Green and Digital Transitions: Global Insights into Sustainable Solutions

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Contents

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Preface

In an era initially characterized by the Great Moderation, economic discourse primarily centered around competitiveness. However, following the 2008 global crisis, the notion of resilience has taken center stage. The disruptions in global value chains during the Covid-19 pandemic underscored the critical importance of resilience and adaptability. The pandemic highlighted that security concerns often supersede considerations of profit maximization or competitiveness.

Events such as the war in Ukraine and the unfolding East-West decoupling have pushed us further away from the traditional economic concept of globalization. Moreover, the energy crisis triggered by the war adds another layer of complexity, making it even more challenging to address the pressing issues of climate change and achieve sustainable development.

This volume, "Insights for the Green and Digital Transition," captures the evolving dynamics of our economic landscape and offers diverse perspectives on navigating the intersections of green and digital transitions, resilience, and the changing paradigms of global economic relations.

Szeged, 2024.

The Editor

Chapter I
Green and Digital Transitions:
Global Perspectives

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Analyzing the models of consumer acceptance of technology from the perspective of preparedness for autonomous vehicles

Tamás Ujházi – Szabolcs Prónay – Zoltán Majó-Petri – Miklós Lukovics

In our study, we review the framework of questionnaire research methods suitable for analyzing the consumer acceptance of vehicle industry innovations, more specifically, of autonomous vehicles. Our aim is to identify the most widely used research models and examine which variables affect consumer acceptance of self-driving technologies to the greatest extent. The various modified versions of the TAM and UTAUT models are the most commonly used models to address the topic in the literature. Both models are characterized by the attempt to predict a consumer's behavioral intention based on the specificities of a technology. Due to the difficulties of prior testing of self-driving technologies, it is worth reviewing these methods from the aspect of how suitable they are for capturing the consumer acceptance of this technology and through what adaptation measures. We do not aim to question the validity of researching the topic by questionnaire surveys, but we find it important to emphasize the significance of cautious adaptation. In the present paper, we intend to provide a methodological basis for future research related to autonomous technology by revising the TAM and UTAUT methods.

Keywords: autonomous vehicles, consumer acceptance, TAM, UTAUT

1. Introduction

Autonomous vehicles (AV) as a disruptive innovation will transform our daily lives in various ways. Whether it is a self-driving car, taxi, means of public transport, means of goods transport, last-mile delivery robot, or drone (Lukovics et al., 2018), an autonomous vehicle entails several potential benefits, from reducing harmful emissions and the number of parking places through defining more predictable departure and arrival times to the opportunities gained by spending less time driving. Nevertheless, a prerequisite of exploiting these opportunities is the consumer acceptance of autonomous technology and thereby its actual use (Cochen et al., 2020). It is especially important since the development level of the technology is at a much more advanced stage than its social acceptance. This is reflected in the fact that there are already several cities in the world where, even though on a testing basis, self-driving vehicles already travel the roads without a control of safety drivers, performing all the dynamic functions of driving completely autonomously (Cochen et al., 2018). On the other hand, there is no full social acceptance yet as many worry about how safe the use of AVs will be, who will be held legally responsible for an occasional accident, and what additional economic, societal, and ethical challenges the spread of AVs entails (Lukovics et al., 2023). Consequently, it is particularly important to explore the consumer acceptance of AVs, more specifically, its barriers (KPMG, 2018). Therefore, in our study, we overview the empirical methods which are specifically intended to examine the consumer acceptance of new technologies.

They mostly rely on logistic regression, and, in addition, we create latent variables from the variables based on modelling structured equations by using least squares method, while explaining the correlation between these variables (Kovács–Lukovics, 2022). Furthermore, we analyze the results obtained with the help of the presented research methodologies in the Hungarian and international literature in terms of the consumer acceptance of vehicle industry innovations.

In our study, first we present the evolution of the most widely used research models in the investigation of technology acceptance, the Technology Acceptance Model (TAM) and Unified Theory of Acceptance and Use of Technology (UTAUT) in particular. We study how these models (and the variables they apply) can be adapted for an efficient analysis of autonomous technologies.

2. Prediction of consumer behavior

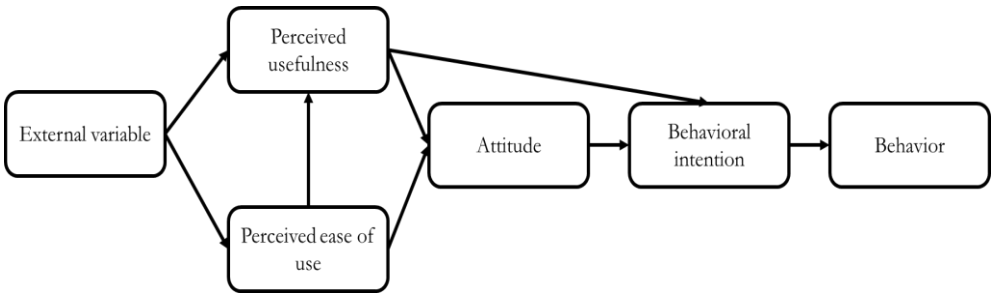
The pioneers of behavioral economics revealed that factors other than what is defined in rationality as interpreted by neoclassical economics also influence consumers in their decision-making processes (Zuti–Lukovics, 2023). These can be defined in various ways and can be internal factors characterizing an individual or specified aspects related to the subject of a studied behavior. Methodologies for examining the adaptation of behaviors can be found among the instruments of psychology. The majority of research methodologies used for analyzing the consumer acceptance of new technologies can be traced back to the Theory of Reasoned Action (TRA) created by Fishbein and Ajzen (1975) (Keszey–Zsukk, 2017). The authors point out that the adaptation of a given form of behavior can be derived from the Behavioral Intention characterizing individuals. It is directly affected by Attitude, which is a state of mental alertness and helps consumers simplify complex situations of decision making (Hofmeister, 2014), as well as by Subjective Norm, which refers to the combined effect of an individual's internal values and the environmental and social factors affecting them (Liu et al., 2019). Going further, Ajzen (1991) argues that behavioral intention cannot be an exclusive factor which influences actual behavior. Therefore, he includes an additional variable, Perceived Behavioral Control in the previously presented model, thereby creating the Theory of Planned Behavior (TPB). It relies on Bandura's (1977) Self-efficacy Theory, which, analyzing individuals' self-judgement, shows to what extent they consider themselves capable to acquire the competences required to exercise a studied form of behavior (Kaye et al., 2020).

In the last decades of the 20th century, several technological innovations occurred, such as the advancement of information technology, which not only fundamentally changed the way of performing standard activities, but their rapid spread necessitated the development of research methodologies which specifically enable analyzing the consumer acceptance of these technologies. In Section 3, we provide an overview of these methodologies, in each case addressing how and to what extent they can be adapted to investigating the consumer acceptance of autonomous technology.

3. Technology Acceptance Model (TAM)

Based on the TRA and TPB models, Davis (1989) created the first version of the Technology Acceptance Model (TAM), in which we can identify the constructions presented in the earlier models, i.e. the actual use of a new technology can be derived from behavioral intention, which is influenced by attitude. It is a novelty in the TAM 1 model (cf. Figure 1) that it defines the two variables influencing attitude, namely, Perceived Usefulness and Perceived Ease of Use. The former shows to what extent it makes an individual's daily life easier if they use the new technology in question, while the latter refers to how burdensome they consider the actual use and learning how to use it (Xu et al., 2018). On the one hand, this model can be easily adapted to self-driving technology since perceived usefulness (it facilitates an individual's mobility) and ease of use can be both well interpreted, but, on the other hand, it provides a rather narrow interpretation of potential influencing factors. The identification of more complex influences is carried out only later, in the TAM 2 and TAM 3 models.

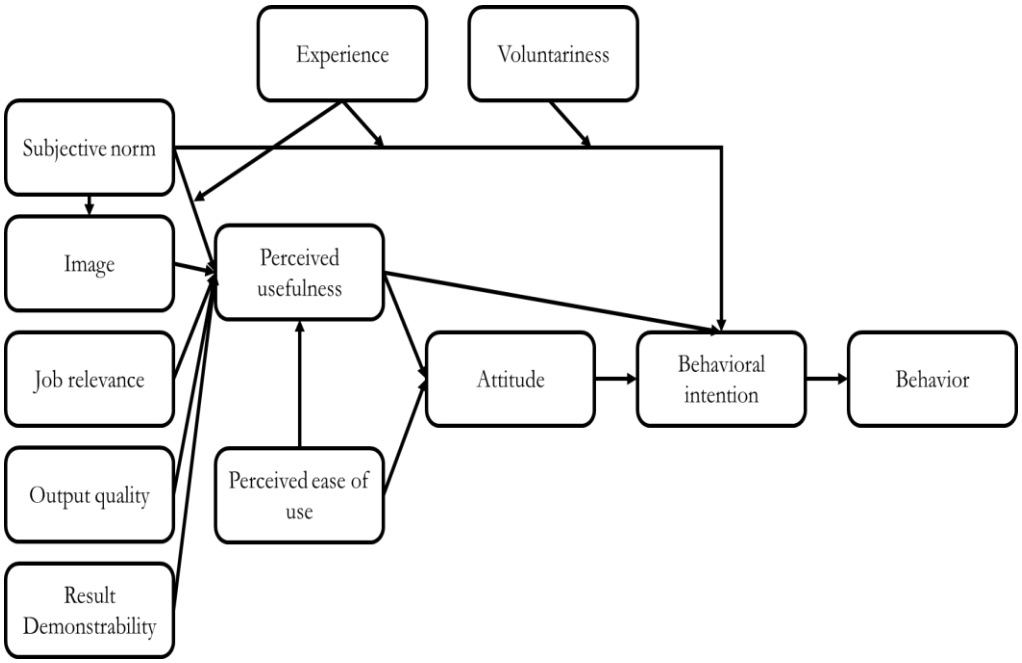
Figure 1. TAM 1 model



Source: Davis (1989)

The TAM 2 model (cf. Figure 2) was elaborated by Venkatesh and Davis (2000), in which they defined the factors influencing perceived usefulness. They claim that subjective norm, already featured in the TRA and TPB models, has a direct effect on behavioral intention, but it also influences perceived usefulness (Raue et al., 2019). This effect is moderated by Experience and Voluntariness. Moreover, it also affects perceived usefulness indirectly through Image with its direct influencing effect. As the TAM models were typically used for examining the acceptance of new technologies in a work environment, they incorporated variables which were specifically targeted at this purpose in the model (Csizmadia, 2019). These are Job Relevance, i.e. to what extent it is compatible with other work processes; Output, i.e. whether it actually leads to a better result; and Result Demonstrability, i.e. how the advantage generated by the use of the new technology can be captured. As this model primarily focuses on the technologies applied in a work environment, it is relatively difficult to adapt it to autonomous vehicles (especially in terms of factors such as "Job Relevance", "Output", and "Result Demonstrability").

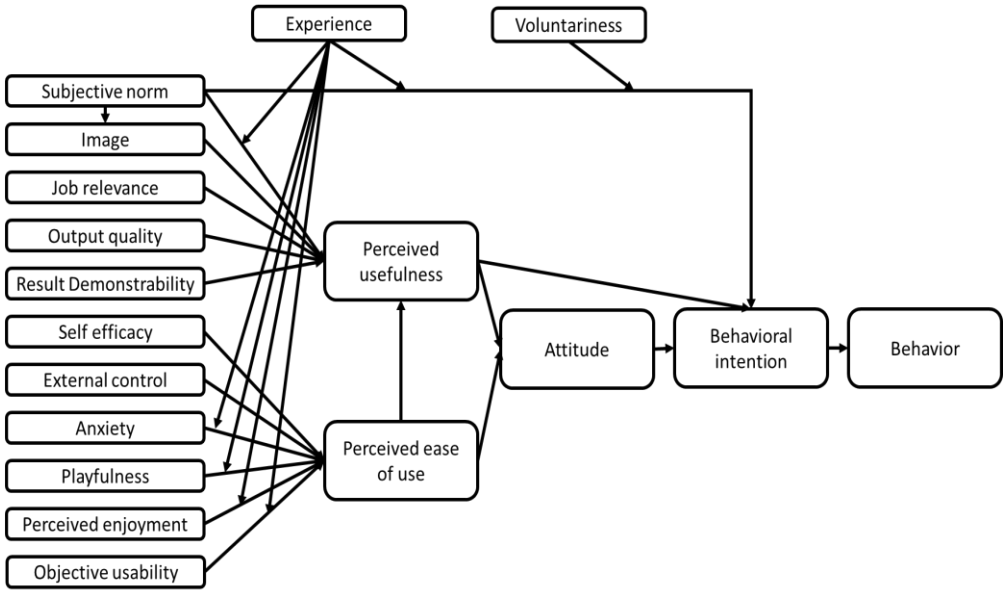
Figure 2. TAM 2 model



Source: Venkatesh–Davis (2000)

In the TAM 3 model (cf. Figure 3), Venkatesh and Bala (2008) included in total four behavioral anchors and two additional correction factors in the model to explain the perceived ease of use. The first behavioral anchor is Technological Self-efficacy, which shows that even though an individual is aware of their own abilities, there is no sufficient information about how difficult the use of a certain new technology will actually be (Strauch et al., 2019). The second anchor is Perceived External Control, which indicates the influencing power of workplace pressure and the support given there. The third anchor is Technological Anxiety, which analyzes an individual's openness to new technologies. Finally, the fourth is the Playfulness of the technology, which refers to how enjoyable it is to use the technology. The correction factors are Perceived Enjoyment and Objective Usability (Stephenson et al., 2020). On the one hand, this model can be better adapted to autonomous technology as it examines a sufficient number of factors the majority of which can be interpreted in terms of this technology, but, on the other hand, the above mentioned factors ("Job Relevance", "Output", and "Result Demonstrability") should still be left out of the model. By contrast, the new independent variables featured in TAM3 contribute to a more complex understanding of the consumer acceptance of autonomous technologies.

Figure 3. TAM 3 model



Source: Venkatesh–Bala (2008)

4. Practical application of technology acceptance models in investigating the consumer acceptance of vehicle industry innovations

Technology acceptance models have been used to examine the consumer acceptance of both self-driving vehicles and other vehicle industry innovations in several cases. At the same time, it is to be noted that the majority of these studies used the adaptation of the theoretical framework of the models with the inclusion of additional variables. We present some examples in the following section.

