exchange (training then strengthens the employee's belief in the employer's care). Some authors indicate that increasing the size of CBs leads to a change in their orientation from co-operative to market (see Jones and Kalmi, 2012; Kil and Miklaszewska, 2017; Coccorese and Ferri, 2019), which translates into a greater focus on results and less attention given to co-operative employee relations (Ory et al., 2006). Moreover, Piasecki et al. (2022) indicate that in large co-operative financial institutions employees manifest a lower propensity for reciprocity regarding HRM practices, in part because they have fewer personal ties than employees in small organisations. SET thus hypothesises that the effect of company size on employer-employee relationships will be opposite to that postulated by HCT. While HCT suggests that the positive influence of training in weakening the impact of competition on turnover intention will occur primarily in large organisations, SET indicates that it will be more effective in small CBs. For this reason, the current study proposes two competing hypotheses:

H3a: In large companies, but not small ones, the positive correlation between competitive intensity and turnover intention is weaker among employees who participate in more intensive training than others.

H3b: In small companies, but not large ones, the positive correlation between competitive intensity and turnover intention is weaker among employees who participate in more intensive training than others.

2. Methodology

In order to verify the research hypotheses, this study used a dataset from a nationwide project on HRM in Polish co-operative banks. Among all the countries in Central and Eastern Europe, Poland has the largest co-operative banking sector, comprising more than 550 companies at the time of research in 2017 (Kil and Miklaszewska, 2017). The project organisers sent an invitation via e-mail to all active CBs and announced additional information about the study during the annual meeting of CBs managers. This information was also spread by two affiliating banks which associated all but two CBs at the end of 2016 (Urząd Komisji Nadzoru Finansowego, 2017). Each bank that decided to participate in the survey received questionnaires about personnel policy and general HR data (the number of branches, fluctuation, etc.) along with a link to the questionnaire to be completed by employees. The questionnaire was administered by a bank representative (in most cases from the HR department). Employees at some banks preferred the paper version of the questionnaire and the content of the forms they received was identical to that of the on-line version. This procedure yielded 1707 employee responses from 43 co-operative banks (i.e. 8% of all banks active at the end of 2017). Although the scope of the survey included all CBs in Poland, in the end the sample structure did not fully reflect the population structure (population data was based on the The Polish Financial Supervision Authority report (Urząd Komisji Nadzoru Finansowego, 2017). Specifically, the Chi-square test indicated that in terms of asset size the structure of the sample is significantly different than the structure of the population (Chi-square: 23.628, p-value: < 0.001), although there are no significant differences in terms of banks' affiliation (Chi-square: 1.387, p-value: 0.239). Analysis of the data revealed that the research sample comprised a higher proportion of large organisations than the population.

In order to measure turnover intention, three statements from Konovsky and Cropanzano (1991) were employed with a five-point Likert-type scale (Cronbach's α was 0.869). Previous studies have

measured competitive intensity in various ways (see Robson and Bennett, 2000; Spanos and Lioukas, 2001; Jones et al., 2016; Kil and Miklaszewska, 2017; Jackowicz et al., 2020; Hoang et al., 2023; Le, 2023; Martini et al., 2023b). In this study competitive intensity was measured similarly as in Robson and Bennett (2000). Specifically, the bank representative was asked to indicate the total number of competitors for each of five categories of financial institutions (co-operative bank, commercial bank, credit union, shadow bank, other). The types of competitors were similar to those analysed by Kil and Miklaszewska (2017). For each type, the respondent could choose not to mark anything or to select from the following response options: 1=one, 2=two or three, or 3=four or more. The minimum value for this variable was 2, while the maximum was 15 (i.e. four or more competitors in each category). The subjective competitive intensity measure was employed instead of market-level objective data due to its appropriateness for capturing the impact of competition on managers' decision-making perceptions (Spanos and Lioukas, 2001). This was important because, as described earlier, according to SET, competition affects employees by influencing managers' behaviour and decisions.

The preparation of the training intensity measure required several steps. First, since part time employees, who comprised only a small part of the total sample (less than 1%), tend to receive fewer opportunities to take part in training (Cooke et al., 2011), they were excluded from further analyses. In addition, contractual employees (1 person) as well as employees who gave unreliable responses, for example, to the question regarding previous training were not considered in further analyses. Next, the respondents who declared that they did not receive any training in the previous year were assigned 0 (The exact wording of the question was: "Did you attend any training events [courses, seminars, conferences] financed by the employer [apart from compulsory training, e.g., health and safety] in 2016?"). Those who confirmed participation in training were asked a further question: "How many training events (courses, seminars, conferences) related to your current job and financed by the employer (apart from compulsory training, e.g., health and safety) did you attend in 2016?". The response options were as follows: 1=one training event, 2=two training events, 3=three training events, 4=more than three training events. As a robustness check, the analyses were performed additionally with the second variable describing the number of training days: "Over the last year, the number of days I spent on employer-funded training (apart from compulsory training, e.g. health and safety) was as follows: 1=less than 1 day, 2=1–2 days, 3=3–4 days, 4=5–6 days, 5=more than 6 days." Taking into account employees who did not attend training (with an assigned value of 0), the variables describing training had scales ranging from 0 to 4 and 0 to 5. Both variables were similar to those employed in earlier studies (e.g. Benson, 2006; Pajo et al., 2010; Koster et al., 2011).

Company size was measured by the number of employees. To avoid distortion of results related to the wide variation in responses (the smallest bank in the sample had 11 employees and the largest, 557) and to simplify the analysis, the study introduced a dummy variable with the threshold set at 100 employees (0 = less than 100 employees, 1 = 100 or more employees). This threshold is analogous to those used in earlier studies (Fabi et al., 2007; Patel and Cardon, 2010; Innes and Wiesner, 2012).

Several control variables were also included in the models: gender (0 = man, 1 = woman), position (0 = non-managerial, 1 = managerial), education (0 = less than post-secondary education, 1 = post-secondary education) and organisational tenure (1 = less than 1 year, 2 = 1–3 years, 3 = 4–9 years, 4 = 10–19 years, 5 = 20 years or more). Many researchers have indicated that these variables affect turnover intention (e.g. Mor Barak et al., 2001; Holtom et al., 2008; Martini et al., 2023a). They are related to the ease of finding alternative jobs (Trevor, 2001; Huang et al., 2006; Holtom et al., 2008) as well as

training intensity (Huang et al., 2006; Cooke et al., 2011; Grund and Martin, 2012), which, according to HCT, are crucial factors influencing the willingness to leave. Moreover, they affect employees' expectations and the strength of their relationship with the employer (e.g., Renaud et al., 2015; Jun and Eckardt, 2023), both of which SET associates with turnover intention.

At the beginning of the calculations, the two-level structure of the data (employees nested in companies) was analysed. Results of this first check provided convincing arguments to perform multilevel modelling (MLM) (likelihood ratio test statistic for turnover intention = 131.37, $p < 0.001$, ICC = 0.15) (Leckie, 2010). Before conducting analyses, the company-level variable describing competition was grand-mean centred, while both variables describing training intensity were group-mean centred, in line with Shen's (2016) recommendations. Control variables as well as organisation size (dummy variable) were not centred. After performing these operations, the study employed two-level linear regression models with maximum likelihood estimation. All the calculations were performed in Stata 17.0.

3. Research results

Table 1 presents mean, standard deviations and correlations among the study variables. Competitive intensity correlates, albeit weakly, with both willingness to quit and the size of CBs. In addition, the two training measures (events and days) are very highly correlated ($r=0.889$) and have a negative, albeit weak, correlation with turnover intention. Interestingly, the correlation between competitive intensity and both measures of training intensity is very weak and negative. Although many authors indicate that competition increases the intensity of HRM practices, the latter result tends to support Kaufman's (2015) argument that competition leads to a (small) reduction in the sophistication of HRM practices.

Table 1. Mean, standard deviations and correlations among the study variables

Variable	M	SD	1.	2.	3.	4.	5.	6.	7.	8.
1. Gender	0.788	0.409								
2. Position	0.243	0.429	-0.189**							
3. Education	0.827	0.378	-0.116**	0.117**						
4. Organisational tenure	3.449	1.139	0.077**	0.190**	-0.359**					
5. Competition	9.985	3.400	-0.093**	-0.009	0.129**	-0.062*				
6. Training (events)	1.859	1.485	-0.038	0.287**	0.022	0.213**	-0.080**			
7. Training (days)	2.234	1.691	-0.041	0.273**	0.036	0.185**	-0.080**	0.889**		
8. Company size	0.612	0.487	-0.013	-0.034	0.077**	0.027	0.186**	-0.039	-0.015	
9. Turnover intention	2.540	1.069	-0.121**	-0.089**	0.188**	-0.065*	0.175**	-0.094**	-0.105**	0.166**

Note: N = 1443, ** $p < 0.01$. * $p < 0.05$. M – Mean, SD – standard deviation; Dummy coded: Gender, 0 = man, 1 = woman; Position, 0 = non-managerial, 1 = managerial; Education, 0 = lower than post-secondary education, 1 = post-secondary education; Company size, 0 = less than 100 employees, 1 = 100 or more employees; Category coded: Organisational tenure, 1 = less than 1 year, 2 = 1–3 years, 3 = 4–9 years, 4 = 10–19 years, 5 = 20 years or more; Training (events), 0 = no training, 1 = one training event, 2 = two training events, 3 = three training events, 4 = more than three training events; Training (days), 0 = no training, 1 = less than 1 day, 2 = 1–2 days, 3 = 3–4 days, 4 = 5–6 days, 5 = more than 6 days; Continuous: Competition; Turnover intention.

Source: Own elaborations

The results of MLM are presented in Table 2 (the results of additional analyses performed as a robustness check are available from the author). Competitive intensity turned out to have significant positive influence on turnover intention (see Model 1 in Table 2). This result confirms hypothesis H1.

In addition, company size was related to a greater willingness to leave; however, this impact was less pronounced (the parameter is at the edge of significance). The effect of competition was still significant when the variable describing training intensity was introduced in the analysis (see Model 2 in Table 2). Finally, training intensity had a significant negative influence on turnover intention.