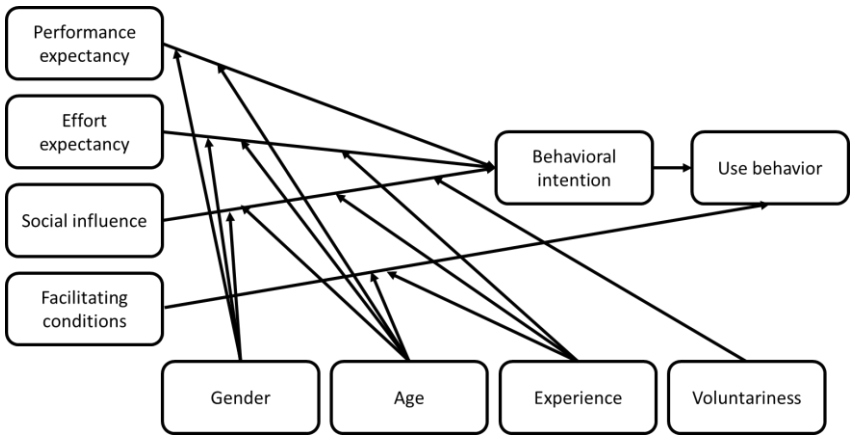
Studying the consumer acceptance of advanced driver assistance systems, Kaye et al. (2022) showed that perceived usefulness and perceived ease of use are both positive predictors of behavioral intention. Examining the public acceptance of connected vehicles, Acharya and Mekker (2022) pointed out that besides physical Safety, Data Protection and Data Security both positively influence behavioral intention. When analyzing the consumer acceptance of self-driving, Tan et al. (2022) highlighted the importance of Pleasure, Anxiety, and previous Knowledge in terms of behavioral intention. Jászberényi et al. (2022) studied the applicability of self-driving vehicles for touristic purposes, which also necessitates consumer acceptance. Therefore, they created their own model named TAMAT relying on the basis of TAM. Their results indicate that application for a touristic purpose and openness to unusual environmental elements have a positive effect on behavioral intention, while adherence to traditional solutions has a negative effect on it. Examining the consumer acceptance of electric vehicles, Wang et al. (2022) pointed out that Trust and Social Influence have a positive effect, while Perceived Threat has a negative effect on behavioral intention. In investigating the consumer acceptance of autonomous

vehicles, Koul and Eydgahi (2018) found that the number of years spent driving and age both have a negative effect on behavioral intention. Müller (2019) studied the consumer acceptance of electric and self-driving vehicles and mobility as a service in a system. He managed to show that the importance of Environmental Protection, Openness to innovation, Perceived Enjoyment, and Objective Usability are all significant influencers of behavioral intention.

5. Unified Theory of Acceptance and Use of Technology (UTAUT)

By synthesizing the previously known technology acceptance models, Venkatesh et al. (2003) created the Unified Theory of Acceptance and Use of Technology (UTAUT) (cf. Figure 4). They accept that behavioral intention directly affects actual use, but instead of a specific analysis of attitude, they define the factors influencing behavioral intention. These are Performance Expectancy, which is the overall advantages resulting from the use of the studied technology (Nistor et al., 2014); Effort Expectancy, i.e. the ease to learn how to use the technology (Guest et al., 2018); Social Influence, i.e. the assessment of the technology by those whose opinion has an effect on an individual's decisions (Kapser–Abdelrahman, 2020); and Facilitating Conditions, i.e. the external factors that facilitate the adaptation of the technology (Slade et al., 2015). The real novelty of the model is that its authors define moderator variables which moderate the effect of the independent variables influencing behavioral intention and actual use. These include Age, Gender, Experience gained by using similar technologies in the past, and Voluntariness (Venkatesh et al., 2016). This model is even more apparent to be adapted to the acceptance of autonomous technology compared to TAM 3 since "performance expectancy" means the benefit of the new form of mobility, while "effort expectancy" refers to learning and using the technology. "Social influence" can be interpreted as the social reactions the use of this technology will trigger. Finally, "facilitating conditions" indicates the availability of external conditions required for the adaptation of the technology.

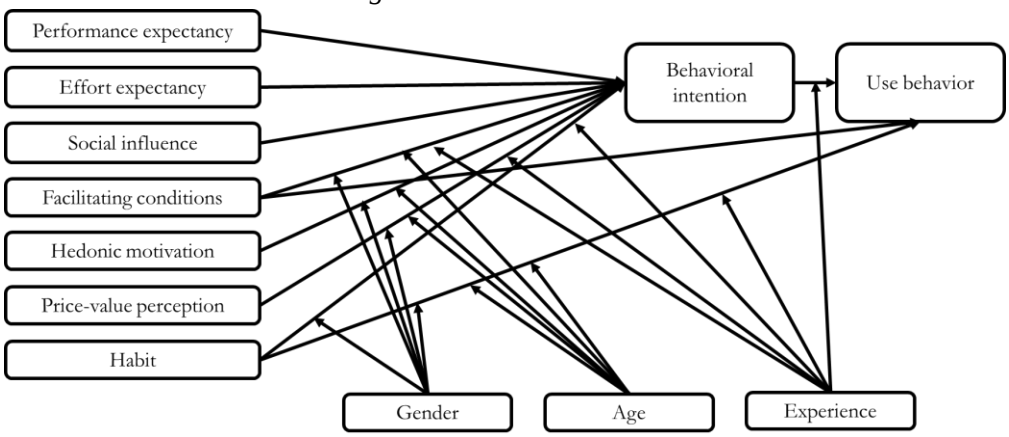
Figure 4. UTAUT Model



Source: Venkatesh et al. (2016)

Venkatesh et al. (2012) created the UTAUT 2 model (cf. Figure 5) to study the acceptance of new technologies for private use. They incorporate three additional variables in the previous UTAUT model. Hedonic Motivation tests the effect of convenience experienced during the use of a new technology and its enjoyment on behavioral intention (Kumar–Bervell, 2016). The examination of Price-value Perception is necessary because consumers must pay the costs of technology use on their own (Foroughi et al., 2023). Habit shows the effect of patterns developed during the use of similar technologies in the past on behavioral intention and actual use. The authors eliminated one of the previously defined moderator variables, voluntariness, from the model as in the case of technologies for private use, workplace pressure is not relevant, since the consumer makes the decision individually (Assaker et al., 2020). Among the above described models, this one is clearly the most suitable for a complex exploration of the acceptance of autonomous technologies. In addition to the adaptation of the independent variables featured in the UTAUT model, the new included variables can also be easily interpreted in the context of autonomous technology. "Hedonic motivation" refers to the experiential nature of travelling and use, while "habit" captures to what extent an individual's previous driving routine influences the intention of acceptance. Finally, "price-value perception" is evident in this area as well; the only detail to be added is that it is practical to analyze the renting costs instead of (besides) purchase.

Figure 5. UTAUT 2 model



Source: Venkatesh et al. (2012)

6. Practical application of the UTAUT in investigating the consumer acceptance of vehicle industry innovations

It is not surprising that UTAUT models have been used in studying the consumer acceptance of vehicle industry innovations in several cases. Similarly to the TAM models, a common feature of these studies is that the original model is extended with additional variables related to the technology in question.

Analyzing the consumer acceptance of self-driving vehicles, Adnan et al. (2018) found that ethical and legal issues have a significant effect on behavioral

intention. Studying the consumer acceptance of self-driving vehicles, Foroughi et al. (2023) assume the lack of price sensitivity. They claim that if self-driving vehicles are able to live up to the expectations attached to them, consumers will be willing to pay for the additional charge of the technology. They also point out that compatibility with already used technologies, trust, and image all influence behavioral intention. Examining consumers' willingness to purchase self-driving vehicles, Leicht et al. (2018) found that besides the variable they included in the model, which is openness to innovation, only performance expectancy, effort expectancy, and social influence have an effect on behavioral intention from the original UTAUT model. Madigan et al. (2017) studied the consumer acceptance of autonomous vehicles. Their results indicate that performance expectancy, effort expectancy, and social influence have the greatest effect on behavioral intention. Osswald et al. (2012) set up the Car Technology Acceptance Model (CTAM) using the framework of UTAUT. They omit all the moderator variables featured in the original model and include new independent variables influencing behavioral intention, namely, anxiety, self-efficacy, safety, and attitude towards new technologies. Analyzing the consumer acceptance of self-driving vehicles, Garidis et al. (2020) show the negative effect of losing the pleasure of driving on behavioral intention. When examining the consumer acceptance of self-driving buses, Cai et al. (2023) point out that performance expectancy, effort expectancy, social influence, and price collectively shape trust, which has a direct positive effect on behavioral intention. Goldbach et al. (2022) also investigated the consumer acceptance of self-driving buses. They revealed that besides performance expectancy and effort expectancy, trust and experience gained during the use of traditional public transport have a great effect on behavioral intention. Korkmaz et al. (2022) reached similar conclusions in examining the consumer acceptance of autonomous means of public transport, demonstrating the effect of experience gained during the use of traditional public transport on behavioral intention. Studying the consumer acceptance of autonomous means of public transport, Nordhoff et al. (2021) found that the compatibility with currently used modes of mobility has the greatest effect on behavioral intention. Investigating the public acceptance of driver state monitoring systems, Smyth et al. (2021) showed that performance expectancy, effort expectancy, social influence, and attitude all have a positive effect on behavioral intention. Finally, analyzing the consumer acceptance of advanced driver assistance systems, Cho et al. (2017) verified the influencing effect of trust, safety, and anxiety in terms of behavioral intention.

7. Discussion

It is a common feature in the results of the presented studies that they verify the usability of the applied methodology for capturing the consumer acceptance of autonomous vehicles. It is true for both the TAM and UTAUT models, moreover, that the obtained results are often in line with the research results which do not specifically use the framework of the two presented models. Kenesei et al. (2022) created their own PLS SEM model in the analysis of consumer trust and risk related to self-driving vehicles. They pointed out that trust towards regulatory institutions has no influence on the other variables included in the model, while trust towards manufacturers has a positive effect on data protection related to privacy, and, in addition, trust towards performance has a

positive influence on risk towards performance. In examining the acceptance of self-driving means of public transport, Launonen et al. (2021) showed that no failure of the autonomous system can be tolerated by consumers, and that trust and safety are of particular importance. Piegon et al. (2021) also highlight that performance expectancy, effort expectancy, safety, and vehicle characteristics are the most important regarding the consumer acceptance of self-driving means of public transport. Shi et al. (2021) reached a similar conclusion, drawing attention to the role of trust in the acceptance of autonomous vehicles. Also using their own model, Xiao and Gouillas (2022) identified the group of consumers who are the most willing to use autonomous vehicles, namely, those who already use innovative solutions in their daily lives, such as electric and hybrid vehicles, or have solar panels installed in their homes, which corresponds with the earlier defined openness to innovation. Finally, Zou et al. (2022) draw attention to the negative effect of nausea due to travelling by car regarding the consumer acceptance of self-driving vehicles.

8. Conclusions

In this study, we have reviewed the research frameworks primarily arrived at via questionnaire surveys, which are most commonly used in investigating the consumer acceptance of autonomous vehicles. We agree that although these methodologies can be used to capture the topic, we still need to consider some methodological limitations. In both the Hungarian and international literature, authors rely strictly on the dependent and independent variables defined in the original TAM and UTAUT models in the rarest of cases (Keszey, 2020). Instead, they include other, frequently similar variables in the models, or they occasionally eliminate variables from the original models (Prónay et al., 2022). The most commonly added variables regarding the consumer acceptance of vehicle industry innovations are knowledge, level of information, trust, social influence, policy, self-efficacy, ecological impacts, openness to innovations, compatibility, perceived threat, and perceived safety (Billanes–Enevoldsen, 2021; Nordhoff et al., 2019). Duboz et al. (2022) identified three main topics in terms of the consumer acceptance of autonomous vehicles: perceptions, expectations, and concerns.

It can be considered a further limitation that the procedures used for analysis can be perfectly applied in examining, for instance, satisfaction and loyalty, where the respondents already have experience about the subject of study. Nevertheless, the number of those who have real-life experience not only about self-driving vehicles, but also about the use of advanced driver assistance systems or other vehicle industry innovations is scarce (Lukovics et al., 2018).

Based on this, we have concluded that although a traditional questionnaire survey is suitable to study the consumer acceptance of autonomous vehicles, it needs to be completed to provide a deeper understanding. First of all, the respondents must be provided with the experience of traveling in a self-driving vehicle during the study, thus we suggest the application of experimental practices. Second, completing it with the use of cognitive neuroscience instruments, through empirical procedures, we could identify emotions such as anxiety, excitement, or overall emotional engagement, which have been proven to influence consumer acceptance (Lukovics et al., 2023). Third, it can also be useful to adapt research methods which are specifically suited to study consumer

preferences related to products still under development, such as the different versions of conjoint analysis (Ujházi, 2023).

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Some global implications of China's new energy policy initiative: Lessons and conclusions

Chen Rurong

The "East Data West Computing" project was launched in February 2022 to alleviate the current imbalance of energy distribution in China and to promote the development of a green digital economy. It is designed to improve the ideal energy layout in China, using the abundant renewable energy available in the West to supply electricity for existing and planned data processing and analyzing centers and other high-tech businesses in the East. The nature of the paper is impact analysis based on qualitative and quantitative research methods. The paper's first objective is to quantify the probable impact of the initiative on China's energy balance in general, the electricity market in particular, its expected effects on Chinese energy imports, and its global implications. The second objective is to analyze the expected impact of the new initiative on the international competitiveness of China's high-tech industries and the structural optimization in the eastern digital industry using a two-way fixed effects model as well as its global implications. Based on the analysis, generalized and instructive conclusions are drawn, first, on the role of renewables in the regional distribution of electricity and the green transition, and, second, on the significance of the supply and price of electricity in the competitiveness of high-tech industries. It is assumed that the project would promote the development of green digital industries across the East and west regions.

At first glance, the paper is a Chinese case study focusing on global effects and implications, exploring the relationship between electricity production and consumption and how the high-tech industries give a chance to arrive at scientifically novel or new conclusions.

Keywords: China, "East Data West Computing", two-way fixed effects model, electricity, high-tech industries, Green Digital Economy Transformation.

1. Introduction

With the escalation of Russia's war against and Ukraine, oil and gas prices have spiked rapidly. In addition, the destruction of gas pipelines has made the energy supply more challenging. China has pursued the principle of energy diversification to mitigate the adverse effects of energy crises on domestic production and life. China has always been a significant energy consumer, with coal accounting for most energy consumption, mainly in the form of power generation. However, with the pollution effects, coal burning has been causing an increasingly severe damage to the environment. Therefore, China has made it a priority task in the 14th Five-Year Plan to realign the energy structure and promote the transition to a green digital economy.

The East Data and West Computing Project includes sending data generated by various industries in Eastern China to data centers in Western China for processing, computing, and storing. In February 2022, the state agreed to construct ten national data center clusters and start the construction of national computing hub nodes. The East Data and West Computing Project has officially started with this announcement. It is necessary to provide a large amount of power support for extensive data processing. This project is based on the abundance of power resources in the western

region, including wind and hydropower. Unlike the original project, 'Western Electricity to the East,' this project provides direct access to electricity in the western regions, and it saves transportation costs from west to east. Ultimately, this will ease tensions between power consumption and generation in the eastern region, drive the economic development of the western region, and facilitate the coordination of regional development efforts (Ismail et al., 2023).

The present paper has two goals: first, it aims to discuss the current energy production and consumption structures in China to determine how the changing energy structure affects the development of the digital economy. Second, it examines the relationship between China's energy structure and its high-tech industries to help the global transition to a cleaner energy supply and consumption pattern. In this paper, I want to answer the following research questions by studying the current energy structure:

(1) What does the structure of energy production and consumption in China look like under the influence of the Russia-Ukraine conflict? Has China's energy structure changed and adjusted?
(2) What are the Chinese government's policies in the current electricity market?
(3) How does the change in energy structure affect the transition to a green digital economy?