Table 2. MLM results for number of training events (random intercept models)

Model	1	2	3	4
Gender	-0.317 (0.000)	-0.314 (0.000)	-0.314 (0.000)	-0.312 (0.000)
Position	-0.302 (0.000)	-0.263 (0.000)	-0.261 (0.000)	-0.254 (0.000)
Education	0.315 (0.000)	0.348 (0.000)	0.341 (0.000)	0.346 (0.000)
Organisational tenure (1-3 years)	0.191 (0.101)	0.316 (0.011)	0.312 (0.011)	0.318 (0.010)
Organisational tenure (4-9 years)	0.417 (0.000)	0.543 (0.000)	0.538 (0.000)	0.550 (0.000)
Organisational tenure (10-19 years)	0.351 (0.001)	0.478 (0.000)	0.481 (0.000)	0.490 (0.000)
Organisational tenure (20 years and more)	0.066 (0.575)	0.223 (0.082)	0.216 (0.091)	0.225 (0.079)
Company size	0.222 (0.053)	0.219 (0.069)	0.218 (0.070)	0.221 (0.065)
Competition	0.036 (0.034)	0.036 (0.041)	0.036 (0.042)	0.029 (0.216)
Training (events)		-0.066 (0.001)	-0.064 (0.002)	-0.101 (0.002)
Competition* Training (events)			-0.015 (0.006)	-0.019 (0.072)
Competition* Company size				0.015 (0.667)
Training (events)* Company size				0.058 (0.133)
Competition* Training (events)* Company size				0.004 (0.745)
Intercept	2.222 (0.000)	2.070 (0.000)	2.078 (0.000)	2.054 (0.000)
Intercept variance	0.077	0.086	0.086	0.085
Within-company between-employee variance	0.943	0.940	0.935	0.933
Number of observations	1512	1445	1445	1445
Log likelihood	-2125.369	-2030.601	-2026.873	-2025.618

Number of organisations in each model: 41; description of the variables provided in Table 1, p-value in parentheses.

Source: Own elaborations

The interaction term turned out to be significant for both measures of training intensity (Model 3 in Table 2). As expected, the influence of competition on turnover intention was much weaker (in fact, statistically insignificant) when the employee received high training intensity (see Figure 1). This finding confirmed hypothesis H2. Additional analysis was performed to check if the influence of training intensity differed in each company. The values of the likelihood ratio test statistic indicated that the random intercept model is equally good as the random slope model (Training events: 0.91, $p=0.633$, Training days: 2.86, $p=0.239$). This means that the interaction between competition and training had similar effects on turnover intention across all analysed organisations (Leckie, 2010).

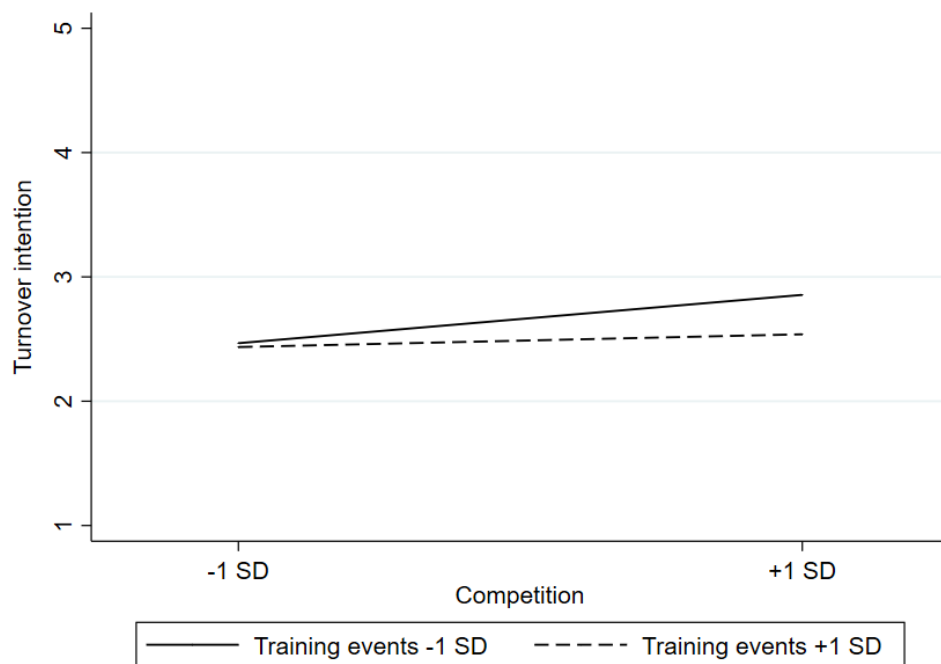


Figure 1. Two-way interaction for Model 3 from Table 2

Note: -1 SD/+1 SD – one standard deviation below/above the mean.

Source: Own elaborations

The three-way interaction term appeared to be insignificant (see Model 4 in Table 2). However, following the suggestions of Kingsley et al. (2017), this study performed an additional analysis of the average marginal effect of competition. Results confirm that with low training intensity, competition correlates positively with turnover intention, irrespective of the size of the organisation. However, for employees who experience more intensive training, the change in turnover intention in small companies is close to zero (training events: 0.003, $p=0.916$; training days: 0.0003, $p=0.992$), whereas for bigger organisations it is stronger and positive, albeit still statistically insignificant (training events: 0.024, $p=0.397$; training days: 0.030, $p=0.279$). This finding suggests that, although size does not directly modify the relationships analysed, it is likely to be associated with other variables that may affect an employee's propensity to leave. Although the results of the analysis did not support either hypothesis H3a or H3b, they suggest that the size of the organisation has an indirect (and not very strong) negative interaction with the beneficial effect of training on reducing the impact of competition.

4. Discussion

At present, CBs are experiencing a number of challenges, one of which being increased competition from commercial banks but also from other players such as shadow banks. This article examines how competitive intensity affects CBs employees' turnover intention. Our basic hypothesis (H1) was that greater competition is associated with higher willingness to leave among CBs employees and this was confirmed. In the light of HCT, the observed relationship can be explained by the fact that rational individuals calculate long-term benefits when presented with increased information about alternative jobs (Huang et al., 2006). From the perspective of SET, competition leads to higher employer expectations from the employee (Forastieri, 2016; Guo et al., 2023) and increasing tension in the

employment relationship that ultimately results in employee dissatisfaction and resignation. In particular, the second explanation seems to fit the characteristics of Polish CBs, as, in the light of Kaźmierczyk and Zajdler's (2020) analysis, greater competition in Polish banking leads to greater stress for employees, and this results in departures. There are many studies showing that employees' stress level positively correlates with their propensity to leave (see e.g. George and K.A., 2015). Employer performance pressure arising as a result of competition can also increase rivalry between employees (Gim et al., 2015). As this attitude is not in line with co-operative values and principles (International Co-operative Alliance, 2015), it is likely to generate strong negative feelings among CBs employees.

A further argument in favour of this explanation is the confirmation of our subsequent hypothesis (H2) that the negative effects of competition is weakened by training. This finding is in line with previous research showing the role of HRM in decreasing employee turnover intention (e.g. Martini et al., 2023a). In the light of SET, participation in training is perceived by the employee as an expression of the employer's concern (Pajo et al., 2010), hence it should counterbalance the negative emotions resulting from increased expectations due to competition. Furthermore, in CBs, training is often an opportunity to educate on co-operative values and principles, which should encourage employees to stay with an employer (Voigt and von der Oelsnitz, 2024). The findings are in line with those of Serenko et al. (2024), who, analysing the influence of participation in training and development for quits in North American credit unions (organisations belonging, like CBs, to co-operative financial institutions (McKillop et al., 2020), concluded that investment in employees' competences increases their loyalty, even if at the same time they become more valuable on the labour market. Other authors studying co-operatives (although not only financial co-operatives) have also identified the beneficial effect of training on employee retention (see Voigt and von der Oelsnitz, 2024).

Analysis of the impact of company size on turnover intention also seems to reinforce explanations based on SET. The size of the organisation directly influences the probability of employee turnover, with larger companies experience greater employee turnover intention; however, this influence seems to be less profound than the impact of competition or training. One explanation may be the tendency noted by some authors of large CBs to turn away from a co-operative to a market orientation (see Jones and Kalmi, 2012; Kil and Miklaszewska, 2017; Coccorese and Ferri, 2019). This process is often linked to less emphasis on co-operative relations with employees and more on results (Ory et al., 2006). Moreover, the analysis of three-way moderation suggests that even if there are no signs of direct influence of size on the relationship between competition, training and turnover intention (the results did not support either hypothesis H3a or H3b), size may have an indirect influence on this relationship with bigger CBs having more problems with competition even when employing intensive training. This is in line with the results of Piasecki et al. (2022), who identified weaker reciprocity among employees of large co-operative financial institutions compared to small ones resulting, among other things, from fewer personal ties.

Conclusions

This study takes an important step towards understanding how external conditions and HRM in CBs affects turnover intention. So far, knowledge about employee-related issues in co-operatives (including financial co-operatives) is limited (Voigt and von der Oelsnitz, 2024). In particular, there is a

lack of articles on the role of competition in shaping the attitudes of employees. This is quite surprising given that employees are key for the development of CBs (Ory et al., 2006; Balina et al., 2014) and there is some literature on the impact of competition on the stability of CBs (e.g. Clark et al., 2018; Jackowicz et al., 2020). Moreover, there are virtually no publications describing the impact of moderators on the competition-turnover intention relationship in CBs. This article makes an important contribution to this gap by explaining how the competition experienced by CBs affects employees' willingness to leave.

This study also responds to the call by Jussila et al. (2012) to undertake in-depth analyses of social exchange in co-operatives. These authors pointed out that in order to better understand the effects of social exchange in co-operatives, it is necessary to understand the conditions in which exchange takes place. An analysis that takes into account the simultaneous effects of competition, training and organisational size is a fine reflection of the complex context in which CBs operate, consisting of external factors (competition) and those of internal factors that are more (training) or less (size) controlled by CBs. In this way, the article also provides a starting point for further research using SET in analysing co-operatives (not only financial).

The conclusions of the study are also relevant to the ongoing discussion on changes in the structure and functioning of CBs resulting from the increasing scale of their activities and the impact of competition, which have led to the dilemma of how to preserve the co-operative identity of these institutions (Kil and Miklaszewska, 2017). For example, Jones and Kalmi (2012) indicate the need for more research into the effects of co-operative growth on its effectiveness while maintaining its democratic nature. They emphasise the need for a better understanding of the factors contributing to the success or failure of co-operatives struggling with the dilemma of increasing scale of operation. Assuming that employees' turnover intention has a number of adverse consequences for the organisation (Griffeth et al., 2000; Holtom et al., 2008), the analysis in this article makes the point that the size of the organisation itself is not necessarily as important (although still requiring consideration) to the success of CBs as other factors such as competition or HRM.

Lastly, this study advances the broad stream of research on the link between HRM and organisational outcomes, in particular it contributes to the ongoing discussion about the eventual results of training on employees' turnover intention (see Jun and Eckardt, 2023). Recently, researchers have begun paying more attention to the role of context, particularly competition, in explaining the HRM-organisational performance relationship (Martini et al., 2023b). This article confirms that organisational circumstances (competition, size) influence employees' attitudes, and this impact is modified by the HRM practices, such as training. Moreover, the novel element of the analysis is the simultaneous consideration of the impact of three factors (two contextual variables and training), which allows us to conclude that appropriate HRM practices can have a positive impact on employee retention even in very unfavourable conditions (high competition and large CBs size).