Several scholars are also exploring the relationship between the energy structure and the economy. Yu and Weidong (2008), for example, use panel data to investigate whether the energy structure and economic growth are cointegrated and argue that the relationship between energy increase and GDP growth is more robust in the eastern region than in the western region. A study by Hou and Hou (2021) asserts that the high-tech industry hurt energy consumption. Most scholars have examined how economic growth factors affect the structure of energy consumption. However, they ignored considering the reverse effects of the energy structure, which is a research gap. This paper discusses the impact of changes in the energy structure on the digital economy, high-tech industries, and industrial upgrading.

The nature of this study is interdisciplinary, combining the energy industry development with economic development issues. The main innovation of this paper is the examination of the relationship between the energy structure and the digital economy in the context of the current technological transformation. Based on an updated strategic planning context, this paper examines how the energy consumption structure influences the Chinese economy's shift to a knowledge-intensive and technology-oriented growth model (Wilczynski, 1972). The experience of China's energy restructuring in this context may be instructive for EU countries in elaborating and implementing their strategy of the energy transition.

China is undergoing a rapid switch to new energy sources for which limited data are available. The current energy data were updated to 2021 but not to 2022, which is the time when Russia’s war against Ukraine began. As a result, this paper is only a starting point for collecting the relevant normative data in the future and using

the existing model for future research to compare and observe how the results of the two studies differ.

The logic of this paper is as follows. Section 2 contains an overview of the previous studies on the relationship between the energy structure and economic development and compare the issues of interest to scholars in different regions. In order to gain a more comprehensive understanding of the significance and innovation of the present study, it is necessary to identify the limitations. Section 3 briefly justifies the reasons for data collection and highlights the meaning and interpretation of the data. Section 4 describes the methodological design. This paper adopts a mixed (qualitative and quantitative) approach. In Section 5, data are visualized to illustrate the distribution of energy portfolios in China and the relationship between the digital economy and energy consumption. A discussion of the differences between this paper and previous studies is provided in Section 6 to answer the research questions of the paper. Section 7 summarizes the man findings and conclusions and indicates directions for further research.

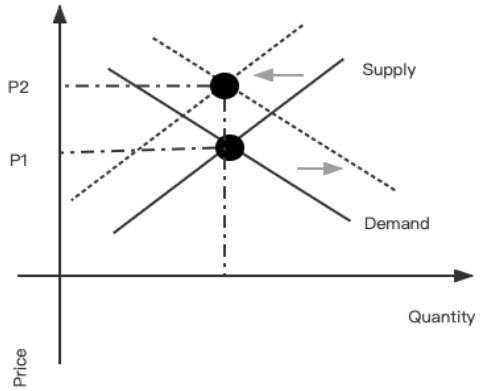
2. Literature Review

2.1. Theoretical background

According to the supply-demand principle, a commodity's price is determined by its supply and demand (Worchel et al., 1975). The individual products of the energy sector are ignored and treated as a tradeable aggregate. Its equilibrium price is dynamically adjusted according to what happens in the market that triggers it. (Figure 1 displays the relationship between supply and demand in a general form.) China is currently in an economic transition, moving from former heavy industries to high-tech industries and gradually transforming into a digital economy. Powerful computers with increasing electricity demand constitute a significant component of the digital economy. Furthermore, Russia's war against Ukraine resulted in a global energy shortage. Therefore, the supply shortage and the rise in demand have led to a rapid rise of energy prices. The increase in electricity and natural gas costs spilled over to the goods and services resulting in the acceleration of global inflation.

The energy supply and demand structure determine a balance between supply and demand (Guo et al., 2023). The structure of the regional distribution of energy and the structure of energy types can be described by visual graphs, and numerous scholars have undertaken in-depth energy supply and demand balance analyses. Analyzing the structure of energy types is necessary for understanding the relationship between raw materials for power generation and electricity consumption. The energy structure can be analyzed according to regional distribution, energy types, and supply and demand. Achieving a low-carbon energy future will require widespread changes in consumer behavior. Therefore, social media will have an impact on consumer perceptions, which will be transmitted to consumer behavior. Ultimately, consumer behavior will change the energy mix (Axsen–Kurani, 2012). The three structures are discussed in this paper. It is essential to study how to achieve coordinated regional energy balances based on the regional distribution structure of energy. It is also critical to pay attention to green digital transformation (Xue et al., 2022).

Figure 1. Supply and demand in the energy industry



Source: own construction

2.2. The relationship between energy structure and economic development

Economic development and energy structure are closely related with each other. Based on the above, the energy structure in this paper can be viewed from the following three perspectives. (1) Economic development increases energy demand, while energy supply also contributes to economic growth. (2) The regional distribution of energy is closely correlated with the local economic growth level. (3) The energy type will influence green economic development. Many researchers mainly focused on three of these parts to discuss the relationship.

Supply-demand is one of the most popular research fields in energy structure. Regarding the relationship between economic transition and development on the one hand, and energy demand structure on the other hand, energy demand increases as the economy develops and the population grows. However, the growth rate of energy demand can be reduced by promoting energy conservation and using renewable energy sources, among other things, which will result in sustainable economic growth. In order to test the endogeneity of the vector's three variables, Hondroyiannis et al. (2002) use vector error correction modeling (VECM) techniques to empirically evaluate the dynamic interactions between energy consumption, real output, and price level. Energy demand can be reduced while economic growth is stimulated by policies that increase economic efficiency through structural reforms (implementation of adjustment policies, implementation of endogenous growth mechanisms) (Hondroyiannis et al., 2002). From an economic perspective, (Rui–Di, 2010) qualitatively analyze the main factors influencing China's energy demand. Employing the grey correlation theory, they empirically examine the relationship between energy demand and the main factors influencing it: energy prices, economic growth, population, industrial structure, energy consumption structure, and consumers' income levels. Judson et al. (1999) estimate the relationship between GDP per capita and energy consumption per capita for the significant economic sectors based on panel data for 123 countries. The paper assumes time and country fixed effects, uses a flexible form of income effects, and finds that the energy demand structure in different sectors is affected differently (Judson et al., 1999). According to Stern (2019), energy

use and economic development are positively correlated. It is important to note that the degree of socioeconomic development will determine energy use efficiency (Stern, 2019). Ozturk and Acaravci (2010) use the autoregressive distributed lag bounds test for cointegration to investigate the issue of long-run causality between economic growth, carbon emissions, energy consumption, and employment rate in Turkey. In the short run, neither carbon emissions per capita nor energy consumption per capita affect real GDP per capita, but the employment rate affects real GDP per capita (Ozturk–Acaravci, 2010). Using panel data for 27 provinces from 1978 to 2008, Sheng et al. (2014) employ an instrumental variable regression technique to examine the relationship between economic growth, energy demand and production, and relevant policies in China. In their study, the authors conclude that strengthening infrastructure development facilitates the establishment of cross-provincial energy markets and energy transfer between regions (Sheng et al., 2014). An adequate energy supply can help economic development. Therefore, optimizing the energy structure and upgrading energy efficiency are necessary to accelerate economic development. According to the Chinese economist Yifu, the energy structure is an essential enabler for economic development (Yifu, 2010). According to Sheng (2011), the C-D production function extension model also revealed an intrinsic proportional relationship between GDP growth and energy consumption growth. He argues that energy structure utilization needs to be improved to achieve sustainable development (Sheng, 2011). According to Xu et al. (2023), the marketization of the supply of energy sources can reduce carbon emissions and pollution by rationalizing energy prices. Ruoxiang and Yi (2003) showed that several factors are essential to promote the optimal allocation of power resources in China, including optimizing the power supply structure, expanding the development of hydropower resources in southwest China, and actively establishing the financing channels for hydropower construction. In addition, the interconnection of power grids plays a vital role in enhancing the ecological environment of China (Ruoxiang–Yi, 2003).

Coordinated regional development is the main economic development task at present. Wang et al. (2020) pointed out that the mismatch of resources phenomenon exists in the eastern and western regions. The findings from Dong et al. (2016) revealed that four local renewable energy industry clusters were formed, including the Bohai Sea region, the Yangtze River Delta, the central region, and the western region. Supply chains were distributed differently based on regional resource allocation as well as economic development level (Dong et al., 2016). All these researchers noticed the regional disparity of energy resources and tried to coordinate the regional development by offering solutions. Siala et al. (2021) think that the deployment of decentralized renewable energy technologies and strategic dam planning are two aspects of the same problem, but they are typically dealt with separately. The distribution of renewable energy can be seen in the form of regional cooperation, centralized planning, and cross-border power trading using solar photovoltaics (Siala et al., 2021).

New Energy can promote green digital transformation. Xue et al. (2022) believed that digital transformation could substantially encourage innovation in green technologies. Its internal mechanism is that digital transformation may boost the level of creativity in green technologies by reducing financing constraints and attracting government subsidies (Xue et al., 2022). Qi with Li (2017) gave their own opinions

on renewable energy consumption, whose results proved the negative relationship between energy consumption and economic growth. The government is not the only contributor to promoting the green energy transformation as there are no significant effects from the innovation subsidy policies (Qi–Li, 2017). While local development of digital technologies tends to result in higher greenhouse gas emissions, local development of environmental technologies tends to result in lower emissions, with big data and computing infrastructures having the worst effects, according to Bianchini et al. (Bianchini et al., 2023).

Based on the above literature, the production and consumption of energy and their relationship with economic development were discussed. Nonetheless, this paper innovatively examines the relationship between energy production and the digital economy by considering the latest national support for digital centers based on a fixed-effect model. It also provides constructive recommendations for measures to be taken in response to the energy crisis in Europe and other countries through analyzing the structure of energy distribution in China's different provinces.

3. Data collection

3.1. The reasons of selection

This paper uses electricity data from 2010 to analyze panel data for 30 provinces. Between 2010 and 2020, there were more complete records and reliable data sources for electricity data. Furthermore, this period also encompassed the era of key energy policies and technological innovations, such as investments and developments in renewable energy and the diffusion and application of smart grids. It is, therefore, possible to gain important insights into the power sector trends, policy effects, and technological developments from electricity data collected during this period.

For selecting 30 provinces for the study of power structures, there are two primary reasons: on the one hand, the data are complete and comprehensive. Each of the 30 provinces represents an economic, energy, and development level in China's eastern, central, and western regions. However, a significant bias can be mitigated due to the reliability of the data, which is based on data collected over ten years from 30 provinces. On the other hand, the Tibetan region may need more comprehensive and accurate data due to its geographic location and other factors. Since incomplete or biased data can negatively affect analysis and decision-making, this paper excludes data from this region to ensure quality stability.

3.2. Description of the data

Data for this paper were collected from the CSMAR[1]. Database for the energy sector and the digital economy, as described below.

[1] CSMAR, i.e. China Stock Market & Accounting Research Database, is a comprehensive research-oriented database focusing on China's Finance and Economy.

Table 1. The data collection and description

Name	Unit	Description
Electricity Generation	100 million kwh	The total power generation.
Hydropower Generation	100 million kwh	Generate the power by using the energy in moving water.
Thermal Power Generation	100 million kwh	Heat energy is converted to electrical energy, and the heat usually can be produced by the coal, natural gas and so on.
Electricity Consumption	100 million kwh	The consumption of electricity
Gross Output Value Of Construction Industry	10,000 yuan	Total of construction products and services, expressed in money terms, produced or rendered by construction and installation enterprises during a given period of time.
Total Population (Year-End)	10,000 persons	A legal population measure, referenced in many legislative and regulatory texts.
Revenue from Software Business	100 million yuan	The revenue from the commercial activity of the software industry.

Source: own construction

4. Research design

4.1. Descriptive and comparative analysis

Comparison is the process of identifying similarities and differences between two or more objects, things, concepts, or phenomena. This paper examines the consumption, the production, the supply structure of energy, and other aspects of energy supply in various Chinese provinces or regions. The energy structure of China is compared horizontally from region to region, and the changes in energy consumption and supply structure are compared vertically over time. By examining China's energy structure distribution and energy policies, we can better understand the energy policies and development directions of different countries and regions.

4.2. Two-way fixed effects model

Fixed effects models (FEMs) or fixed effects regression models are methods of analyzing panel data. Generally, two-way fixed effects refer to both time and individual fixed effects. Wallace, Hussain consider these two-way error components disturbances first (Wallace–Hussain, 1969). The differences between each province are fixed to compare the effects of different regions on the digital economy. This is due to the significant differences between China's eastern and western regions. Regarding the fixed time effect, since China is developing rapidly, the changes can be enormously quick, so adjusting time helps reduce the impact of macrocycles.
The basic two-way error model is as follows:

$$u_{it} = \mu_i + \lambda_t + \nu_{it} \quad (i = 1, \ldots, N; t = 1, \ldots, T)$$

μ_i *denotes the unobservable individual effect*;

λ_t *denotes the unobservable time effect*;

ν_{it} *is the remainder stochastic disturbance term*.

Usually, the calculation process is by simple regression:

$$y_{it} = \alpha + \beta x_{it} + \mu_i + \nu it$$

$$\bar{y}_{i.} = \alpha + \beta\bar{x}_{i.} + \mu i + \bar{v}_{i.}$$
$$\bar{y}_{.t} = \alpha + \beta\bar{x}_{.t} + \lambda t + \bar{v}_{.t}$$
$$\left(y_{it} - \bar{y}_{i.} - \bar{y}_{.t} + \bar{y}_{..}\right) = \beta(x_{it} - \bar{x}_{i.} - \bar{x}_{.t} + \bar{x}_{..}) + (v_{it} - \bar{v}_{i.} - \bar{v}_{.t} + \bar{v}_{..})$$

Usually, The calculation of μ and λ is by OSL simple regression:

$$\tilde{\mu}_i = (\bar{y}_{i.} - \bar{y}_{..}) - \beta(\bar{x}_{i.} - \bar{x}_{..})$$
$$\tilde{\lambda}_i = (\bar{y}_{.t} - \bar{y}_{..}) - \beta(\bar{x}_{.t} - \bar{x}_{..})$$

In fixed-effects models, individual heterogeneity is considered in a time-invariant manner. Nevertheless, fixed-effect models have the disadvantage of wasting too much freedom when identifying fixed effects. The specific model is as follows.

$$Revenue\ from\ Software\ Business_{it} = \beta_0 + \beta_1 Power\ Consumption_{it} + \eta \sum_j X + \lambda_i + v_t + \varepsilon_{it}$$

i denotes that the variables will change from the individual side;
j denotes the number of control variables;
t denotes that the variables will change over time;
β_0 *is the constance;*
β_1 *and* η *are the coefficiences of the regression;*
X is the data set of controlable variables;
λ *is the individual fixed effect;*
v is the time fixed effect.

Under the strategic plan of 'East data, West computing', this paper explores the impact of energy transformation on the digital economy. Consequently, the income of the digital economy is used as the dependent variable, the energy production structure as the core explanatory variable, and the remaining infrastructure output and total population as control variables. The extent of the impact of energy on the digital economy is observed for a fixed region and fixed time.