One limitation of the study is that it presents data at the employee and organisational levels but excludes information on the competition experienced by individual branches of a bank. As the level of HRM in bank can vary considerably between locations (Bartel, 2004), the interaction of competition with training may produce different results depending on the branch. Thus, as Holtom et al. (2008) indicated, turnover research should ideally cover not only the individual and organisational levels, but also the department level. Although it would require more sophisticated models, subsequent studies would do well to take into account all three levels of analysis.

Another limitation of the current study is that the same respondents answered questions on training and turnover intention, which raises concerns about the risk of common method bias. This risk may have been lessened by the fact that both employees and bank representatives were assured of the confidentiality of the data provided, the measurement of training and turnover intention were separated from each other in the questionnaire, and representatives of two sectoral institutions were consulted regarding the content of the statements (Podsakoff et al., 2003; Kock et al., 2021). However, in subsequent studies it would be worth considering using an even greater variety of respondents to provide, for example, information on the number of trainings in which employees participated as indicated by branch managers.

To validate the results obtained in this study, researchers should also consider using other measures of competition or training. With respect to competition, it would be interesting to ask branch managers not only about the number of direct rivals, but also about their subjective impression of the areas in which competition is felt most strongly (e.g. product characteristics, promotional strategies) (Spanos and Lioukas, 2001) and the dynamics of change in competitive intensity. In addition, distinguishing between the impact of different types of competitors (e.g. commercial banks versus other co-operative banks) would be worth considering since their influences on a bank's decisions probably differ (Coccorese and Ferri, 2019). Moreover, it would be worthwhile to ask about the types of training employees receive, since employee development might include various forms of training (see Ju and Li, 2019), including formal and informal training, the latter of which is extremely common in small organisations (Pajo et al., 2010) such as most CBs.

From the managerial point of view, it is important to bear in mind that the competition experienced by CBs has a considerable impact on employees' attitudes. Managers should take this into account when deciding, for example, to open branches in areas with a high density of financial institutions. In banks that are already operating in an environment of high competition, it is important, in light of SET, to ensure that competitive pressure does not translate into a weakening of employee relations and attachment to the bank in general. Additionally, since increasing the bank's size seems to be related to problems with staff retention, for CBs that have already reached a large scale of operation, caring about the bonds of employees with each other and with their supervisors may be especially crucial.

Managers in CBs have various tools to nurture employee relations and, in particular, a variety of HRM practices. The results of this survey indicate that one of these practices, namely, training, contributes to reducing employees' propensity to leave in a highly competitive environment. Given that there are other HRM practices, such as financial rewards, which are oriented even more towards shaping employee attitudes (Jiang et al., 2012), one can expect that managers have many ways of dealing with high competitive intensity. This study proposes that they constantly monitor employee attitudes through annual or more frequent surveys. This would allow for controlling shifts in employees' feelings during changes experienced by CBs when entering new areas.

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Data Availability Statement: The representatives of banks as well as individual employees who participated in the research project were assured raw data (about banks and about employees) would remain confidential and would not be shared. Therefore, the data cannot be shared with third parties in any form.

Conflicts of Interest: The author affirms no conflict of interest.

Reference

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Tourism Development and Financial Inclusion: The Role of Contextual Factors in Vietnam

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Abstract

This study investigates the relationship between tourism development (TD) and financial inclusion (FI) in Vietnam, considering the influence of contextual factors such as domestic private sector development, education attainment, and institutional quality. The study employs a two-step generalised method of moments (GMM) estimator to address unobservable heterogeneity, simultaneity, and dynamic potential endogeneity for consistent estimation. The findings support the theoretical perspective of ecotourism and tourism-led growth, revealing that increased tourism revenue, passenger arrivals, shopping malls, and goods sales positively contribute to the FI index and its components. Notably, the study highlights the moderating role of domestic private sector development, effective institutions, and higher education levels in enhancing the nexus. Based on our findings, policy implications are drawn to foster sustainable tourism and financial inclusion. First, policymakers should prioritise supporting the growth of domestic private sector enterprises, emphasising local ownership for mutual benefits. Second, investing in education, especially in underserved areas, is essential for improving financial inclusion, as higher education levels facilitate engagement with formal financial services and reduce financial voluntary exclusion. Third, enhancing institutional quality is vital to creating a fair and transparent environment in the tourism industry, promoting responsible practices, and empowering local communities.

Key words

tourism development, financial inclusion, sustainability, Vietnam.

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Introduction

Financial inclusion is a critically important factor in driving economic growth, poverty reduction, and sustainable development. Indeed, access to a diverse range of financial services empowers individuals and businesses to participate actively in the economy, make informed financial decisions, and improve their overall well-being (Demirguc-Kunt et al., 2018; Xu et al., 2022). Siddik (2017) highlights its significant role in empowering women and its contribution to economic growth and various social aspects (e.g. education, poverty reduction, and health) through improving business health, as access to credit and financial services allows entrepreneurs and SMEs to grow and invest in productive ventures. Financial inclusion is also seen as complementary to anti-money laundering and counter-terrorist financing efforts, as it enhances transparency (De Koker and Jentzsch, 2013). Notably, it is also seen as a cushion to mitigate the negative impacts incurred during the COVID-19 period, especially in developing countries, where it improves food insecurity (Arshad, 2022). Thus, improving financial inclusion has gained significant attention from both the scientific community and policymakers (Sanderson et al., 2018).

Despite numerous studies identifying the improvement of financial inclusion (e.g. institutional arrangements, economic growth, and educational attainment), there has been limited emphasis on the role of tourism development, one of the most significant contributors to economic growth and social welfare. For example, in Vietnam, tourism contributed to GDP, increasing from 6.3% in 2015 to 9.2% in 2019 before being severely impacted by COVID-19. Moreover, the profound effects of the pandemic and social distancing measures have drawn considerable attention to this sector throughout the recovery process. It is worth noting that empirical studies focusing on the causal relationship between tourism development and financial inclusion are scarce, while theoretical evidence is relatively abundant. Thus, this study aims to assess the causal effects of tourism development on financial inclusion and its components.

There are at least two additional reasons why examining the role of tourism development (TD) in financial inclusion (FI) is essential: (i) it is crucial to establish a sustainable tourism strategy, assessing its impact on various aspects of the economy, where finance serves as its lifeblood; and (ii) reevaluating the relationship between tourism development and comprehensive finance provides a more accurate perspective for their post-COVID-19 recovery. Moreover, the TD–FI relationship is complex and requires consideration of multiple interrelated development conditions, given the fragmented nature of the tourism industry. Accordingly, each element, such as landscapes, cuisine, lodging, and local culture, plays a crucial role in ensuring sustainable tourism development. As Le and Tran (2023, p. 2) noted, “it requires the alignment of stakeholders in the exploitation of public heritage and chain tourism services such as catering, accommodation, and regulation with local governing bodies”. Thus, a deeper understanding of the contextual conditions is necessary to harness the benefits of tourism development for the local community. Scheyvens (1999) claims that tourism’s ultimate goal is to empower the local community to develop their culture and indigenous tourism.

This research makes several contributions. First, it identifies the causal relationship between tourism development (TD) – represented by four dimensions, namely tourism revenue, passenger arrivals, consumer goods consumption, and commercial centres – and financial inclusion in Vietnam from 2013 to 2020. Considering its rapid socio-economic transformations, studying a dynamic economy such as Vietnam is noteworthy (Fan et al., 2019). Vietnam has a prosperous and fast-growing tourist sector, as well as various UNESCO-recognised tangible and intangible heritages and sub-national

policy independence at the provincial level, referred to as an “independent laboratory” (Tu-Anh and Perkins, 2021). This sub-national focus creates favourable conditions for establishing causal relationships.

Second, we utilise the generalised method of moments (GMM) estimator with UNESCO-recognised heritage as an exogenous instrumental variable to account for unobservable heterogeneity, potential dynamic endogeneity, and simultaneity. The study combines household-level data to assess the financial inclusion index with provincial-level macro data, creating a unique panel dataset for impact evaluation. Third, the study is a pioneer in assessing the role of contextual factors in moderating the relationship between TD and FI. Accordingly, we concentrate on three common discussions: the need for a practical institutional framework (e.g. formalisation and corruption reduction), private sector development (both domestic and foreign), and educational attainment. Our research aims to help policymakers understand the significance of contextual factors in constructing sustainable tourism development strategies, empowering local communities, and preserving indigenous cultures against the encroachment of modern forms of entertainment. Furthermore, the study contributes to the body of knowledge related to sustainable tourism development and improved financial inclusion.

The remaining parts of the study are organized as follows: Section 2 provides a literature review on discussions related to the impact of tourism development on financial inclusion and the specific context in Vietnam. Section 3 presents the research data and methodology, followed by Section 4 presents the research findings. Section 5 discusses the achieved results and proposes some policy implications.

1. Literature review

1.1. *Tourism development and financial inclusion*

Karpowicz (2016) states that barriers to financial exclusion can be classified into access, depth, and efficiency. Accordingly, access barriers are related to physical infrastructure, documentation requirements set by financial institutions, and bureaucratic procedures involved in accessing financial services, while depth barriers encompass collateral requirements, information disclosures, and contract enforcement procedures. Indeed, factors like distance to financial facilities and burdensome paperwork can discourage both individuals and businesses from utilizing formal financial services, making them significant hindrances to financial inclusion (Demirguc-Kunt et al., 2018).

Regarding efficiency, Honohan (2008) continues that the informal market faces constraints due to limited capacity and resources, and the formal financial market's operations are influenced by rules and regulations that may lead to the exclusion of marginalized groups. Financial exclusion may also arise voluntarily, referred to as “voluntary exclusion” (Sanderson et al., 2018). This occurs when individuals, for religious, cultural, or disinterest reasons, choose to store money at home using traditional methods like burying it in jars, considering it a characteristic and secure practice among local communities. Moreover, limited financial services in underdeveloped regions, combined with the risk of fraud, may further diminish local residents' trust in these offerings, resulting in limited financial inclusion opportunities. Given the arguments above, tourism development (TD) can enhance financial inclusion through various mechanisms, as indicated by previous studies. *First*, TD often requires infrastructure improvements, primarily through increased private sector investments in transportation networks, communication systems, and banking facilities. For instance, the influx of tourists motivates financial institutions to expand their services to cater to both tourists and local residents (Kusluvan et al., 2010). This expansion creates the establishment of new branches, ATMs, and mobile banking

services in underserved areas, thereby improving financial access. These infrastructure investments enhance the availability of financial services, particularly in remote regions, thus broadening the reach of formal financial institutions (Sarma & Pais, 2011).