5. Results

5.1. The energy distribution in China

Over the past decade, China has witnessed a significant increase in its electricity production. The National Bureau of Statistics estimated that China would produce 8.88 trillion kilowatt hours of electricity by 2021, up from 4.98 trillion kilowatt hours in 2012 (Fisher-Vanden et al., 2004). Total electricity production varies from province to province: Jiangsu, Guangdong, Shandong, Zhejiang, and Fujian provinces have been at the forefront of electricity production in the eastern region. There is a relatively low level of electricity production in the central region, but it is also increasing. Electricity production has steadily risen in Henan, Hunan, and Hubei provinces although it is relatively low in the central region but also growing. The total electricity production in Henan, Hunan, and Hubei provinces has risen yearly.

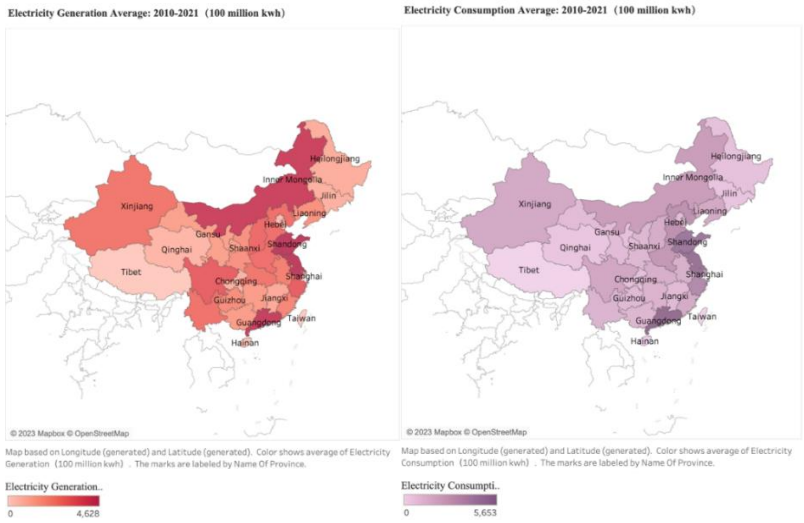
Regarding consumption, China's electricity consumption has been increasing over the last decade. Electricity demand has gone up significantly due to dynamic

economic growth and accelerated urbanization. The eastern region includes Guangdong, Zhejiang, Jiangsu, and Shandong. These provinces have been ranked among the top in the country in terms of electric power consumption and production capacity. Among them, Guangdong Province's electricity consumption is the highest in the country. The electric power demand and production capacity in the central region, including Hunan, Hubei, Henan, Jiangxi, etc., are relatively low. The imbalance between supply and demand is the most critical problem of China's present electric power resources. The distribution of China's electricity production and consumption is shown in Figure 2.

A significant source of electricity in China is thermal power, primarily coal, and natural gas. China enhanced thermal and hydroelectric power generation over the past decade at different rates. By 2021, it generated 58,058.87 billion kilowatt-hours (kWh) of thermal power, an increase from 3,416.6 billion kWh in 2010 (Dinani et al., 2023). The growth of hydropower has been significantly faster in the last decade, having increased from 686.7 billion kWh in 2010 to 134.01 billion kWh in 2021. Many hydropower plants have been constructed in the Yangtze River basin, the Yellow River basin, and the Pearl River basin, resulting in China's vigorous development of hydropower energy.

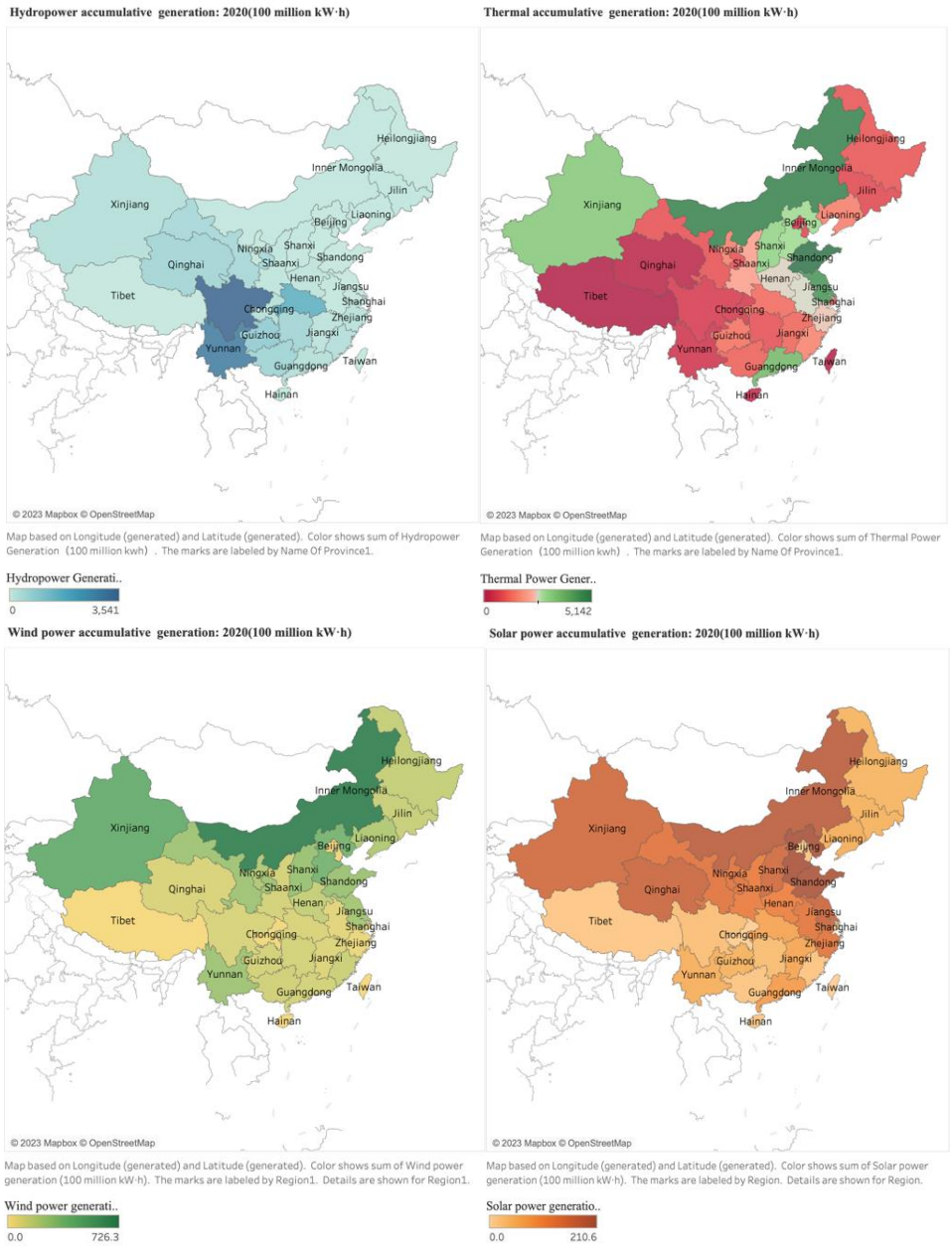
The share of thermal power in China's electric energy structure is decreasing year by year as it transforms into a clean energy and low-carbon structure (Su et al., 2023). Hydropower is taking its place as a clean energy source. In Sichuan, hydroelectric power makes up 85 percent of the province's electricity generation, which varies from province to province. Most of the average power came from Hubei hydropower. Inner Mongolia, Xinjiang, Shandong and Jiangsu are at the top of thermal power production, but the reasons for their high production volumes vary. The first two regions concern the provinces that produce Western Electricity East, while the latter two ones the need for economic development. Figure 3 demonstrates the distribution of electricity by type of energy carriers.

Figure 2. The distribution of China's electricity production and consumption



Source: own construction based on CSMAR database

Figure 3. The distribution of China's electricity by type of power resources



Source: own construction based on CSMAR database

Wind and solar power is mainly generated in the country's northwestern part, with Inner Mongolia, Shaanxi, Xinjiang, and Qinghai provinces having abundant wind and solar resources. As of 2020, Inner Mongolia generated the highest amount of wind power at 726.29 kWh, while Beijing had the least at 3.74 kWh. This large gap

indicates that the power resources in the eastern region are significantly less abundant than those in the western part.

Table 2. The structure of energy import and export

Year Sign	Name Of Product	Imports	Exports	Balance	Unit
2020	Coal	30361	319	-30042	10,000 tons
2020	Coke and Semi-coke	298	349	51	10,000 tons
2020	Crude Oil	54201	164	-54037	10,000 tons
2020	Gasoline	48	1600	1552	10,000 tons
2020	Kerosene	266	997	731	10,000 tons
2020	Diesel Oil	119	1976	1857	10,000 tons
2020	Fuel oil	1253	1583	330	10,000 tons
2020	Liquefied petroleum gas	2005	95	-1910	10,000 tons
2020	Other Petroleum Products	2606	323	-2283	10,000 tons
2020	Natural Gas	1397	52	-1345	100 million m3
2020	Electricity	48	218	170	100 million KWH

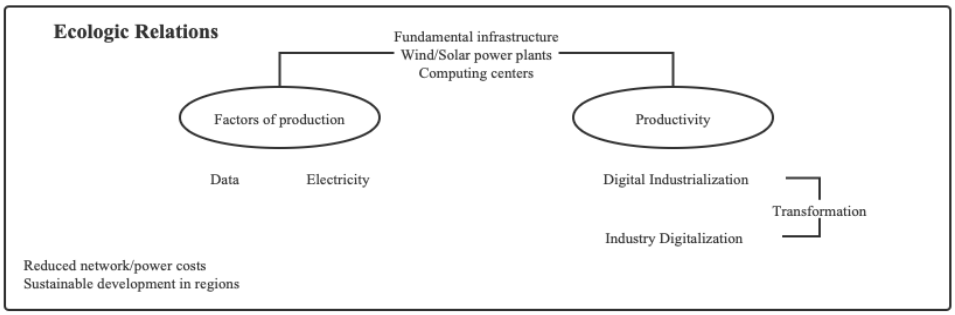
Source: own construction based on CSMAR database

China imports more energy than it exports, with crude oil, coal, and natural gas constituting its main energy import items. In contrast, its exports are mainly gasoline, diesel, and other petroleum products. There is a large trade deficit in crude oil, with imports of 542.01 million tons and exports of just 1.64 million tons. In 2020, coal, with imports of 303.61 million tons and exports of 3.19 million tons, ranked second in the energy trade balance. Diesel, gasoline, and other petroleum products constituted the majority of energy products with a trade balance surplus.

5.2. Digital business activity

Figure 4 below displays the relationship between the new energy development plan and the establishment of the big data center in terms of production factors, productivity, and production relations. The policies of digital transformation constitute the beginning of these production relations. The most critical issue in the 14th Five-Year Plan is to achieve technological transformation, i.e. the use of science and technology as a carrier to promote the overall economy. Digital economies cannot function without the infrastructure and computing power of data centers. Therefore, the government initiated the 'Eastern Digital and Western Computing' program, applying the logic of distributional energy to the computing system. This means relying on power production sites and establishing computing centers, where the data from the East will be arithmetical in the West. Increasing data centers' layouts in the West will significantly increase green energy use. The green energy in the West will be consumed nearby, while data centers' energy use efficiency will be continuously optimized through technological innovation, large-scale data centers, and low-carbon development measures. Digital tools will be used in the industry (in a process called digital industrialization) and manufacturing will achieve digital transformation (in a process called industry digitalization). Thus, energy production and consumption patterns will be optimized, and the computing efficiency of arithmetic centers will be improved.

Figure 4. The distribution of China's electricity types



Source: own construction

This paper innovatively divides the GDP average into three categories. From figure 5, we can depict that the western region, except Sichuan Province, is in the range of 111.3 billion yuan, while the central and Sichuan Provinces are in the second echelon of economic development, and the eastern coastal region, especially Shanghai, Jiangsu, and Guangdong, are among the most economically developed regions.

There is a connection between economic development and digital services. These services are also divided into three categories in this paper. On the right of Figure 5, we can see that the more developed the economy in the East, the higher the revenue of its digital services. Only Sichuan has a high level of digital revenue in the Midwest, indicating a more mature digital economy. The pace of digitized industrialization in Sichuan increased in 2021, with the value added of the core industries contributing to the digital economy reaching 432.41 billion yuan, a 6.5 percent year-on-year increase, that is 1.6 percentage points higher than the regional GDP growth rate and contributing 10 percent to the province's economic growth. There has been a significant increase in digital economy revenues in the eastern region, indicating that the degree of digital economy development is consistent with the level of overall economic development in the region. Furthermore, the eastern region is characterized by a digital policy environment and industry clusters, making regions such as Guangdong and Shanghai leaders in digital services. As opposed to the level of economic development reflected in GDP, the level of digital economy development in the central region is not in line with its comprehensive economic development level, and its digital economy development level remains at a unified level with other Western regions, which needs to be improved.

Figure 5. The distribution of China's GDP and Revenue from software business

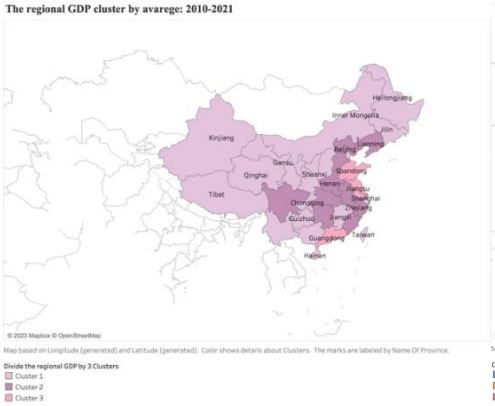
Summary Diagnostics

Number of Clusters:	3
Number of Points:	32
Between-group Sum of Squares:	1.6784
Within-group Sum of Squares:	0.21258
Total Sum of Squares:	1.891

Centers

Clusters	Number of Items	Avg. Regional GDP
Cluster 1	18	11113.0
Cluster 2	11	31807.0
Cluster 3	3	73355.0
Not Clustered	0	

The regional GDP cluster by avarege: 2010-2021



Map based on Longitude (generated) and Latitude (generated). Color shows details about Clusters. The marks are labeled by Name Of Province.

Divide the regional GDP by 3 Clusters
Cluster 1
Cluster 2
Cluster 3

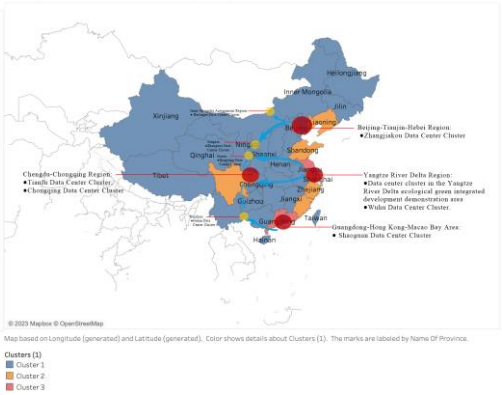
Summary Diagnostics

Number of Clusters:	3
Number of Points:	32
Between-group Sum of Squares:	2.4352
Within-group Sum of Squares:	0.14397
Total Sum of Squares:	2.5791

Centers

Clusters	Number of Items	Avg. Revenue from Software Business
Cluster 1	23	327.6
Cluster 2	6	2949.1
Cluster 3	3	7760.7
Not Clustered	0	

The regional business revenue cluster by avarege: 2010-2021



Map based on Longitude (generated) and Latitude (generated). Color shows details about Clusters (1). The marks are labeled by Name Of Province.