Furthermore, improved access to banking services, including mobile banking and digital payment systems, allows previously unbanked individuals and small businesses to engage in the formal financial system, resulting in economic empowerment and fostering financial inclusion (Donovan, 2012). Arner et al. (2020) assert that this empowerment benefits local businesses and individuals by facilitating savings, credit access, and investment opportunities. *Second*, expanding the tourism industry creates employment prospects, particularly within the informal sector, resulting in higher income levels and reduced poverty rates (Giaoutzi & Nijkamp, 2006). As individuals experience improved financial circumstances, they become more inclined to interact with formal financial services, including opening bank accounts, accessing credit facilities, and utilizing savings products. This heightened involvement in formal financial services provides a foundation for accessing other financial instruments, such as insurance and investment opportunities, thus enhancing financial inclusion (Giaoutzi & Nijkamp, 2006). *Third*, tourism development catalyzes entrepreneurship and the growth of small and medium-sized enterprises (SMEs) (Liu, 2003), contributing to the expansion of the financial sector and the diversification of financial services. In response to the demands of the tourism industry and associated businesses, financial institutions introduce innovative financial products tailored to the needs of entrepreneurs, such as microcredit and microinsurance, which facilitate financial inclusion among previously underserved populations. This mechanism, which reduces involuntary exclusion (Sanderson et al., 2018), enhances trust in the financial system and addresses barriers like affordability, inappropriate product design, and eligibility criteria. As stated by Deaton (2013), developing new products through the growth of private enterprises makes them more accessible, affordable, and beneficial for all, including the poor and vulnerable in society. Ohlan (2017) adds that the upsurge in tourism creates a demand for various goods, services, and experiences, opening opportunities for local entrepreneurs to enter the market and cater to these needs. To seize these opportunities, entrepreneurs often require access to financial services to initiate or expand their ventures. Notably, tourism development has notable impacts in reducing voluntary exclusion, as the exposure to foreign tourists may influence the local residents' mindset regarding financial services. Positive experiences with financial services combined with increased demand for larger payment transactions contribute to enhancing trust levels and knowledge utilization of financial services, ultimately improving financial inclusion.

The consideration of tourism as a driver of FI has faced significant criticism. *First*, as observed during the COVID-19 pandemic, an overreliance on tourism as the primary economic sector can render local economies vulnerable. This overdependence may impede diversification efforts, limiting the growth of other industries and reducing economic resilience, especially in light of fluctuations in tourist arrivals and economic downturns caused by the pandemic (Podhorodecka, 2018). *Second*, the influx of tourists often leads to price hikes, particularly in popular tourist destinations, making living costs unaffordable for local residents. Consequently, they may struggle to cope with escalating rents, food prices, and other essential needs. It is essential to note that in economies heavily reliant on tourism during the COVID-19 era, rapid decreases in cash flow (mainly from tourism) have generated significant financial costs across various service sectors. Thus, this has restricted the introduction of new financial services and increased the financial burden on existing services (Podhorodecka, 2018).

Another reason in the specific context of developing countries and decisive government intervention is crowding-out effects. Indeed, the need to invest in and maintain tourist infrastructure, encompassing airports, hotels, roads, and utilities, make local governments may bear the burden of these costs, diverting resources from other crucial sectors like education, healthcare, and public services. This imbalance can impede overall financial development and worsen inequalities within the community (Hall & Lew, 2009). Another concern relates to the time lag in the impact of tourism on FI. Indeed, when destinations invest in tourism infrastructure and services, it takes time for these developments to attract an increasing number of visitors and generate substantial tourist expenditures, which, in turn, go to positive effects on the financial status of the local economy (e.g., business revenues and government taxes & fees) (Balaguer & Cantavella-Jorda, 2002; Comerio & Strozzi, 2019). However, a thriving tourism industry can bolster a destination's reputation over time, attract further investments, and significantly contribute to economic and financial market growth (Tugcu, 2014).

1.2. The roles of conditional background

Tourism is a highly fragmented industry, different from others that produce a specific product, necessitating the involvement of multiple stakeholders. This, for example, includes public governments for exploiting public heritage, the private sector for chain tourism services, and local residents for their indigenous culture. Specifically, concerning the financial domain, developing tourism to yield financial welfare for local populations requires several factors, such as the commitment of local businesses, effective institutional frameworks, and educational attainment. Manyara and Jones (2007) emphasize the concept of community-based enterprises (CBEs) and underscore the role of the private sector in empowering local communities compared to foreign corporations, which may increase local dependence on their operations, including financial aspects. The authors argue that revenue generated by local enterprises tends to circulate within the community, benefiting a broader range of stakeholders and contributing to the local economy. For example, in Vietnam, the rapid increase in tourist arrivals in the Northwest provinces (e.g., Sa Pa) does not significantly boost the local revenue because tourists spend little in these areas, given the facts that limited development of local products/services.

Duval (2004) also cautions that in areas with substantial tourism revenue, large multinational corporations and international hotel chains often dominate the local tourism industry, leading to the repatriation of profits to their home countries. This dominance of foreign corporations can create challenges for locally-owned enterprises, resulting in a loss of economic benefits within the community. Additionally, tourists' demand for imported goods and services can further exacerbate leakages, where a significant portion of tourist spending remains outside the local economy (Canh & Thanh, 2020; Nguyen et al., 2021). It should be noted that fostering financial inclusion is not solely about providing access but also involves stimulating employment and generating revenue at the local level. Scheyvens (1999) concludes that empowering residents in the tourism development process is an ultimate goal in national development, enriching indigenous cultures.

The institutional framework is the next crucial moderating factor, besides the maturation and integration of the domestic private sector. Accordingly, given that some developing countries possess famous landmarks (e.g., the pyramids in Egypt), when there is a significant proportion of informal sector activities, an increase in the number of tourists not only fails to improve the local financial market but may exacerbate the prevalence of informal financial services. This is because, in some underdeveloped regions, local residents try to take advantage of tourists ("rid off") for various tourism-related expenses (e.g., taxi fares to reach historical sites or fees for guided tours). To do so, they must

rely on cash-based payment methods. It should be noted that evolving private services (e.g., Uber and Grab) mitigate this issue.

In the same vein, Buultjens et al. (2016) find that although Sri Lanka experienced a large influx of foreign tourists, the government's ineffective policies negatively impacted the livelihoods of economically disadvantaged individuals in various sectors, including the financial sector. At a more effective management level, Stone and Stone (2011, p. 97) affirm that different institutional and governance mechanisms result in different impacts on tourism development, particularly emphasizing the significance of "training for local people in tourism and management and use of single-community rather than multi-community trusts."

Education is another crucial factor in transforming tourism benefits into financial well-being for individuals. For instance, education enriches the positive nexus by equipping individuals with the necessary skills and knowledge to access formal financial services, make informed decisions, and foster entrepreneurship. This empowerment of local communities promotes economic diversification and ensures sustainable growth (Atkinson & Messy, 2013; Nawaz, 2022). Taking all the aforementioned arguments into consideration, combined with the time lag effects of tourism development on financial inclusion, it explains why some studies, when examining the general equilibrium analysis, do not observe clear impacts (Kumar, 2014).

1.3. Vietnam's context

Financial inclusion for individuals in Vietnam has shown significant progress in recent times, primarily due to the combined efforts of the government, the private sector, and technological advancements. The nation has achieved notable advancements in expanding access to formal financial services for its population by adopting digital payment systems and mobile banking platforms, such as Momo, Shopee Pay, ZaloPay, and other online payment services. In the context of local tourism activities in Thua Thien Hue province, for example, Huế-S has been developed to facilitate payments for tourism-related expenses.

However, foreign direct investment (FDI) in the tourism sector in Vietnam has been relatively limited. As of 2021, the total number of investment projects in accommodation and food services, as well as arts, entertainment, and recreation, were only 26 and 1, respectively, out of 1818 projects. Similarly, the registered capital for these projects accounted for less than 0.5% of the overall FDI registered (General Statistical Office [GSO], 2023a). Nonetheless, it is worth mentioning that commercial centres in major cities have seen significant contributions from foreign companies, such as Aeon Mall (Japan), Saigon Centre, and Diamond Plaza (Singapore). Vietnam's financial access can be categorized into three types: formal (banking and state-owned financial institutions), informal (relatives, informal networks, and some alternative methods like Hui/Ho), and semi-informal (Putzeys, 2002). Notably, a considerable disparity exists in the level of financial development across the country; Accordingly, predominantly underdeveloped regions mainly rely on informal financial sources (e.g., from relatives), while big cities show relatively substantial ownership rates of bank accounts, ATMs, credit cards, and online payment services. The figure below illustrates the variations in the four component indices for financial inclusion in Vietnam.

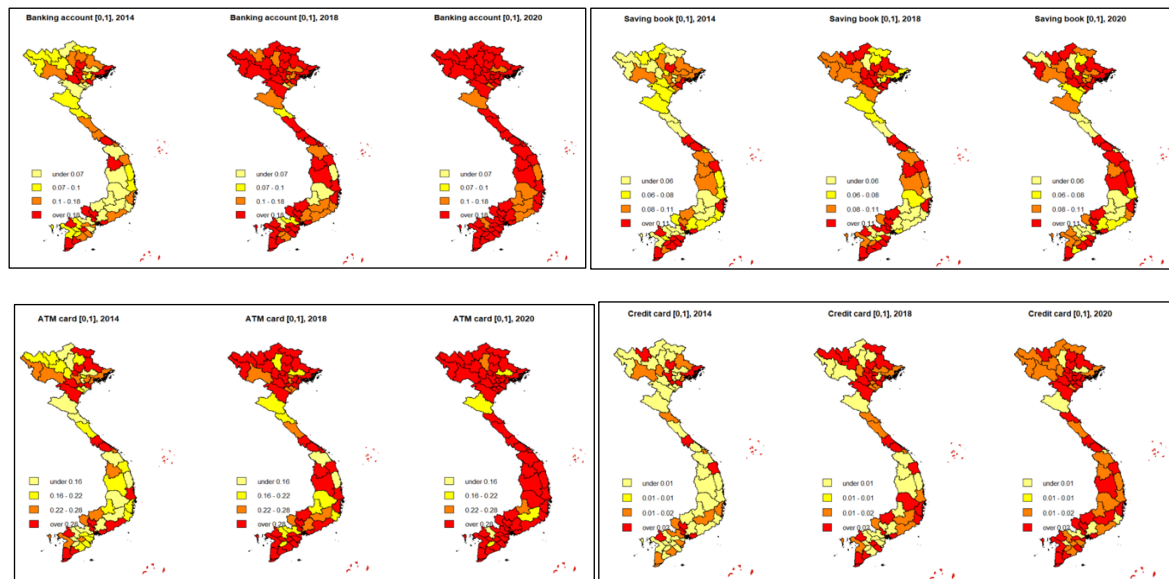


Figure 1. The evolution of financial inclusion components, 2014-2020

Note: The data is computed at the household level and aggregated to the province/city level.

Source: Authors.