Clusters (1)
Cluster 1
Cluster 2
Cluster 3

Source: own construction based on CSMAR database

5.3. Two-way fixed effects model

This study examines how energy demand and supply structures affect the digital economy. In contrast to previous literature focused on one side of energy, this paper incorporates energy production and consumption into a model that includes fixed effects to determine whether they facilitate or inhibit the growth of the digital economy's income (Li, 2023).

The most common panel regression models consist of POOL, fixed effects, and random effects models. It is necessary to perform the Hausman test on the data before applying the fixed effects model (Hausman, 1978). A p-value of less than 0.05 indicates that the FE model is superior to the RE model and vice versa for the RE model. In contrast to random effects, fixed effects assume that individual effects within groups are fixed and that individual differences are reflected in specific intercept terms. The random-effects model assumes that all individuals have the same intercept term and that differences between individuals are random, as reflected, in part, in the random interference term.

The Hausman test (Table 3) presented a significance chi (4) =13.55 at a 5 percent level, $p=0.000<0.05$, implying that the FE model is superior relative to the RE model. With the above analysis, Stata recommended the FE model as the final result.

Table 3. Hausman test

	Coefficients (b) FE1	(B) RE1	(b-B) Difference	sqrt(diag(V_b-V_B)) Std. err.
Electr~ption	1.479779	1.729886	-.2501066	.2132553
Hydropower~n	-1.14248	-1.021253	-.1212269	.1887279
ThermalPow~n	-1.207244	-1.1448	-.0624432	.189766
TotalPopul~d	1.084045	-.2431236	1.327169	.4014389
GrossOutpu~i	.0000228	.0000264	-3.59e-06	2.04e-06

b = Consistent under H0 and Ha; obtained from **regress**.
B = Inconsistent under Ha, efficient under H0; obtained from **xtreg**.

Test of H0: Difference in coefficients not systematic

chi2(4) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= **13.35**
Prob > chi2 = **0.0097**

Source: own computation

In this paper, 353 data volumes are used to fix the time and province. The 'Between' group data is beyond 1, which means that there is a great difference in individual provinces. The same situation happens here 'within' the group. Fixing by province is to reduce individual variation due to the energy portfolio. This will enable us to examine better the impact of energy supply and consumption on the income of the digital economy. The primary purpose of fixing time is to reduce the impact on digital economy income due to economic cycles over ten years. Therefore, this paper places constraints on time and individuals to control for confounding factors so that the impact of each factor on income can be more clearly determined. The P-value of the model is 0.000, significantly showing that this model made a success for the modeling. Table 4 contains the summary of the indicators.

Table 4. The summary of indicators

Variable		Mean	Std. dev.	Min	Max	Observations	
Revenu~s	overall	1630.468	2828.783	.268	20382.1	N =	357
	between		2395.8	1.64539	8151.074	n =	30
	within		1553.326	-4075.528	14043.87	T-bar =	11.9
El~ption	overall	2025.59	1478.549	159.02	7867	N =	360
	between		1411.499	279.35	5653.017	n =	30
	within		504.8028	204.7979	4289.338	T =	12
Hydrop~n	overall	360.962	641.5986	.0317	3724.458	N =	360
	between		615.8063	2.885333	2575.681	n =	30
	within		209.8827	-1001.299	1509.739	T =	12
Therma~n	overall	1555.386	1284.436	91.8	6197.961	N =	360
	between		1218.813	152.5341	4554.864	n =	30
	within		458.0272	4.122106	4287.242	T =	12
TotalP~d	overall	4570.407	2759.491	563	12684	N =	356
	between		2801.837	586.3618	11174.98	n =	30
	within		193.9682	3836.387	6079.422	T-bar =	11.8667
GrossO~i	overall	6.43e+07	6.32e+07	1994842	3.82e+08	N =	360
	between		5.75e+07	3127111	2.57e+08	n =	30
	within		2.80e+07	-6.85e+07	1.90e+08	T =	12

Source: own computation

The FE model is used as the final result of this study. According to Tables 5 and 6, electricity consumption shows a sign at 0.01 level (t=3.94, p=0.000<0.01), and the regression coefficient value is 1.4798>0, indicating that electricity consumption has a positive effect on revenue from the software business. For hydropower generation, it shows a 0.01 level of significance (t=-3.38, p=0.001<0.01), and the regression coefficient value is -1.1425<0 demonstrating that hydropower generation has a significant negative effect on revenue from the software business. Thermal power generation shows significance at 0.01 level (t=-3.64, p=0.000<0.01), and the regression coefficient value is -1.2072<0 proving that thermal power generation has a significant negative effect on revenue from the software business. For the total population (year-end), it shows a 0.01 level of significance (t=2.58, p=0.010<0.05), and the regression coefficient value is 1.0840>0, referring to the fact that the total population (year-end) has a significant positive effect on revenue from the software business. The business will have a significant positive effect on relationships. For gross output value of the construction industry, it shows significance at the 0.01 level (t=6.09, p=0.000<0.01), and the regression coefficient value is 0.000>0, highlighting that the gross output value of the construction industry will have a significant positive relationship with revenue from the software business.

Table 5. The results of the fixed effect model

Fixed-effects (within) regression		Number of obs	= 353
Group variable: **ProvinceSign**		Number of groups	= 30
R-squared:		Obs per group:	
Within = **0.5284**		min	= 9
Between = **0.3803**		avg	= 11.8
Overall = **0.3530**		max	= 12
		F(5,318)	= 71.27
corr(u_i, Xb) = **-0.8413**		Prob > F	= **0.0000**

Source: own computation

Table 6. The results of the fixed effect model

RevenuefromSoftwareBusiness	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
ElectricityConsumption	1.36974	.3410589	4.02	0.000	.6987227	2.040757
HydropowerGeneration	-1.02334	.3257544	-3.14	0.002	-1.664246	-.3824336
ThermalPowerGeneration	-.8743075	.2976183	-2.94	0.004	-1.459857	-.2887577
TotalPopulationYearEnd	.9946784	.4139523	2.40	0.017	.1802472	1.80911
GrossOutputValueOfConstructi	.0000251	3.53e-06	7.12	0.000	.0000182	.000032
_cons	-5615.159	1751.573	-3.21	0.001	-9061.295	-2169.023
sigma_u	3790.6338					
sigma_e	1125.9843					
rho	.91891915	(fraction of variance due to u_i)				

F test that all u_i=0: F(29, 318) = 19.82 Prob > F = **0.0000**

Source: own computation

6. Discussion

6.1. China's energy structure

In China, the distribution of power resources is uneven geographically, with economically developed eastern coastal regions possessing substantial power resources. In contrast, western regions have limited power resources, requiring more investment in developing clean energy. Coal is the primary thermal power source, and China is the world's first coal producer. Coal resources are primarily concentrated in North China, Northeast China, and Northwest China, including Shanxi, Shaanxi, Inner Mongolia, and other provinces. China is rich in hydropower resources, and hydropower generation occupies a prominent share. The use of hydropower is gradually replacing thermal power for the generation of electricity as a clean energy source. Most hydroelectric resources are located in China's southwestern, southern, and northwestern regions, such as Yunnan, Sichuan, Guangxi, Gansu, etc. Aside from hydropower and thermal power, China is currently developing wind, nuclear, and solar power to diversify the energy supply caused by difficulties due to resource depletion. Wind and solar resources are costless to obtain, but their supply is unstable and seasonal. Wind power is more abundant in winter and spring and is mainly located in the northwestern part of China. Solar resources are mainly at high altitudes and collected in daytime. Wind and solar power currently faces storage and transmission difficulties.

As a result of the Russian-Ukrainian war, China is intensifying its plans to establish an ecological energy supply system. The Chinese government released a strategic plan for East Digital and West Computing in 2022, which aims to connect and combine computing power and digital resources. Data computing centers are established in the western region through a distributed energy supply approach that allows hydro- and wind power to supply power directly to the computers, optimizing the previous strategy for transmitting electricity from the west to the east. By taking advantage of the abundant power resources in the Western region, it advocates establishing computing centers there. Through this project, the eastern region's power congestion problem can be eased, and the western region's economic development is promoted to achieve the 14th Five-Year Plan's goal of coordinated regional development. However, distributed power generation requires a high level of infrastructure development in the region, which increases the pressure on the local government to invest in energy infrastructure.

6.2. The impact of energy strategies on the digital economy

It is possible to examine the impact of the energy structure on the digital economy by fixing the province and time. There is evidence that conventional energy production will reduce the income of the digital economy to some extent. The results of the study indicate that hydroelectric and thermal power production negatively affects the digital economy.

A thermal power plant generates electricity by burning fossil fuels like coal, oil, and natural gas. Due to the large amount of greenhouse gases, such as carbon dioxide released, this type of power generation has detrimental effects on the digital

economy. Environmental issues can limit the manufacture and use of electronic devices and the energy consumption of the Internet, which can threaten the sustainability of the digital economy.

A hydroelectric plant is expensive to build and operate, especially in a remote or mountainous area. Consumers may be burdened with these costs through their electricity bills, which could negatively impact the cost of the digital economy. However, there may be negative impacts on the local environment, especially on rivers and fish habitats. In this case, communities and environmental groups may protest the construction of hydroelectric plants, adversely affecting the digital economy. Power supply stability is the most directly influencing factor. Weather and seasonal changes influence energy generation by hydropower plants. During low water levels or climate change, the power supply may become unstable, disrupting the digital economy.

It is important to note that the development of the digital economy depends on many computer calculations. Hence, the consumption of electrical energy contributes to its development. In contrast, from the energy consumption perspective, the higher the electric energy consumption, the greater the benefit to the digital economy. An inadequate or unstable power supply will have a detrimental effect on the normal functioning of the digital economy and may even result in its collapse. However, the digital economy will also affect electricity and energy consumption. Increasingly, people shop, watch videos, and play games online, all of which requires significant electricity. Consequently, as the digital economy develops rapidly, the demand for electricity in digital production, transportation, and other fields will also increase. Therefore, electric energy consumption directly affects the growth and operation of the digital economy.

As for demographic factors, this paper also examined the impact of the population on the digital economy. The population provides workers for the digital economy on the supply side. Denser populations raise the demand for digital life, lifting income for digital economies. The digital economy requires people to have specific digital skills to participate effectively. It is, therefore, crucial for the development of a digital economy that the population has a high level of computer literacy and digital skills. A country's digital economy may be limited if its population needs digital skills in general. From the market side, the population is a significant consumer of e-commerce. Consumer behavior can also significantly affect the development of the digital economy. Younger generations of consumers are more likely to shop online and pay digitally, contributing to the growth of the digital economy.

An adequate infrastructure construction provides an ideal hardware facility environment for the development of the digital economy, which in turn raises its income. The development of communication, cloud computing, and financial infrastructures all play crucial roles in facilitating the digital economy. High-speed and reliable communication networks are required to facilitate the transmission and exchange of large amounts of data in the digital economy. Communication infrastructure includes broadband, mobile, and satellite networks, fiber optics, etc. By providing these, people can use various digital technologies more efficiently and promote the development of the digital economy. The construction of cloud

computing infrastructure can make it easier for digital economy enterprises to use cloud computing technology, reduce enterprise costs, and improve efficiency. Investment in education infrastructure can boost the development of the digital economy by cultivating more high-quality talents. The development of technologies such as electronic payment and virtual currency requires the support of financial infrastructure such as banks and payment institutions. This can improve the efficiency and security of the digital economy.

7. Summary and conclusions

This paper has analyzed the relationship between the energy portfolio and the digital economy, particularly the latest energy strategy. Using China's energy structure as a basis, it has provided some ideas and possible solutions for the energy security strategies of countries in Europe and the rest of the world. Electricity consumption has a significant positive effect on revenue from software business (satisfied at 1% level of significance, $p<0.01$), hydropower generation and thermal power generation have a significant negative effect on revenue from software business has a significant negative effect. The negative effect is mainly due to the distributional effect that leads to the allocation of government funds in the construction of power stations and subsidies for digital business economic activities. Both total population (Year-End) and gross output value of the construction industry have a positive effect on revenue from software business, i.e. population growth leads to an adequate labor force and strong consumer power, and a well-developed infrastructure helps accelerate the delivery of services across regions in the digital economy.

This study has led to the following conclusions. Distributed energy will become a mainstream way of getting the energy China needs in the future. This paper used a visual map to illustrate China’s energy distribution structure and its structure of energy supply and demand. The energy structure was analyzed from the perspectives of energy product types, regional distribution, and energy supply and demand. The world's energy distribution structure is unbalanced, so inter-regional deployment has become the mainstream method for resource allocation. However, Russia’s war against Ukraine has highlighted the vulnerability of resource distribution in cross-regional deployments. To reduce dependence on regional resources, the focus of the energy portfolio will be on exploring new energy sources and adopting new technologies. The establishment of an energy ecosystem was initiated by China very early on. Energy has been transformed from trans-regional transmission to local consumption through the early 'Western Electricity Transmission Strategy" and the current 'Eastern Data and Western Computing Strategy’. That is, a data computing center is established in the western region to send the data collected in the eastern region to the west for computing. European countries should take this idea as a point of reference. This approach reduces the damage of the energy crisis.

New energy generation methods, such as wind power, are expected to become the new trend. According to the supply and demand structure of energy, the higher the energy consumption, the greater the income. The traditional methods of generating power harm the digital economy, making it imperative that renewable

energy and clean energy be promoted. As the digital economy develops rapidly, large amounts of energy will be required, and traditional energy sources will put increasing pressure on the environment. The use of new energy sources is more environmentally friendly and renewable, reducing the impact of energy consumption on the environment and promoting the sustainable development of the digital economy. To ensure the healthy development of the digital economy, it is necessary to strengthen the management and control of electric energy consumption. In addition, it is necessary to promote the sustainable development of energy consumption**.** Among these measures are initiatives to develop clean energy, improve energy utilization efficiency, and optimize the energy supply chain to synergistically develop the digital economy and energy consumption. Therefore, the state should implement new energy support policies, reduce taxes on energy companies for energy technology innovation, and increase incentives for new energy patents. It is anticipated that this will lead to the development of new energy sources. The digital economy is profoundly affected as the size of the population**,** and its characteristics change. As a result, the development of the digital economy must consider various factors within the population. This is to meet different populations' needs better and facilitate the digital economy's sustainable growth. Infrastructure development significantly impacts the digital economy, which benefits its efficiency and security, reduces costs, and promotes its development.

As a significant contribution of this paper, it organizes and summarizes China's past energy distribution structure, from which the problems in the past energy development are identified, and solutions are proposed. Furthermore, this paper used a fixed-effects model to analyze the relationship between energy structure and the digital economy in the context of China's digital transformation and new energy transformation.

There are, however, some limitations to this paper. Due to the delay in the collection of statistical data, the data in this paper extends only to 2021. Consequently, this paper will prove to be a valuable line of research for analyzing the future trend of energy more clearly after new data has been collected.

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The changing role of China in global value chains: Effects of the COVID-19 pandemic and geopolitical tensions

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The implementation of China's "reform and opening-up" policy paved the way for leveraging the country's comparative advantage in labor costs and its abundant pool of low-skilled workers to attract foreign investments and transform the country from isolation to become an integral part of the global economy. China gradually deepened its embeddedness in global value chains (GVCs) and ultimately emerged as the leading trading partner to most of the developed countries, however a shift in global sentiment and a fundamentally wavered belief in trade liberalization – initially triggered by the aftermath of the 2008 financial crisis, subsequently amplified by geopolitical tensions, protectionist policies, national security concerns and the COVID-19 pandemic – set back the pace of globalization and specifically raised concerns about the inherent risks associated with the significant reliance on China – as well as on the geographically spread production networks in general – when it comes to global production. The aim of the paper is to examine how the aforementioned events of the past decade and the lately arising call for increased resilience affected China's role and weight in global production, as well as to identify trends in the dynamics of the country's GVC participation through the combination of qualitative and quantitative methods.

Keywords: GVC, China, pandemic, decoupling, resilience

1. Introduction

While many of the classical frameworks on international trade were set on the premise that cross-border trade takes place in the form of exporting and importing final products, the post-World War II trade liberalization efforts – including the gradual reduction of tariff and non-tariff barriers through a series of multilateral and reciprocal agreements (Ruta, 2017) – paired up with the rapid development of information and communication technologies (ICT) and revolutionary advancements in transportation modes fundamentally changed the nature of global trade in the second half of the 20th century (Antrás–Chor, 2021). A shift in the regulatory environment towards liberalization and advanced technologies enabled companies to disintegrate their production stages for efficiency gains and transfer (offshore) the fragmented production blocks to various geographical locations with comparative advantages primarily in labor costs (Inomata, 2017). The gradual proliferation of cross-border production networks – driven by a desire for efficiency gains – were subsequently labelled as the "new paradigm" for the global economy based on global value chains (GVCs) (Baldwin, 2006).

The fact that countries no longer had to be capable of performing the full sequence of production tasks and process raw materials to finished products on their

own opened opportunities for developing countries – China[1] serving as the most notable example – to step on the path of growth and development through specialization (Hollweg, 2019). Consequently, the global economy became deeply interconnected and incrementally reliant on China starting from the 1990s as many of the firms domiciled in developed countries began to transfer their low value-added manufacturing tasks to China – with a comparative advantage in labor costs and an abundant pool of potential workers (Urata, 2001). The latter, and the size of the national economy per se, is an important determinant when it comes to assessing a developing country's potential impact on global trade, as many other post-Soviet countries had also liberalized their economies in the 1990s, however, their impact was limited compared to China's. Over time, China has emerged as the top trading partner for a significant portion of developed and developing countries, as well as the prime destination of FDI flows, while its embeddedness and weight in GVCs have deepened.

The 2008 financial crisis wavered the decades-long sentiment of continuous trade liberalization and was proven to be a turning point for the global economy by dismantling the predominant belief in the net positive effects ("win-win") of international cooperation (World Bank, 2020). As a result of a series of events (e.g. emerged national security concerns derailing Sino-US relations, or the COVID-19 pandemic) in the past decade, the overall political momentum has shifted by different considerations coming into play with regards to the decision-making process concerning international trade and outsourcing – supplementing, if not replacing the pure efficiency-seeking and resource-optimizing considerations. The recent emergence of the desire for increased self-reliance and resilience, as well as rising national security concerns, changed the dynamics of the global economy and the perception of China as a trading partner or an FDI destination.

The purpose of this paper is to analyze the (i) root causes and (ii) impacts of the partial retreat of globalization from the perspective of China, particularly through the lense of its changing role in international trade and global value chains. To form a coherent logical structure, I start by introducing the theoretical foundations from a historical perspective by briefly elaborating on the development of GVCs, then – through the qualitative analysis of the literature – I proceed to review China's role and participation patterns in the global economy starting from the implementation of the economic reforms in the 1980s up until the financial crisis. Subsequently, I contextualize the research topic by analyzing some of the major trends of the past decade that influenced the dynamics of international trade, followed by a section that focuses on how these trends – with special attention to geopolitical tensions and the COVID-19 pandemic – impacted China's role and weight in GVCs. To test the theoretical framework against empirical data and quantify the trends assessed in the paper, I am going to focus on FDI inflow as a quantitative proxy to measure how political tensions between the West and China may have influenced the decoupling sentiment in the past 15 years from an investment perspective through a comparative analysis of FDI data. Finally, I summarize the key findings of the paper and offer pathways for academic discussion and future research.

[1] Hereinafter understood as the People's Republic of China.

2. What are global value chains?

2.1. Drivers and evolution

The theoretical foundations for global value chains were initially laid through the concept of global commodity chains (Hopkins–Wallerstein, 1986; Gereffi–Korzeniewicz, 1993), emphasizing the importance of networks and coordinated production processes involving the input of multiple economic actors in order to produce a final product. Subsequently, Jones and Kierzkowski (1990) described the notion of firms "slicing up" the production process to production blocks and connecting the chain of blocks by service links. Baldwin (2006) provided a comprehensive analysis to explain how value chains emerged and international trade gained momentum by identifying the drivers of the broader "unbundling" process in a historical context. He identified the first unbundling period ("old paradigm") as occurring in the late 19th century when the proliferation of steam ships and railways caused transportation cost to rapidly decline, enabling the production to be separated geographically from the point of consumption, creating a "North" versus "South" split. Likewise, the driver of the second unbundling ("new paradigm") also happened to be a series of revolutionary advancements, this time – about a century after the first unbundling, the "transition period" interrupted by two world wars and the economic and monetary instability in-between the two unbundling periods – in the ICT sector, which ultimately made service-offshoring possible and intensified the competition between workers globally. While the first unbundling enabled the geographic separation of production and consumption, the second unbundling set the ground for the separation and transfer of production processes. Grossman and Rossi-Hansberg (2008) labelled the "new paradigm" as "task trade" to describe the notion of international division of labor and task-specialization for the sake of productivity gains and efficiency maximization, while Feenstra (1998) captured this notion by drawing a parallel between the disintegration of production and the integration of global trade.

Foreign direct investments (FDI) and international trade are the key drivers and the two most indicative metrics of global value chain activities (OECD, 2017), as the former measures the flow and stock of cross-border investments by economic actors (primarily by multinational enterprises), and the latter represents the commercial ties and transactions between companies located in different countries. As a result of the second unbundling, starting from the early 1980s, the growth of FDI flows began to outperform the annual expansion of global trade – and therefore became an important component of GDP growth (Kalotay–Sass, 2021) – as firms operating in industrialized countries like the United States or Japan began to offshore labor-intensive production and assembly tasks – then labor-intensive service industry functions (Mankiw–Swagel, 2006) – to developing countries, at the time mostly in the East Asian region (Urata, 2001).

Consequently, international trade in intermediate goods (parts and components) was rapidly expanding (Johnson–Noguera, 2021; Degain et al., 2017), outgrowing the expansion of trade in final goods during the 1990s (Yeats, 1998).

By 2013, more than 50% of manufacturing imports and 70% of service imports were intermediate goods and services, respectively (OECD, 2013).

2.2. Definition and macroeconomic measurement

A global value chain encompasses the full range of activities – consisting of a series of stages in a predetermined sequence – required to produce a product or a service from conception to final use, with each stage adding value and with at least two stages being performed in different countries (Antràs, 2019; OECD, 2013). Depending on the number of times an intermediate product crosses borders throughout the value chain, we can differentiate between simple (one border-crossing) and complex (at least two border-crossings) GVCs (Wang et al., 2017).

In conjunction with the elevated level of international trade in intermediate goods, the shortcomings of conventional, gross export-import data analysis were realized by academia when it comes to measuring international trade flows, analyzing the external orientation of national economies, and adequately assessing the role and embeddedness of particular countries in global value chains (Campa–Goldberg, 1997). On a macroeconomic level, the two key metrics of measuring GVC participation are backward and forward participation rates. The former represent the "buyer's perspective" and therefore indicate the imported foreign value-added content embodied in a country's gross exports, whereas the latter is often called the "seller's perspective", measuring the share of domestic value-added content of exports not destined for final consumption, but the respective inputs to be further used in production by another country and re-exported subsequently (Antràs–Chor, 2021; Ndubuisi–Owusu, 2021). As many of the GVC activities take shape in the form of trade in intermediate goods and services, the core notion of GVC analysis from a trade perspective is to separate the imported input from the domestic added-value content, which brings us closer to adequately assessing a country's embeddedness in GVCs (WTO, 2023).

Alongside the value-added trade analysis, the examination of FDI flows is also a fundamental component of understanding the trends of the global economy. The relevancy of FDI-analysis from a GVC perspective lies in the fact that cross-border vertical specialization activities – i.e. firms increasing production efficiency and optimizing costs through establishing foreign subsidiaries in other countries, while keeping the control and ownership in-house, as opposed to outsourcing value chain activities to foreign contractors who are independent by ownership from the original firm (Kogut, 1985; Yi, 2003) – can be most appropriately measured through foreign direct investments (Blonigen, 2005). For the sake of completeness, it needs to be noted that there is no perfect way of precisely breaking down the composition of FDI to have a clear metric for GVC-related investments aiming to build productive capacities (Kalotay–Sass, 2021).

3. China becoming an integral part of the global economy

While the decades immediately following World War II were hallmarked by the creation of the US-led institutional framework for free trade, the active participants of the internationally liberalized trading ecosystem were essentially restricted to the Unites States, Western Europe, and Japan (a group of countries that will be hereinafter referred to as "the West"). Later on, starting from the late 1980s, formerly isolated countries – including China, India, then the former member states of the CMEA and the Soviet Union – also began to open up their markets and lift trade barriers, which ultimately resulted in the average annual growth of international trade outperforming the growth of global output. The period from the early 1980s until the financial crisis of 2008 is commonly considered to be the heyday of deepening global economic integration – greatly facilitated by the rapid technological development, most importantly in the information and communication technology (ICT) sector – through trade liberalization (Irwin, 2020).

The People's Republic of China was established in 1949, but the country remained isolated until the early 1980s, when the practical implications of Deng Xiaoping's "reform and opening-up" started to manifest and "socialism with Chinese characteristics" began to take shape. As the central government began to decentralize the means of productions and lift restrictions on foreign direct investments, and formulated special economic zones in the coastal regions (Kissinger, 2011), a period hallmarked by massive inflow of FDI followed – which peaked in the 1990s (Antrás, 2020). Subsequently, China strengthened its position as an emerging participant of the global economy by joining international organizations and multilateral trade agreements, including the IMF, World Bank, and later the WTO (Vogel, 2018). These decades were not only characterized by rapid economic growth but were also accompanied by increased social prosperity (Mitter–Johnson, 2021). The integration of China into the global trading ecosystem not only led to an unprecedented alleviation of poverty within the country but also reshaped the global economy and served as the one of the key catalysts for the economic boom of the past decades (Rajah–Leng, 2022). Nevertheless, China's ascent to become a dominant global economic power was not – and is still not – a seamless process, primarily due to the active governmental interventions in the Chinese market that contradicts the core WTO principles. Over the course of the years preceding the country's WTO admittance – as well as in the decades that followed, up until today – the Chinese economic regime fueled heated debates among the participants of the liberalized global trading ecosystem (Mavroidis–Sapir, 2021).

As China had a significant comparative advantage in labor cost and a greatly abundant pool of low-skilled workers – ready to be re-channeled from agriculture to industrial production (Eichengreen et al., 2012) –, the country became highly attractive for Western companies that were seeking opportunities to optimize their production costs and, therefore, increase their efficiency and profitability (Urata, 2001). As a result, China developed into the first and foremost destination of offshored, low value-added, labor-intensive production activities – tapping into GVCs by initially participating in low value-added tasks affiliated with the middle of the

smile curve[2] (Inomata, 2013). In line with the theory of the investment development path (Dunning, 1981; Dunning, 1986; Dunning–Narula, 1996), the continuous inflow of FDI induced booming economic growth in China and set the country on a developing trajectory with steadily increasing forward and backward GVC participation rates (OECD, 2021). The country's integration into the global economy was primarily based upon its incrementally deepening role in processing trade – that is, the process of importing intermediate goods (e.g. materials, parts, and components), assembling the imported inputs, and then re-exporting the finished products to foreign markets (Dai et al., 2016). Processing trade primarily took place in the country's export processing zones located along its Eastern coastline. As a result, while initially accounting for only 2.7% of the global industrial production in 1990, China gradually evolved into the largest actor in the global manufacturing industry. By 2010, almost 20% of the worldwide industrial production was taking place in China (Müller–Voigt, 2018). Within the same time span of two decades, China also overtook the US as the largest value-added manufacturer by 2010 (Black–Morrison, 2021).

From an international trade perspective, as a result of China's increased embeddedness in global and regional value chains, intra-regional trade in the early 21st century expanded rapidly in Asia, while it slightly decreased in North America and Europe. By the same token, both North America and Europe recorded gains in inter-regional trade, primarily explained by these regions' deep economic ties with China (Dollar, 2019). Although the tide has been apparently turning lately as China's participation rate in Asian value chains is declining simultaneously with its changing role in GVCs (Herrero–Nguyen, 2019), inferring an economic strategy focusing not on regional, but primarily on domestic production linkages within China.

4. Major trends of the global economy in the past decade

4.1. From globalization to slowbalization

"Slowbalization" became a term commonly used in the IB academic discourse to describe the retreat of globalization in the decade following the financial crisis and recession of 2008-10 (Economist, 2019), which was subsequently exaggerated by a partial decoupling between the United States and the People's Republic of China, the COVID-19 pandemic, and the direct and indirect impacts of the war waged by Russia against Ukraine.

As Antrás (2020) argues, the deglobalization trend observed in the past decade is an inherent consequence – exacerbated by the aforementioned phenomena – of the unsustainably high pace of globalization (labelled as "hyper-globalization")

[2] The "smile curve" is a term coined in the 1990s to describe the visual representation of the different value-added contents of upstream, production and downstream stages in a typical GVC. The X axis shows the stages of the production process in sequential order, while the Y axis represents the value-added content of the respective stage. Upstream and downstream activities typically contain higher added-value compared to the "middle" section of the production process, which generally consists of the labor-intensive assembly and production stages – and hence the smile-shaped curve (Inomata, 2023).

that took off after 1980s – in the sense that recent deglobalization or slowbalization trends are just correcting mechanisms for excessive- or hyper-globalization. The era of hyper-globalization was hallmarked by growing international interdependence, therefore by the same token, deglobalization can be described as "the process of weakening interdependence among nations" (Witt, 2019b:2). Empirical data also reaffirms the theoretical framework that under de-globalizing circumstances, countries tend to rely on foreign inputs – and FDI – to a lesser extent, and the focus starts to shift towards domestic production as opposed to a relatively elevated level of international trade in goods and services. According to Irwin (2020), global economic integration hit a historical turning point in 2008 – in line with the findings of Witt (2019b) – as the ratio of the sum of world exports and imports divided by world GDP – a proxy labelled the "trade openness index" – had started to decrease for a prolonged period of time for the first time since the end of World War II. As the post-recession years shed light on the pitfalls and shortcomings – partially derived from the underregulated nature – of the global economy, the realizations induced increased protectionism and inward turning momentum in countries that were previously the engines of globalization. This phenomenon can be partially attributed to the inherent structural economic setbacks following the crisis, however, the turning sentiment was further exacerbated by a shift in policymaking, supported by publications focusing on the disadvantages of international integration from the perspective of developed countries, especially from the point of view of low-skilled workers (Autor et al., 2013).