The impact of various contextual factors (e.g., private sector development, institutional framework, and educational attainment) on financial inclusion in Vietnam is quite evident. Specifically, in the pre-COVID-19 era, the Northwestern mountainous regions, such as Sa Pa (Lào Cai), Mộc Châu (Sơn La), and Hà Giang, characterized by a high concentration of ethnic minority groups and attractive tourist destinations, witnessed a rapid expansion of banking services, including ATM and credit card account openings. Also, online payment services for tourism-related transactions experienced increased utilization.

Concerning government management, the phenomenon of “zero-dong tours” or “negative-price tours” does raise the hypothesis about the sound institutional framework requirement for the nexus between TD and FI. In such tours, foreign travel companies cover all expenses for welcoming tourists, including monetary incentives to the companies that send the tourists. These foreign companies recoup their initial costs through additional services or shopping experiences at the destination, and these services are primarily connected with other foreign companies rather than local service providers. Consequently, domestic travel agencies do not profit significantly from such cheap or “zero-dong” tours, as most of the profits flow back to the travel companies in the tourists’ country of origin.

Regarding the impact of educational attainment on the relationship, a noticeable phenomenon can be observed in the North Central and Northern Mountainous regions. In these areas, both the role of tourism and educational attainment have experienced notable increases. Specifically, the North Central and Northern Mountainous regions have seen a considerable rise in tourist revenues, from 141.7 billion VND in 2014 to 387.7 billion VND in 2019. Moreover, educational attainment has significantly improved, with the proportion of high school graduates increasing from 65.76% in 2006 to nearly 97.84% after ten years in 2016 (General Statistical Office [GSO], 2023b). These regions also exhibit a high growth rate in the adoption of formal financial services (ATM cards, bank accounts, and credit cards) compared to other regions in the country. The figure below illustrates a comparison of financial inclusion indices (detailed calculation provided in the subsequent section) at each percentile level.

Accordingly, the left panel of Figure [2] illustrates that provinces/cities with higher levels of educational attainment (literacy $\geq 50\%$) exhibit greater financial inclusion across all percentiles, while the right panel of Figure [2] asserts that those with better public governance (as indicated by the Provincial Competitiveness Index [PCI]) demonstrate higher performance in terms of financial inclusion.

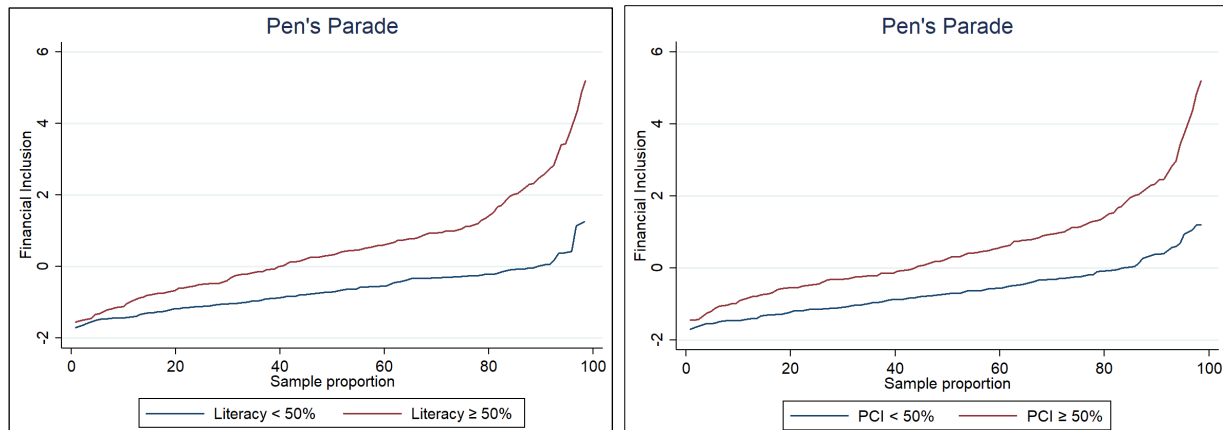


Figure 2. Pen's Parade for financial inclusion based on the literacy and institutional level, Vietnam from 2013 to 2020

Source: Authors. Notes: The acronym PCI refers to the Provincial Competitiveness Index, which reflects a superior quality of public governance from a business perspective.

2. Data and methodology

2.1. Data

Sanderson et al. (2018) review studies investigating the determinants of financial inclusion and find that most research employs two main types of data: micro-level data (individual or household level) or macro-level national data. While micro-level studies may not account for factors related to local cultural characteristics, national-level research does not guarantee to identify heterogeneous unobservable factors influencing local financial development (Patten, 2016). Hence, this study leverages data at the sub-national level (i.e., the 63 provinces and cities in Vietnam). We utilize data from three primary sources.

First, financial inclusion refers to individuals' and families' access and usage of affordable financial services and products to manage their financial needs effectively. This concept encompasses the availability and usage of services like savings accounts, loans, insurance, payment systems, and other financial tools that are accessible, affordable, and suitable for households to participate fully in the formal financial system (Demirguc-Kunt et al., 2018). Following this definition, Tran and Dinh (2021) provide available data to examine the level of comprehensive financial inclusion in Vietnam from the household-level Vietnam Household Living Standards Survey (VHLSS) dataset, including indicators such as receiving larger formal loans, having bank accounts, savings books, and ATM cards. It is worth noting that VHLSS also records some information about non-life insurance. However, upon detailed examination, most of these insurance types are not related to financial services but primarily personal property insurance (e.g., home or automobile). The household-level data is then aggregated at the provincial level annually and is available from 2014 to 2020.

To build the financial inclusion index, akin to prior research by Tran and Dinh (2021), we use Principal Component Analysis (PCA) to reduce the data dimensionality from four components: having bank accounts, savings books, credit cards, and ATM cards. It is pertinent to note that, alongside

the theoretically representative factors for the financial inclusion index and the data's availability, the components utilized for computation above facilitate a relatively comprehensive examination of various types of financial services in Vietnam, thereby offering a holistic perspective on the issue under consideration. Also, to the best of our knowledge, the current study provides the most extended dataset on financial inclusion in Vietnam, spanning from 2014 to 2020. The composite index is calculated using the following formula (see details in Appendix 1); thus, it will exhibit a standardized distribution (with a mean of 0 and a standard deviation of 1). The evolution of financial inclusion in Vietnam from 2014 to 2020 is shown in the Appendix 2.

$$FI_{i,t} = \sum_{m=1}^4 Eigenvalue_{j,i,t} \times Proportion_{i,j,t} \quad (1)$$

Second, tourism revenue is often considered the primary proxy in research assessing the impact of tourism development (TD) on the variables of interest (Canh & Thanh, 2020; Nguyen et al., 2021); we also explore other aspects, such as the number of tourists (including both domestic and international tourists), the number of shopping centres, and the volume of goods transported to these tourism destinations. Investigating the number of passengers and the volume of goods transported to tourism destinations can provide valuable insights into the willingness to pay for tourism activities by each passenger (Le & Tran, 2023), while the number of shopping centres partially reflects the quality of tourism development. It is worth noting that Vietnam experiences varying levels of tourism development, as some provinces/cities attract a large number of tourists (e.g., Hà Giang) but do not generate significant tourism revenue, whereas others (e.g., Đà Lạt) capitalize on tourism-related activities to generate substantial income. Thus, collecting multiple indices to define TD can provide additional information during the evaluation and formulation of appropriate policies. The tourism development data was collected from statistical yearbooks from 2010 to 2020. Additionally, we gathered other relevant data related to the socio-economic development of the provinces/municipalities, as discussed in the literature review, including private sector development, educational attainment, and other relevant indices. Third, the study employs the Provincial Competitiveness Index (PCI) as a representative measure to assess the level of institutional development. This index is widely used in empirical research (Le & Tran, 2023; Van Le & Tran, 2022; Van Le et al., 2022). We also collect manual data from UNESCO to record both tangible and intangible heritage sites in Vietnam for the robustness check of the experimental research model (see more Appendix 3).

The availability of sub-national level data in Vietnam offers notable advantages, including: (i) rapid changes in socio-economic conditions (e.g., tourism growth and financial development), (ii) relative independence in making socio-economic policy decisions of provinces and cities in Vietnam (compared to the central and other localities) produce the favourable condition to establish causal relationships by significantly mitigating the “contagion effect” (i.e., provinces and cities adapting from areas that achieved rapid tourism and financial development). Notably, Vietnam has been considered a region with numerous UNESCO-certified heritage from 1993 (e.g., the Complex of Hue Monuments) to 2022 (e.g., Art of pottery-making of Chăm people). The UNESCO recognition is an exogenous process, thus, seen as an appropriate instrument for this study. The study depicts the evolution of variables from 2013 to 2020 in Table 1.

Table 1. Descriptive statistics

Year (t) =		2013		2015		2017		2019	
	Units	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
Financial indicators									
Having banking account _{t+1}	[0,1]	0.134	0.097	0.190	0.130	0.252	0.149	0.321	0.163
Having saving books _{t+1}	[0,1]	0.091	0.057	0.102	0.068	0.116	0.072	0.122	0.072
Having ATM card _{t+1}	[0,1]	0.234	0.113	0.296	0.123	0.345	0.135	0.431	0.154
Having credit card _{t+1}	[0,1]	0.014	0.017	0.02	0.023	0.024	0.029	0.032	0.036
Financial Inclusion [FI] _{t+1}	z-score	-0.638	0.944	-0.214	1.19	0.184	1.338	0.669	1.396
Independent variables									
Tourism revenue	billion VND	441	2294	483	2505	573	2897	709	3587
Number of passengers	100 Mil-lion	0.453	1.427	0.491	1.575	0.583	1.907	0.703	2.374
Number of shopping malls	1 unit	2.381	4.817	2.683	5.538	3.063	6.096	3.825	7.12
Volume of goods sales	billion VND	0.463	0.903	0.512	0.976	0.628	1.182	0.777	1.429
Control variables									
Gross domestic product per capita	Million VND	32.339	29.329	34.796	30.641	40.263	30.771	45.699	31.444
Literacy	[0,100]	92.643	7.018	92.976	6.908	93.302	6.735	93.702	6.822
FDI implemented	US dollars (million)	212	479	293	711	269	634	248	439
Moderating variables									
Private enterprise rate	[0,1]	88.71	9.93	89.134	10.032	92.1	7.466	93.675	6.705
Domestic private enterprise (DPE)	[0,1]	69.43	18.93	68.37	19.12	68.66	19.75	69.20	20.55
Multidimensional enterprise (MNE)	[0,1]	19.281	20.506	20.762	21.168	23.436	21.737	24.477	21.897
PCI	PCI Vietnam	58.073	3.24	58.323	3.143	62.397	2.943	65.663	2.6
Instrumental variable									
UNESCO recognition	1 unit	0.127	0.421	0.143	0.435	0.159	0.482	0.159	0.482
Observation		63		63		63		63	

Source: Developed by the authors.

2.2. Econometric model

We have adapted the theoretical framework of ecotourism proposed by Ross and Wall (1999) for the basis setup. The authors emphasize the significance of fostering synergistic relationships between the local communities and tourism to achieve sustainable development objectives, with a particular focus on improving financial inclusion in our case. In the context of providing local socioeconomic benefits, the theory outlines several mechanisms that can enhance growth, and we believe they can lead to improvements in financial inclusion: (i) increasing employment opportunities and ensuring a more equitable distribution of tourism revenues can create a stable financial flow within the community; (ii) improving local infrastructure, including transportation, communications, and access to financial services, thus enhancing the ease of accessing financial services such as ATMs and credit cards; (iii) enhancing access to public services; (iv) fostering improved intercultural relations and appreciation through positive interactions between hosts and tourists, pushing the acceptance of new financial services more likely; (v) stimulating tourism-driven local capacity building, which contributes to self-sufficiency, decentralization, and empowerment of the local community; and (vi) increasing foreign exchange earnings.

Moreover, according to the research by Kusluvan et al. (2010); Ohlan (2017), local tourism development enables the growth of private financial services by providing diverse, easily accessible, and customer-tailored services that cater to various customer segments. It fosters inter and intra-business connectivity. Our study draws on two experimental research studies to assess the impact of tourism development on different variables of interest (Canh & Thanh, 2020; Nguyen et al., 2021) and incorporate findings from studies that identify factors influencing financial inclusion, as synthesized by Sanderson et al. (2018). The model is formulated as follows:

$$FI_{i,t} = \beta_0 + \beta_1 TD_{i,t-1} + \sum_{j=1}^J \beta_{i,j} Z_{i,t,t-1} + \varphi_i + \lambda t + \varepsilon_{i,t} \quad (2)$$

where $FI_{i,t}$ represents the financial inclusion (FI) index and its components in province/cities i in year t . $TD_{i,t-1}$ reflects the level of local tourism development (TD) and is represented through the four aspects mentioned earlier. Measuring the impact of TD with a lag of one year partly addresses the issue of reverse causality (as claimed by Gopalan and Khalid (2022); Shi et al. (2021)) and accounts for the time lag in their practical effects on financial development. Specifically, for instance Balaguer and Cantavella-Jorda (2002), tourism development requires time to build credibility, attract tourists, establish ecosystems, and generate sufficient financial inflows to develop the local financial market, followed by personal finance.

$Z_{j,i,t}$ denote control variables in the model, which are synthesized from previous studies. We control for educational attainment (Evans, 2016; Uddin et al., 2017) and local income level (Soumare et al., 2016; Zins & Weill, 2016). We also control for the presence of foreign direct investment (FDI) and its inflows to ensure the level of local engagement amid local economic growth (Giaoutzi & Nijkamp, 2006), thereby partly mitigating potential manipulation by foreign corporations towards local citizens (e.g., events like “zero-dong tours”). Accordingly, we utilize FDI implemented rather than registered FDI to reflect their actual impact in current times (for example, after the global financial crisis, Vietnam witnessed nearly four times the increase in registered FDI compared to 2008, while actual FDI inflows were only 1/7 of the registered amount). Notably, Arcand et al. (2015) implies the credibility of an inverted-U-shaped correlation between financial development and income per capita; thus, drawing inspiration from this study, we integrate the square of local economic growth into the estimated equations.

The symbols φ and λ denote unobservable time-invariant factors and time trends, respectively. Unobservable time-invariant factors such as geography, culture, and long-standing customs deeply embedded in the local population for centuries played a crucial role in shaping the tourism culture (e.g., Tay Nguyen gongs or Hue court music), while time trends (e.g., technology) significantly influence the ability and quality of new financial services replacing traditional financial practices (e.g., savings deposits or Vietlot vs Hui/Ho) (Jiang et al., 2022; Putzeys, 2002). The term ε reflects the errors in the model. To further investigate and validate the hypotheses concerning the contextual conditions moderating the nexus, specifically the level of private sector development (domestic), educational attainment of the population, and institutional development, we examine the influence of the interaction between TD and the moderating variables (M_j). The model is formulated as follows:

$$FI_{i,t} = \beta_0 + \beta_1 TD_{i,t-1} + \alpha_1 M_{i,t-1} + \eta_1 TD_{i,t-1} \times M_{i,t-1} + \sum_{j=2}^J \beta_{i,j} Z_{i,t,t-1} + \varphi_i + \lambda t + \varepsilon_{i,t} \quad (3)$$

where M_j represents the three main variables of interest. *First*, the development of private enterprises is measured by the proportion of domestic and foreign private enterprise labor in the total labor

force in both public and private sectors (π) (Van Le & Tran, 2022; Van Le et al., 2022). Using this index, we can differentiate the contributions of domestic private enterprises (DPE) and multinational enterprises (MNE). *Second* and *third*, the average educational attainment and the provincial competitiveness index (PCI) are considered to examine the moderating roles of educational attainment and institutional quality in the relationship.

2.3. Endogeneity

The estimation models based on equations (2) and (3) encounter certain limitations related to (i) dynamic potential endogeneity and (ii) confounding effects, which could affect the validity of the results. Dynamic potential endogeneity arises, *first*, in both models when past tourism development is influenced by previous financial inclusion levels (e.g., increased usage of convenient financial services leading to higher expenditure in tourism). In such cases, the fixed-effects estimator may introduce bias and produce inconsistent outcomes (Wintoki et al., 2012).

Second, confounding effects can also impact the estimates if both past tourism development and current financial inclusion are influenced by an external factor not captured in the model. For instance, the 2017 Law on Tourism (09/2017/QH14) introduced regulations regarding support for local tourism development. It notably emphasized the establishment of local financial development through the creation of a tourism development support fund. It should be noted that detailed guidance for setting up this fund was provided about one year later (168/2017/NĐ-CP). These external factors can confound the relationships between tourism development and financial inclusion, leading to biased estimations.

Some studies have employed the autoregressive distributed lag (ARDL) approach to estimate the relationship (Ohlan, 2017; Shahbaz et al., 2017); however, this approach has limitations in fully addressing causal relationships. For instance, ARDL assumes one-way relationships between variables and does not consider feedback effects. Thus, ARDL results may only be partially accurate when simultaneous causality exists. While ARDL can detect the presence of a causal relationship between variables, it cannot determine the direction of causality (i.e., which variable is causing changes in the other) (Paul & Bhattacharya, 2004).

We utilize a two-step generalized method of moments (GMM) estimator to overcome these issues. The GMM estimator considers unobservable heterogeneity, simultaneity, and dynamic potential endogeneity, thus providing a more robust approach (Blundell & Bond, 1998; Van Le et al., 2022; Wintoki et al., 2012). Despite the advantages, the GMM estimator relies on the additional assumption that instrument changes are uncorrelated with the fixed effects (φ), which means $E(\Delta UNESCO_{i,t}, \varphi_i) = 0$ for all i and t . The estimator can also produce spurious estimates due to their complexity. Thus, to ensure the consistency of the coefficients in the model, it is crucial to include external exogenous variables as instrumental variables (Roodman, 2009; Wintoki et al., 2012).

We use the number of UNESCO recognitions as a valid and exogenous instrument; Accordingly, the UNESCO recognition process is considered entirely independent, depending on the uniqueness of the heritage and the criteria set by the UNESCO organization. This implies the assumption of the exclusion condition for the instrumental variable, where theoretically, $Cov(u, UNESCO|Z) = 0$ is guaranteed. Regarding the relevant condition, we can easily verify the correlation of UNESCO with the explanatory variables (i.e., tourism developments)—the correlation coefficients of the instrumental variable with the explanatory variable range from 0.068 to 0.37 (see in Appendix [4]). For technical tests, we present four tests accompanying the GMM estimator: the serial correlation test of AR(1) and

AR(2), the Hansen test of overidentification, and the Diff-in-Hansen tests of exogeneity. Thus, the formula is followed by the first stage regression in equation (2).

$$TD_{it-1} = f(UNESCO_{it-1}, TD_{ijt-2}, Z_{ijt-1}) \quad (2)'$$

3. Results

3.1. Main results

Table 2 presents estimations using Ordinary Least Squares (OLS) and fixed effects (FE) regression to assess the impact of tourism development (TD) indicators on the financial inclusion (FI) index.

Table 2. Estimation results with OLS and FE estimators

Dependent variable	Financial Inclusion Index							
Estimators	OLS	FE	OLS	FE	OLS	FE	OLS	FE
Columns	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Tourism revenue in log	0.231*** (0.038)	-0.003 (0.107)						
Number of passengers			0.254*** (0.029)	0.161** (0.080)				
Number of shopping malls					0.096*** (0.013)	0.069*** (0.022)		
Volume of goods sales							0.422*** (0.077)	0.356** (0.145)
Gross domestic product per capita	0.032*** (0.007)	0.000 (0.013)	0.040*** (0.008)	0.007 (0.013)	0.034*** (0.008)	0.007 (0.013)	0.038*** (0.008)	0.008 (0.013)
Gross domestic product per capita squared	-0.000*** (0.000)	0.000 (0.000)	-0.000*** (0.000)	-0.000 (0.000)	-0.000*** (0.000)	-0.000 (0.000)	-0.000*** (0.000)	-0.000 (0.000)
Literacy	0.034*** (0.009)	-0.001 (0.044)	0.035*** (0.008)	-0.008 (0.040)	0.035*** (0.007)	-0.003 (0.039)	0.034*** (0.008)	-0.010 (0.039)
FDI implemented	0.000** (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Provinces/cities dummies	No	Yes	No	Yes	No	Yes	No	Yes
Constant	-5.337*** (0.833)	-0.607 (4.097)	-5.025*** (0.733)	-0.123 (3.675)	-4.966*** (0.655)	-0.757 (3.632)	-4.980*** (0.727)	-0.056 (3.653)
Observations	243	243	252	252	252	252	252	252
R-squared	0.659	0.616	0.660	0.624	0.682	0.635	0.649	0.629
Number of province/city		62		63		63		63

Source: Developed by the authors.

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

In cases where both dynamic potential endogeneity and cofounders do not exist, the fixed-effects estimation will be consistent. The higher coefficient of OLS compared to FE is attributed to the influence of unobservable time-invariant factors (e.g., cultural communication, geography, ethnicity), causing the OLS estimates to be overestimated.

The initial estimations confirm the ecotourism/tourism-led growth theory in the financial sector. Specifically, an increase in the number of passengers, shopping malls, and volume of goods sales led to an increase in the financial inclusion index in Vietnam from 2013 to 2020. The visually linear relationship between tourism development and financial inclusion also is demonstrated in the Appendix 5. These findings are also consistent with previous studies that highlight how tourism development can enhance financial markets, financial services, and individual finances (Donovan, 2012; Giaoutzi & Nijkamp, 2006; Kusluvan et al., 2010; Liu, 2003; Ridderstaat et al., 2022).