When it comes to GVCs, this trend manifested in a sharp but rather temporary reshoring activity that took place right after the crisis, however, the trend eventually lost momentum by the early 2010s, and key indicators of GVC performance have been rather stagnating since (Alvarez et al., 2021).

4.2. Geopolitical tensions

As uncertainty increased in the past decade, so did trust in GVCs decrease, and, as a political response, populism reared its head to offer solutions to the drawbacks and adverse impacts of hyper-globalization (Rodrik, 2018). Partially driven by the anxiety caused by the loss of – mostly low value added – manufacturing jobs over the decades in developed countries, as well the increased role of embedded national security concerns in discussions revolving around global value chains, we have witnessed a proliferation of inward-looking strategies lately. Leading politicians in economic powerhouses like the United States, United Kingdom, Brazil or China have been openly advocating for protectionist measures raising the importance of self-reliance mainly regarding knowledge- and IP-intensive, or dual-use technology production processes that include the use of artificial intelligence, quantum computing, advanced robotics or semiconductors (Solingen et al., 2021).

Despite the United States serving as the flagship of globalization for decades, President Trump announced the "America First" policy in the mid-2010s and introduced a set of tariff barriers over time – mostly concerning the bilateral trade with China, but simultaneously the US withdrew from several multilateral agreements – as protectionist measures, allegedly with the aim of supporting the

domestic economy. A process that was subsequently followed, under the Biden administration, by embracing policy stances like friend-shoring – aiming to shift supply chains away from China to "trusted countries" (Yellen, 2022) – or the strategic self-reliance with regards to cutting-edge semiconductor manufacturing (Allison–Schmidt, 2022). Consequently, by now, hostile attitude towards China is founded on bipartisan support in US politics (Shirk, 2023). At the same time, China has also shown signs of turning inwards by pursuing governmental policies targeting the country's transformation from a labor intensive to a knowledge intensive economy with high domestic added value (Li, 2018), as well as with domestically designed and produced cutting-edge technology equipment (Allison–Schmidt, 2022).

4.3. COVID-19 pandemic

The global outbreak of COVID-19 – which, from an economic perspective, can be defined as an "exogeneous shock of uncommon magnitude imposed on firms with international commercial linkages" (Verbeke, 2020) – in the first half of 2020 severely disrupted value chains and had a negative impact on gross output (Kumagai et al., 2020). The protective safety measures self-imposed by the governments of most of the developed and emerging countries have put restrictions on the movement of people and goods, and hence disrupted business operations in many sectors primarily through the combination of the following four channels: (i) reduction in employment, (ii) sharp drop in travel, (iii) plummeting demand for services that require face-to-face interactions among participants, and (iv) increased costs of international transactions (Maliszewska et al., 2020).

The increased uncertainty resulted in both supply (e.g. of semiconductors, personal protective equipment, or simply through the overall delays in cross-border trade) and demand (e.g. increased for medical supplies, streaming services, digital gadgets; decreased for non-essential consumer goods or services that require proximity of people) side shocks (Baldwin–Tomiura, 2020), as well as plummeting FDI flows (Strange, 2020). The impact and severity of the economic shocks caused by the pandemic was uneven among different countries and regions (Kalotay and Sass 2021) and was prolonged and exacerbated due to the fact that countries were hit at different times, exposing the vulnerability of GVCs that are ultimately based on the premise of uninterrupted global interconnectedness. Diversified supplier networks may have contributed to increased resilience in GVCs, however the pandemic shock showcased that, as a rule of thumb, the higher the complexity of a value chain is, the more exposed it is to disruptions (Solingen et al., 2021). By the same token, it is important to note that the interconnectedness of production blocks amplified the waves of supply shocks (Sforza–Steininger, 2020). Furthermore, as the epicenter of the pandemic happened to be in China, value chains heavily reliant on inputs from Chinese companies were more severely affected. Considering how deeply integrated China is in value chains, the impact of Chinese lockdowns and facility shutdowns rapidly became widespread in the world economy (McKibbin–Fernando, 2021).

4.4. A rising call for increased resilience

Any disruptive event, even if the direct impact is restricted to a single firm, is going to have indirect effects on a broader set of economic actors through the propagation mechanisms of the trading relationships and the – intra- and intersectoral (Tokui et al., 2017) – input-output dependencies (Acemoglu et al., 2016). International production networks are highly exposed to risks – furthermore, empirical evidence shows that longer GVCs tend to be more vulnerable to external shocks, partly because of the lack of risk-mitigation mechanisms (Solingen et al., 2021) – and are also capable of propagating disruptions in the economy. Smaller shocks tend to have negligible effect on GVC operations, however, large shocks typically trigger strong responses and adjustments (Hunneus, 2018).

The core notion of resilience – from an economic, ecological and engineering perspective – is the ability to absorb and overcome external shocks in the shortest possible time (Giuseppina–Michele, 2018). As Solingen et al. (2021:21) defines, GVC resilience is "the ability of these chains to anticipate and prepare for severe disruptions in a way that maximizes capacity to absorb shocks, adapt to new realities, and reestablish optimized operations in the shortest possible time".

5. China's changing role and weight in global value chains and international trade

The two distinguishable and broader driving forces behind China's changing role in GVCs are the overall slowing pace of globalization – as assessed earlier – and the country's economic decoupling from the United States. Decoupling is defined as the "process of weakening interdependence between two nations or blocks of nations" (Witt et al., 2023:1) and can be measured through the trends of GDP-weighted FDI flows and trade data. Furthermore, in its core, it can be largely attributed to the fact that after decades of being economically dependent on the US and the West, China by now has emerged as the legitimate challenger of US hegemony (Allison, 2017, Witt, 2019a).

As revolutionary advancements in the technology sector were among the most significant drivers of the disintegration of production processes historically, the tide has been apparently turning. On the one hand, some of the cutting-edge technologies – for example, 3D printing, advanced robotics or AI-based solutions – carry the potential of (at least partially) eliminating the need for human labor, foreseeably in relatively low value-added manufacturing activities, which has practical implications for US and European companies offshoring their activities to China (Witt et al., 2023). The combination of new opportunities for cost-efficient localized production and the high pace of real wage increase in China – which far outgrew the real wage increase in other Southeast Asian countries – is likely to reduce the Western companies' dependence on offshored Chinese production activities (Huang et al., 2021). On the other hand, with the (a) continuous sophistication and proliferation of dual-use technologies (i.e. commercial and military) – as well as the intensifying battle for the dominant role in cutting-edge technologies, like semiconductor production (Patel, 2022) –, and (b) China's increasing dominance in sensitive technological areas like battery production,

national security concerns emerged as a primer consideration in a number of knowledge-intensive GVCs with regards to what activities to offshore and to where (Hille, 2020; Hu et al., 2021), considering the concerns revolving around the proper protection of intellectual property rights (Antrás, 2020). According to the framework composed by Witt et al. (2023), companies – and governments – may pursue different value-chain strategies depending on two factors: (a) strategic importance in conjunction with national security considerations, and (b) reshorability of the process, which can be understood as the realistic feasibility of moving offshored production processes back to the home country. Consequently, China's significance in GVCs is likely to lessen over time as the US led bloc of nations are still the leading innovators with much of the GVCs dominated by Western lead firms (Witt, 2019a) – although there is a growing number of Chinese lead firms in some areas. For Western lead firms, the incentives to transfer low value-added processes to China are fading due to the country's diminishing comparative advantage (although it is important to note that Chinese labor productivity increased significantly in the past decades), while lead firms may be reluctant to establish Chinese subsidiaries for high value-added activities (Antrás, 2020) – ultimately curbing China's trajectory to move up the value chains through international cooperation. On the other hand, many multinational enterprises (MNEs) with production facilities in China are producing in the country primarily to satisfy the local demand, therefore, they hardly have any incentive to reshore these activities as long as the continuous economic growth and increasing prosperity keep Chinese consumption at steady levels (McKinsey, 2020). Furthermore, the increased number of Chinese-owned production capacities that are crucial for GVC operations also influence the country's long-term embeddedness in value chains. Overall, any reshoring trend from China that may follow is likely to take years due to the hysteresis of value chains related to sunk costs (Di Stefano et al., 2022).

Supplementing the aforementioned considerations, a set of political and economic factors further amplifies the deterioration of the relationship between China and the West, and therefore infers changes in China's role in GVCs. Although the turning point in political sentiment is commonly realized as a post financial crisis phenomenon, trade and FDI data prove that the economic interdependence between the US and China has started to fall years before 2008, and the trend has been ongoing since (Witt et al., 2023). Among the core reasons – apart from the rising wage levels – we can mention (a) the slowing economic growth in China that implies lower returns on investments (Eichengreen et al., 2012), and (b) substantial and often unpredictable government interventions that increase the overall level of uncertainty. In conjunction with the latter, the willingness of Chinese policymakers to make politically motivated economic interventions was undeniably showcased during the COVID-19 pandemic, with draconian lockdowns, arrests, additional taxes, and factory shutdowns frequently enacted without prior notice (Mitchell et al., 2022). It consequently led to the realization of the vulnerability of GVCs that rely on single-sourcing methods with Chinese partners. In other words, the occasional unreliability of Chinese upstream suppliers and the uncertain regulatory environment triggered many Western firms and governments to shift their focus from taking into account solely cost-oriented considerations to putting more

emphasis on value chain resilience (Rapoza, 2020). One potential way of spreading risk – although at the expense of a certain degree of redundancy and hence reduced efficiency (George–Schillebeeckx, 2022) – in GVCs is geographical diversification by building parallel supplier networks and endorsing the "China+1" sourcing strategy (Black–Morrison, 2021). From the perspective of China, it implies the reduction of the country's embeddedness in value chains – explained by the desire of partner countries to reduce their dependencies on China and hence increase the overall value chain resilience (Baldwin–Freeman, 2022) –, which is contrary to the intentions and efforts of the Chinese government to (i) increase the global economy's dependence on China through the deep integration of Chinese firms in GVCs (Rudd, 2021), and (ii) position the country as a de facto monopoly concerning a set of crucial raw materials-based inputs. This aspect is especially relevant from the perspective of the European Union, as EU member states, by and large, became asymmetrically integrated in value chains dominated by Chinese firms in a sense that while China managed to increase its DVX (domestic value of third country's exports, or export of intermediates for re-export) vis-à-vis the EU, the European value-added content of Chinese re-exports (FVA, from China's perspective) has fallen. In other words, this trend indicates that the EU became more reliant on Chinese input than vice versa (Herrero–Nguyen, 2019). On the other hand, continuous and potentially accelerating economic detachment from the West is likely to have a detrimental effect on China's ability to escape the middle-income trap (Witt, 2016).

Chinese governmental policies, 5-year plans and strategic documents outline the vision of the country's leaders with regards to China's desired position in the global economy and the designated pathway for the development of the domestic economy (Witt, 2022). "Made in China 2020" was one of the first broader frameworks that explicitly made reference to the China's desire to gain strategic independence – for example, through significant governmental subsidies for domestic R&D – and to become less reliant on foreign technological inputs (Müller–Voigt, 2018). Although China is likely to fall short on the quantifiable goals of this strategic document, the country's latest 5-year plan (enacted in 2020) remains consistent with the inward-oriented sentiment focused on 'dual circulation' (Hu et al. 2021). It keeps the reduced dependence on foreign supplies among the top priorities and puts emphasis on strengthening domestic markets – both from the supply (domestic production) and demand (domestic consumption) side (Takahashi, 2020; Black–Morrison, 2021). Furthermore, the governmental plan highlights the importance of scientific and technological self-reliance (Luo–Witt, 2022) – even if it comes at the cost of short-term economic pain (Asia Society, 2023). The aforementioned policies can be interpreted as strong government interventions that are fundamentally contradictory to the principles of liberalized markets.

One practical way of pursuing such strategies is to enact policies and provide governmental funding for the purpose of deepening and upgrading domestic value chain linkages, which can ultimately lead to the increase in the value-added content of exports (Banga, 2014). Alternatively, countries may decide to reshore activities to increase the domestic value-added content in a given GVC, while – by the same token – decreasing their exposure to external shocks and increasing their

self-reliance (Titievskaia et al., 2020; Alvarez et al., 2021). To a certain extent, both China and the US are currently moving on this trajectory.

With deteriorating economic ties with the West, China has been pursuing geopolitical initiatives globally in the past decade – most notably the Belt and Road Initiative – with the aim of building political and economic partnerships – which can be understood as a sphere of interest – primarily in the developing world (Nordin–Weissmann, 2018). In the context of China's participation in GVCs, one potential implication of such efforts is that it may set the foundation for Chinese companies to start offshoring labor-intensive, low value-added activities to, for example, African countries with lower wage levels compared to China, which could ultimately facilitate a higher value-added content generated in China through increased efficiency (Lewin–Witt, 2022). Shifting the production to higher value-added tasks is called upgrading in the literature (cf. Humphrey, 2004). On the other hand, such a trend could also potentially help African countries to "move up the value chain" (Gibbon, 2008) by acquiring capabilities and accumulating knowledge through leveraging the spillover effects derived from the extensive networks built through GVC activities.

6. Comparative FDI analysis to identify quantifiable trends in investment flows

6.1. Approach and methodology

The key findings of the OECD's recent analysis about the value-added trade of China (OECD, 2022) reaffirm the slowing momentum of the country's GVC trade – foreign value-added content of exports, domestic value-added content driven by foreign final demand, share of imported intermediate inputs subsequently embodied in exports all fell between 2008 and 2018. As mentioned before, the other proxy commonly understood as an adequate indicator of measuring GVC activities is FDI.

The following quantitative analysis conducted by the author is based on the view held by Witt et al. (2023), who argue that FDI flows are the most proper way of measuring contemporary trends, as both trade data and the amount of FDI stock in a given country can largely be attributed to strategic decisions made years, or even decades ago – which could partially explain how trade in goods between the US and China reached a record high volume at $691 billion in 2022 (Martin–Monteiro, 2023) –, whereas the inflow of FDI can be used to quantify the contemporary appetite of foreign firms to invest and establish affiliates in a given country. When attempting to assess the relative position of China, a relevant proxy can be to measure its ability to attract foreign investments compared to emerging countries that may serve as alternatives when it comes to offshored value chains activities. The potential beneficiaries of China's detachment from GVCs might be Taiwan and Southeast Asian emerging countries, as well as Mexico due to its proximity to the United States and low wage-level (Hille, 2020; Rapoza, 2020). The FDI data of UNCTAD (2023) was used during the analysis, the observed period is 15 years (2007–2021).