The results of the generalized method of moments (GMM) are presented in Table [3], considering unobservable heterogeneity, simultaneity, and dynamic potential endogeneity. In this analysis, UNESCO recognition is employed as an exogenous instrument, along with lagged instruments, to ensure consistent estimation (Roodman, 2009; Wintoki et al., 2012). As a rule of thumb, the estimated parameter using 2SLS should not exceed three times that of the corresponding estimate obtained through OLS (Lal et al., 2023). Also, technical tests (i.e., AR(1), AR(2), Hansen test of overidentification restrictions, and Difference-in-Hansen tests of instrument exogeneity) further confirm the instrument's validity. It is noteworthy that the coefficient of tourism revenue to FI in column (2) of Table 2 is not statistically significant, whereas its coefficient in column (1) of Table 4 is positive and statistically significant, reflecting the consequence of estimation bias when endogeneity exists. Thus, Table 3 provides consistent results of causal effects.

Furthermore, the results present a positive and statistically significant correlation between literacy and financial inclusion in Vietnam, consistent with previous studies (Atkinson & Messy, 2013; Nawaz, 2022). This finding reinforces the link between educational attainment and financial access and usage, supporting that improved literacy can enhance individual financial welfare. We also reconfirm the hypothesis posited by Arcand et al. (2015), which suggests the existence of an inverted U-shaped correlation between financial development and income per capita.

Table 3. Estimation results with GMM estimator

Dependent variable	Financial Inclusion Index			
	GMM	GMM	GMM	GMM
Estimator				
Columns	(1)	(2)	(3)	(4)
Tourism revenue in log	0.274** (0.118)			
Number of passengers		0.242*** (0.041)		
Number of shopping malls			0.079*** (0.028)	
Volume of goods sales				0.369*** (0.080)
Gross domestic product per capita	0.034** (0.015)	0.032*** (0.011)	0.032** (0.016)	0.030** (0.015)
Gross domestic product per capita squared	-0.000*** (0.000)	-0.000*** (0.000)	-0.000* (0.000)	-0.000* (0.000)
Literacy	0.055 (0.052)	0.159*** (0.049)	0.144*** (0.049)	0.174*** (0.059)
FDI implemented	0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
Year Dummies	Yes	Yes	Yes	Yes
Constant	-7.382 (4.590)	-16.358*** (4.551)	-14.927*** (4.713)	-17.723*** (5.441)

Columns	(1)	(2)	(3)	(4)
Observations	243	252	252	252
Number of province/city	62	63	63	63
Exogenous instrument	UNESCO, 1-year lagged of dependent variables			
AR(1)	0.041	0.033	0.011	0.018
AR(2)	0.350	0.417	0.555	0.565
Hansen test of overid. restrictions	0.688	0.446	0.137	0.486
Difference-in-Hansen tests of exogeneity of instrument subsets (p-value)	0.400	0.674	0.109	0.258

Source: Authors.

Note: Standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

3.2. The role of contextual factors and robustness checks

We further extend the empirical examination of the moderating factors' influence on the nexus, as depicted in equation (3). The results are presented in Table [4]; Accordingly, *first*, in Panel A, the moderating effect of education attainment on the relationship is confirmed in columns (1), (3), and (4). Specifically, when local tourism revenue (column [1]) increases, the financial inclusion index grows faster with increasing individuals' educational attainment. This finding aligns with prior research (e.g., Sanderson et al. (2018)), which suggests the concept of voluntary exclusion. For example, individuals' participation in financial services may be hindered by their lack of awareness of the convenience of such services. Thus, as educational levels rise, financial services are optimally utilized from tourism revenue increase, leading to an increase in financial inclusion. This phenomenon can be readily observed in recent years in the Northwestern mountainous regions of Vietnam (e.g., Sa Pa [Lào Cai], Mộc Châu [Sơn La], and Hà Giang), which are home to various ethnic minority groups and attract tourists; Accordingly, these destinations have witnessed the rapid expansion of banking services (e.g., ATM and credit card accounts).

Second, in Panel B of Table 4, we examine the moderating role of institutional quality, represented by the provincial competitiveness index (PCI), on the relationship. Institutions can influence locals' engagement level in tourism development and their ability to obtain a larger share of its benefits through various mechanisms. For instance, Stone and Stone (2011) emphasize using single-community trusts instead of multi-community trusts in tourism development to maximize benefits for local communities. Another example is the phenomenon of "ripping off tourists" at tourist destinations in developing countries; Accordingly, given inefficient institutions, various exploitative practices may take advantage of tourists, and to do so, the locals frequently maintain cash payment instead of transitioning to online financial services. Consequently, ineffective institutions may adversely affect the nexus in the early stages of tourism development.

Community-based enterprises (CBEs) within the tourism industry emphasize the significance of local private enterprise involvement in the development of the welfare of localities compared to foreign enterprises (Duval, 2004; Manyara & Jones, 2007). The authors imply that the answer to whether tourism development positively impacts local people's welfare lies in the profit margin of tourism activities for local tourism revenue (e.g., the phenomenon of "zero-dong tours" in Vietnam and Thailand). Van Le and Tran (2022); Van Le et al. (2022) indicate that growing both domestic and foreign private enterprises contributes significantly to poverty reduction, inequality reduction, and the yield of diverse financial services at affordable prices for the local population. Thus, evaluating the moderating impact of (domestic) private sector development (PSD) on the nexus may yield mixed results.

Third, we test this hypothesis in Panel C of Table 4. The results show that the moderating effect of PSD on the relationship is statistically significant (columns [1], [3], and [4]); Accordingly, this effect primarily stems from domestic private enterprises and not from foreign private enterprises. This once again confirms the role of domestic business network development in sustainable tourism development, given that the local domestic private enterprises also better understand the local culture and empower localities. This finding is consistent with the observations made by Canh and Thanh (2020) in low- and lower-middle-income countries, indicating that domestic tourism reduces economic instability compared to foreign tourism by creating new jobs and fostering stable domestic investment while being less reliant on external demand and supply, which could potentially pose international shocks. Notably, foreign tourists engaged in “zero-dong tours” or “negative-price tours” in Vietnam neither contribute to the domestic economy nor foster the development of domestic financial services.

Table 4. The role of moderating factors in the relationship between TD and FI

	(1)	(2)	(3)	(4)
Dependent variables:	Financial Inclusion Index (overall)			
Variables of Interest	Tourism revenue in log	Number of passengers	Number of shopping malls	Volume of goods sales
Panel A: Literacy				
Literacy × variables of Interest	0.050*** (0.012)	0.106 (0.089)	0.017** (0.008)	0.205*** (0.072)
Observations	243	252	252	252
R-squared	0.653	0.627	0.643	0.644
Number of province/city	62	63	63	63
Panel B: Provincial Competitiveness Index (PCI)				
PCI × variables of Interest	0.479* (0.250)	0.774 (0.603)	0.197* (0.116)	1.520 (1.285)
Observations	243	252	252	252
R-squared	0.628	0.634	0.645	0.636
Number of province/city	62	63	63	63
Panel C: Private Sector Development (PSD) = Domestic Private Enterprises (DPE) + Multinational Enterprises (MNE)				
PSD × variables of Interest	0.012** (0.005)	0.019 (0.014)	0.003* (0.002)	0.038* (0.020)
R-squared	0.641	0.639	0.650	0.645
Panel C.1: Domestic Private Enterprises (DPE)				
DPE × variables of Interest	-0.000 (0.002)	0.005* (0.003)	0.001** (0.001)	0.007* (0.004)
R-squared	0.621	0.636	0.648	0.638
Panel C.2: Multinational Enterprises (MNE)				
MNE × variables of Interest	0.003 (0.002)	-0.004 (0.003)	-0.001 (0.001)	-0.004 (0.004)
R-squared	0.622	0.629	0.638	0.631
Observations	243	252	252	252
R-squared	0.621	0.636	0.648	0.638
Number of province/city	62	63	63	63

Source: developed by the authors.

Note: All model are controlled for (i) variables of interest, (ii) moderating variables, (iii) control variables, (iv) and year dummies. Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

To examine the mechanisms of how each facet of local tourism development impacts financial inclusion (FI), we investigate the effects of these aspects on FI components: having banking accounts,

saving books, ATM cards, and credit cards. The results are presented in Appendix [6], with several notable findings as follows: (i) an increase in tourism revenue enhances the proportion of individuals owning ATM cards; (ii) the influx of tourists and goods through tourist destinations improves both banking accounts and credit card ownership; and (iii) the presence of shopping malls (representing shopping hubs) positively influences the payment methods of individuals (i.e., ATM and credit cards) and banking account ownership.

Conclusions

The study examines the impact of tourism development (TD) on financial inclusion (FI) in Vietnam, focusing on the role of contextual factors (i.e., domestic private sector development, education attainment, and institutional quality). Our analysis utilizes a two-step generalized method of moments (GMM) estimator, considering unobservable heterogeneity, simultaneity, and dynamic potential endogeneity. To ensure consistency in estimation, we use the UNESCO recognition as an exogenous instrument alongside lagged instruments (Roodman, 2009; Wintoki et al., 2012). The findings confirm the theoretical perspective of ecotourism and tourism-led growth in the financial domain. Accordingly, the increase in tourism revenue, the number of passengers, shopping malls, and the volume of goods sales positively contribute to the FI index and its components in Vietnam from 2013 to 2020.

Notably, effective institutions (as proxied by PCI) and higher education levels are identified as moderating factors that enrich the positive effects of tourism on financial inclusion. Domestic private sector development emerged as crucial in promoting financial inclusion, as predicted by community-based enterprises (CBEs) theory, where higher engagement of localities contributes to local welfare compared to large multinational corporations.

Based on our findings, several policy implications can be drawn to promote tourism development and financial inclusion as follows: (i) policymakers should prioritize supporting the growth of domestic private sector enterprises, especially community-based enterprises; Accordingly, emphasizing local ownership will benefit the locals and its economy; (ii) Investing in education, particularly in underserved areas, is vital to improving financial inclusion. Indeed, higher education levels were associated with reducing financial voluntary exclusion and facilitating more significant engagement with formal financial services, contributing to increased financial inclusion; and (iii) enhancing institutional quality is crucial to creating a fair and transparent environment for the tourism industry, ensuring responsible tourism practices and empowering local communities.

Our research has certain limitations that should be acknowledged. First, financial inclusion measurement has some constraints, as specific components, particularly financial loans and related insurance, were not fully captured. Second, the data recorded for the 63 provinces from 2013 to 2020 is relatively limited, especially when utilizing the GMM estimator with lagged variables as instrumental variables, which may produce spurious results in cases with small sample sizes and short observation periods. However, these limitations are mainly due to data availability in Vietnam and can be addressed in the future with more comprehensive and abundant data. Moreover, the instrumental variable used in this study (UNESCO recognition) is theoretically and technically valid, thus yielding consistent results.

Future research can further develop in several aspects. First, they examine the relationship in the context of COVID-19, where social distancing policies have significantly impacted the tourism industry, creating shocks that require investigation—second, exploring the influence of informal sectors on

the relationship under study, as they play a substantial role in the Vietnamese economy. A more comprehensive understanding of the dynamics between tourism development and financial inclusion can be achieved by addressing these areas in future studies. In other words, incorporating lagged dependent variables into the estimated equations may be a feasible option for future research.

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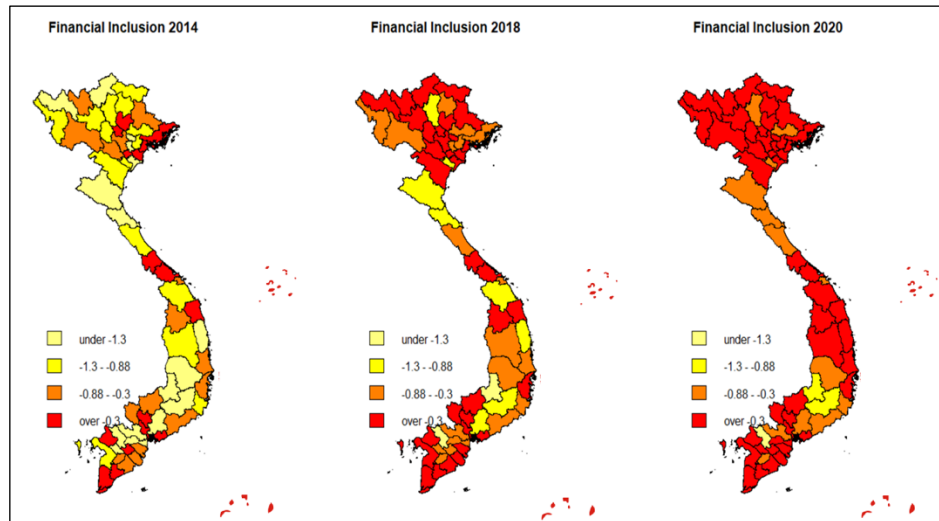
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Appendixes

Appendix 1. Parameters to calculate the financial inclusion index, using PCI

Components	Eigenvalue	Difference	Proportion	Cumulative
Component 1	3.016	2.449	0.754	0.754
Component 2	0.567	0.238	0.142	0.896
Component 3	0.328	0.239	0.082	0.978
Component 4	0.089	.	0.022	1.000

Source: developed by the authors.

**Appendix 2.** Evolution of financial inclusion in Vietnam, 2014-2020

Source: developed by the authors.

Appendix 3. List of tangible and intangible heritage recognized by UNESCO in Vietnam

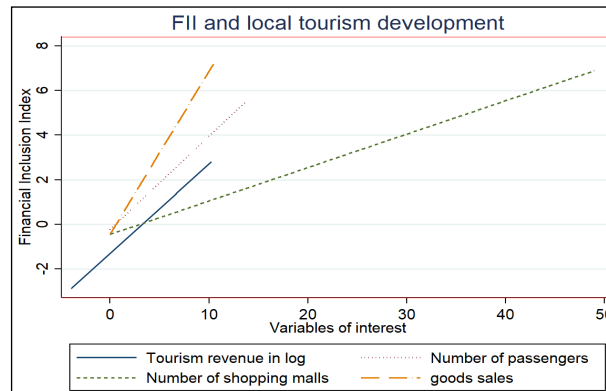
Provinces/cities/region	Elements on the Lists	Year of recognition
Tangible Cultural Heritage		
Quang Ninh	Hạ Long Bay	1994/2000
Thua Thiên Huế	Complex of Huế Monuments	1993
Quang Nam	Mỹ Sơn Sanctuary	1999
Quang Nam	Hội An Ancient Town	1999
Quang Bình	Phong Nha – Kẻ Bàng National Park	2003
Ha Noi	Central Sector of Imperial Citadel of Thăng Long	2010
Thanh Hoa	Citadel of the Hồ Dynasty	2011
Ninh Bình	Tràng An Landscape Complex	2014
Intangible Cultural Heritage		
Hue	Nha Nhac, Vietnamese court music	2003
Kon Tum, Gia Lai, Dak Lak, Dak Nong and Lam Dong.	Space of gong culture	2005
Phu Tho, Vinh Phuc, Hanoi, Bac Giang, Bac Ninh, Hai Phong, Hai Duong, Hung Yen, Ha Nam, Nam Dinh, Thai Binh, Ninh Binh, Thanh Hoa, Nghe An, Ha Tinh and Quang Binh.	Ca trù singing	2009
Bac Ninh	Quan Họ Bắc Ninh folk songs	2009
Ha Noi	Gióng festival of Phù Đổng and Sóc temples	2010
Phu Tho	Xoan singing of Phú Thọ province, Viet Nam	2017
Phu Tho	Worship of Hùng kings in Phú Thọ	2012
Southern Vietnam	Art of Đờn ca tài tử music and song in southern Viet Nam	2013
Nghe An, Ha Tinh	Ví and Giặm folk songs of Nghệ Tĩnh	2014
Vinh Phuc, Bac Ninh and Hanoi	Tugging rituals and games	2015
Quang Binh, Quang Tri, Thua Thiên Hue, Quang Nam, Quang Ngai, Binh Dinh, Phu Yen, Khanh Hoa and Da Nang	The art of Bài Chòi in Central Viet Nam	2017
Northwest region	Practices of Then by Tày, Nùng and Thái ethnic groups in Viet Nam	2019
Lai Chau, Son La, Dien Bien, Yen Bai.	Art of Xòe dance of the Tai people in Viet Nam	2021
Ninh Thuan	Art of pottery-making of Chăm people	2022

Source: Author synthesis from UNESCO

Note: <https://ich.unesco.org/en/state/viet-nam-VN?info=elements-on-the-lists>**Appendix 4. Correlation between explanatory and instrumental variables**

	UNESCO	Tourism revenue in log	Number of passengers	Number of shopping malls	Volume of goods sales
UNESCO	1.000				
Tourism revenue in log	0.370	1.000			
Number of passengers	0.124	0.559	1.000		
Number of shopping malls	0.091	0.630	0.894	1.000	
Volume of goods sales	0.068	0.611	0.925	0.941	1.000

Appendix 5. Linear relationship between tourism development indicators and financial inclusion index, Vietnam from 2013 to 2020



Source: Authors

Appendix 6. Regression of tourism revenue on financial inclusion components

Dependent variables	Financial Inclusion	Banking Account	Saving books	ATM card	Credit card
Tourism revenue in log	-0.003 (0.107)	0.003 (0.013)	-0.003 (0.007)	0.023* (0.012)	-0.003 (0.003)
Gross domestic product per capita	0.000 (0.013)	-0.002 (0.002)	0.001* (0.001)	-0.001 (0.001)	-0.000 (0.000)
Gross domestic product per capita squared	0.000 (0.000)	0.000* (0.000)	-0.000* (0.000)	0.000 (0.000)	0.000 (0.000)
Literacy	-0.001 (0.044)	0.002 (0.006)	0.001 (0.003)	-0.004 (0.005)	-0.000 (0.001)
FDI implemented	0.000 (0.000)	0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	0.000 (0.000)
Dummy variables	Yes	Yes	Yes	Yes	Yes
Constant	-0.626 (4.086)	-0.043 (0.520)	0.020 (0.286)	0.545 (0.462)	0.028 (0.133)
Observations	243	243	243	243	243
R-squared	0.616	0.687	0.188	0.742	0.220
Number of province/city	62	62	62	62	62

Source: Authors.

Note: Standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Appendix 7. Regression of number of passengers on financial inclusion components

Dependent variables	Financial Inclusion	Banking Account	Saving books	ATM card	Credit card
Number of passengers	0.161** (0.080)	0.016 (0.010)	-0.003 (0.006)	-0.001 (0.009)	0.011*** (0.003)
Gross domestic product per capita	0.007 (0.013)	-0.001 (0.002)	0.002* (0.001)	-0.001 (0.001)	0.000 (0.000)
Gross domestic product per capita squared	-0.000 (0.000)	0.000 (0.000)	-0.000* (0.000)	0.000 (0.000)	-0.000 (0.000)
Literacy	-0.008 (0.040)	0.002 (0.005)	-0.000 (0.003)	-0.004 (0.005)	-0.000 (0.001)
FDI implemented	0.000 (0.000)	0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	0.000 (0.000)
Dummy variables	Yes	Yes	Yes	Yes	Yes
Observations	252	252	252	252	252
R-squared	0.624	0.683	0.169	0.733	0.300
Number of province/city	63	63	63	63	63

Source: Authors. Note: Standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Appendix 8. Regression of number of shopping malls on financial inclusion components

Dependent variables	Financial Inclusion	Banking Account	Saving books	ATM card	Credit card
Number of shopping malls	0.069*** (0.022)	0.007** (0.003)	0.001 (0.002)	0.005* (0.003)	0.003*** (0.001)
Gross domestic product per capita	0.007 (0.013)	-0.001 (0.002)	0.002* (0.001)	-0.001 (0.001)	-0.000 (0.000)
Gross domestic product per capita squared	-0.000 (0.000)	0.000 (0.000)	-0.000** (0.000)	0.000 (0.000)	0.000 (0.000)
Literacy	-0.003 (0.039)	0.003 (0.005)	0.000 (0.003)	-0.004 (0.005)	-0.000 (0.001)
FDI implemented	0.000 (0.000)	0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	0.000 (0.000)
Dummy variables	Yes	Yes	Yes	Yes	Yes
Observations	252	252	252	252	252
R-squared	0.635	0.693	0.186	0.741	0.271
Number of province/city	63	63	63	63	63

Source: Authors.

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

Appendix 9. Regression of number of goods sales on financial inclusion components

Dependent variables	Financial Inclusion	Banking Account	Saving books	ATM card	Credit card
Volume of goods sales	0.356** (0.145)	0.044** (0.018)	-0.005 (0.010)	0.006 (0.017)	0.021*** (0.005)
Gross domestic product per capita	0.008 (0.013)	-0.001 (0.002)	0.002* (0.001)	-0.001 (0.001)	0.000 (0.000)
Gross domestic product per capita squared	-0.000 (0.000)	0.000 (0.000)	-0.000* (0.000)	0.000 (0.000)	-0.000 (0.000)
Literacy	-0.010 (0.039)	0.002 (0.005)	-0.000 (0.003)	-0.004 (0.005)	-0.000 (0.001)
FDI implemented	0.000 (0.000)	0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	0.000 (0.000)
Dummy variables	Yes	Yes	Yes	Yes	Yes
Observations	252	252	252	252	252
R-squared	0.628	0.690	0.169	0.733	0.307
Number of province/city	63	63	63	63	63

Source: Authors.

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



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