Even though FDI is considered to be an adequate proxy to assess investment flows in the context of GVC activities, in line with reasons mentioned earlier in this

paper, one must note the limitations as well. For example, Beugelsdijk et al. (2010) raise awareness of the hidden biases FDI stock analysis may imply when it comes to assessing the affiliate activities of MNEs, and Antalóczy and Sass (2014) describe how indirect FDI flows – motivated by practical financial incentives – may distort the results of FDI analysis and the conclusions drawn. Moreover, Sutherland and Anderson (2015) elaborate on how the aforementioned limitations and biases may influence our understanding of the actual activities of Chinese MNEs.

6.2. Data analysis

If we contemplate the average annual FDI inflow growth rate (using current price values) in five-year periods, the analysis undeniably proves that China, by and large, has been lagging behind in attracting new investments compared to other observed countries. With its single digit annual growth over the past 15 years – which was just narrowly in positive territory between 2012 and 2016 – almost all examined countries outperformed China in inflow FDI. The pivotal notion of relocating production blocks from the "strategic competitor" China to a "friendly" Taiwan is not reaffirmed by this analysis, but the main beneficiaries appear to be Southeast Asian countries. Consequently, the trend of more FDI flowing to countries that can serve as alternative destinations of relocated value chain activities – at the expense of continuous investment flows to China – is verified by Figure 1.

Table 1. Average annual FDI inflow growth rate, 2007–2021

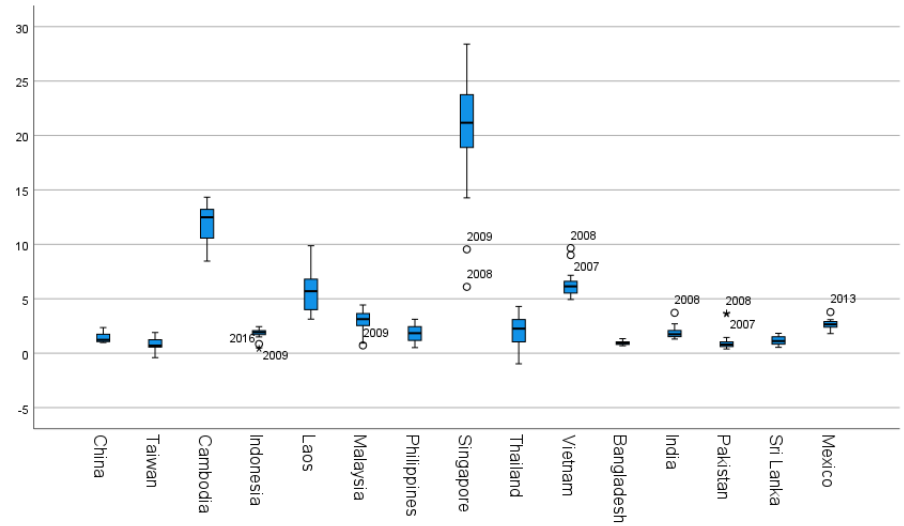
Region	Country	2007-2011	2012-2016	2017-2021	2007-2021
Eastern Asia	China	12.3%	1.6%	6.5%	6.8%
	Taiwan	-52.7%	3.4%	4.6%	-14.9%
South-eastern Asia	Cambodia	29.0%	11.4%	7.4%	15.9%
	Indonesia	50.0%	-17.3%	85.3%	39.3%
	Laos	16.2%	30.8%	11.1%	19.4%
	Malaysia	100.7%	0.4%	34.9%	45.3%
	Philippines	4.3%	35.0%	8.2%	15.8%
	Singapore	35.6%	13.8%	11.6%	20.3%
	Thailand	3.3%	78.9%	-80.7%	0.5%
	Vietnam	41.3%	11.2%	4.6%	19.0%
Southern Asia	Bangladesh	13.3%	16.6%	8.4%	12.7%
	India	19.0%	6.9%	2.4%	9.4%
	Pakistan	-17.0%	22.7%	-2.1%	1.2%
	Sri Lanka	24.5%	0.3%	2.5%	9.1%
Central America	Mexico	10.1%	14.8%	0.9%	8.6%

Source: *Source*: own construction based on UNCTAD (2023)

Furthermore, considering the FDI inflow shown relative to the GDP helps to adequately assess how new investments kept pace with the growth of overall economic output. For most of the observed countries, the value was considerably lower in 2021 compared to 2007 – which can be at least partially attributed to "slowbalization" trends –, although China stands out as one of the worst performers

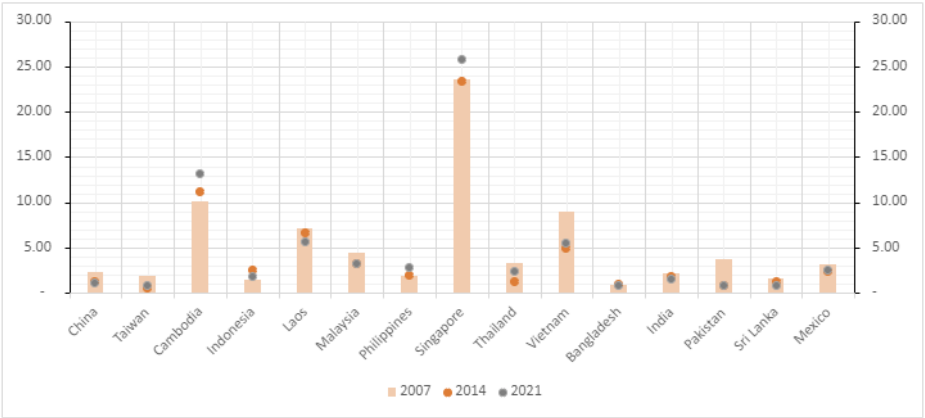
in this domain by a sharp fall from 2.35% to 1.05%. Only the Philippines, Cambodia, Indonesia, and Singapore managed to attract more FDI relative to their GDP by the end of the examined period. For completeness, it is important to note that due to the size of the economy per se, the nominal inflow of FDI to China in 2021 still exceeds the Singaporean, Indian and Mexican FDI inflows *combined*.

Figure 1. Box plot analysis of FDI inflow (% of GDP), 2007–2021



Source: own construction based on UNCTAD (2023)

Figure 2. Time series analysis of FDI inflow (% of GDP), 2007–2014–2021



Source: own construction based on UNCTAD (2023)

The aforementioned trends may be interpreted as signs and early indicators of the relative decline of China as for its role as the first and foremost destination of foreign direct investments among emerging markets, however, the country's still dominant role becomes visible if we contemplate its share in global FDI inflows. Even though the decoupling sentiment shows clear signs, more than 1 out of every 10

dollars of FDI invested globally ended up finding its way to China in 2021. Due to the robustness of the domestic market, its mass production potential and still deep embeddedness in GVCs, China remains economically attractive amidst all challenges. In the interest of truth, one must note that the size of the country per se is a crucial determinant in China's share of global FDI inflows. Both in terms of population and land area, China is among the largest countries, therefore at least part of its significance in the global share of FDI inflows can be attributed to this variable.

Table 2. FDI inflow as % of global FDI inflow, 2007-2021

Region	Country	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Δ (pp.) 2007-2021
Eastern Asia	China	4.38	7.29	7.60	8.25	7.70	8.24	8.49	9.16	6.57	6.54	8.35	9.55	9.54	15.51	11.44	7.05
	Taiwan	0.41	0.37	0.23	0.18	- 0.12	0.22	0.25	0.20	0.12	0.47	0.21	0.49	0.56	0.63	0.34	- 0.07
South-eastern Asia	Cambodia	0.05	0.06	0.08	0.10	0.10	0.14	0.14	0.13	0.09	0.12	0.17	0.22	0.25	0.38	0.22	0.17
	Indonesia	0.36	0.63	0.39	0.99	1.19	1.30	1.29	1.56	0.81	0.19	1.26	1.42	1.61	1.93	1.27	0.91
	Laos	0.02	0.02	0.02	0.02	0.02	0.04	0.05	0.06	0.05	0.05	0.10	0.09	0.05	0.10	0.07	0.05
	Malaysia	0.45	0.48	0.12	0.65	0.76	0.63	0.83	0.78	0.49	0.55	0.58	0.53	0.53	0.33	0.73	0.28
	Philippines	0.15	0.10	0.16	0.08	0.12	0.22	0.26	0.41	0.27	0.40	0.63	0.69	0.59	0.71	0.66	0.52
	Singapore	2.24	0.79	1.50	4.13	2.48	4.09	3.88	5.23	2.89	3.30	5.05	5.10	7.18	7.83	6.26	4.03
	Thailand	0.45	0.58	0.52	1.05	0.15	0.88	1.09	0.35	0.43	0.17	0.51	0.91	0.32	- 0.50	0.72	0.27
	Vietnam	0.37	0.64	0.61	0.58	0.47	0.57	0.61	0.66	0.57	0.62	0.86	1.07	1.09	1.64	0.99	0.62
Southern Asia	Bangladesh	0.03	0.07	0.06	0.07	0.07	0.09	0.11	0.11	0.11	0.11	0.13	0.25	0.19	0.27	0.18	0.15
	India	1.33	3.17	2.88	1.97	2.25	1.65	1.93	2.47	2.14	2.17	2.44	2.91	3.41	6.65	2.83	1.50
	Pakistan	0.29	0.37	0.19	0.15	0.07	0.06	0.09	0.13	0.08	0.13	0.15	0.12	0.15	0.21	0.13	- 0.16
	Sri Lanka	0.03	0.05	0.03	0.03	0.06	0.06	0.06	0.06	0.03	0.04	0.08	0.11	0.05	0.05	0.04	0.01
Central America	Mexico	1.70	1.99	1.44	1.96	1.59	1.48	3.31	2.18	1.72	1.52	2.09	2.35	2.32	2.90	2.00	0.29

Source: own construction based on UNCTAD (2023)

7. Discussion and conclusions

International cooperation and reciprocal trade agreements were the founding blocks of the era following World War II. Formal multilateral arrangements, the liberalization of capital flows and technological advancements paved the way for countries to move away from self-reliance and establish a world order based on international partnerships and division of labor (Antrás, 2020). Over the course of the past several decades, the increased level of living standards, the considerable alleviation of poverty and productivity gains in China can largely be attributed to the integration into the global economy through liberalization (Dollar, 2017). Initially taking part in low value-added, specialized tasks of production chains set the foundation for the knowledge- and technology transfer required to stimulate the domestic economy and paved the way for upgrading – both on an industrial and human capital level (World Bank, 2020).

However, the era of cost-focused international cooperation seems to have come to an end globally. Although IB scholars (e.g. Koren–Tenreyro, 2013; Todo et al., 2015; Solingen et al., 2021) tend to agree that the benefits of trade openness, international diversification and GVC participation outweigh the potential drawbacks caused by the increased exposure to foreign suppliers, the first decades of the 21st century showcased that emerging geopolitical tensions among economic powerhouses, rising national security concerns, and the potential of worldwide

pandemics may bring novel factors into play and override the pure efficiency-seeking considerations when it comes to offshoring decisions.

With Sino-US tensions steadily rising on multiple fronts, further decoupling (which is an ongoing phenomenon as the FDI analysis reaffirmed) is likely to follow in the years to come – inferring deep economic implications and the potential of partially restructured value chains. Inward-oriented governmental policies and strategies such as the current Chinese 5-year plan with special attention to the propagation of dual circulation or US federal subsidies for companies to backshore activities may further accelerate and exacerbate the trends observed in this paper. This phenomenon will almost certainly serve as fertile ground for future research as relocating production parts is anticipated to be a decades-long process – just as it was the case with China decades ago (Hille, 2020).

After all, empirical evidence of the last 70 years tends to confirm the notion that nation states, by and large, are better off when they step on the pathway of exploiting the underlying potential in international trade and economic openness. Even upon considering the political and economic turmoil of the past decade, the temporary retreat of globalization – which is not historically unprecedented and can be (at least partially) attributed to inevitable great power conflicts occurring from time to time (Antrás, 2020) –, and the deteriorating political and economic ties between the US and China, I agree with Witt (2002) that the logic of comparative advantages will always incentivize economic actors to engage in international trade in the long run.

As for the years and decades to follow, China's role in GVCs will most likely be influenced by the practical implications of notions like the trade-off between efficiency and resilience, strategic self-reliance, national security and technological hegemony. How these factors will shape the economic ties and the dynamics of interdependency between China and the West is going to be one of the core matters of the 21st century global economy.

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Cabo Delgado, the northern coastal part of Mozambique: turbulent past, chaotic present… and prosperous future?

Tibor Pintér

The importance of Mozambique's northern coastal province of Cabo Delgado has increased with the outbreak of the Russian-Ukrainian war, although it was no less important before. In the last ten years, large reserves of natural gas and gemstones have been discovered and the last few years have seen the rise of a jihadist movement under the aegis of the Islamic State. Russian aggression has increased Europe's appetite for natural gas in its desire to reduce Russian energy dependence. The discovery of natural gas in Mozambique has created huge opportunities for the poor country, as international gas companies have invested heavily in Cabo Delgado. Although the past and present of the region is very chaotic and unstable, the future could be prosperous if the problems highlighted in this study are mitigated.

Keywords: Mozambique, Cabo Delgado, ASWJ, LNG, FLNG, interventional forces

1. Introduction

On 24 February 2022, Russia invaded Ukraine, causing a turmoil in almost every aspect of life. The effects of the protraction of the war and the aftermath of the coronavirus epidemic also affected international political and economic developments. Rising commodity prices and inflation pose a major challenge to policy makers in both developing and developed countries.

When we look at natural resources, including natural gas, there has been a fundamental change in the last year. The European Union has relied heavily on pipeline gas, because until the war Russia dominated pipeline gas imports, which were almost 40%. Natural gas is important for the European Union, accounting for 25% of its energy needs, equivalent to about 400 billion cubic metres. With domestic production at 10%, import dependence remains significant. With the outbreak of the war, the EU has had to change its strategy and has started to reduce its dependence on Russia and the energy it provides. Even though Norway has taken the position over from Russia as the main pipeline gas importer, the EU's energy strategy is shifting towards liquefied natural gas (LNG). As a liquid, LNG takes up about 600 times less volume than gas at normal barometric pressure, which makes it easier to transport over long distances without pipelines, usually in specially designed ships. LNG supplies are available in a wide range of countries around the world and the global LNG market is growing rapidly. The EU has imported 98 billion cubic metres of LNG as of early 2022. This is 39 cubic metres more than at the same point in 2021 (European Commission, 2022).

Between January and September 2022, the United States (44%), Russia (17%) and Qatar (13%) accounted for the majority of the EU's LNG imports. Globally, the United States, Australia and Qatar are the most relevant (European Commission, 2022). However, other sources should not be overlooked. Africa's

role may become increasingly important for the world because of its rich natural resources, and the same is true for the natural gas industry. The impact of the war on the LNG market has led to a kind of Hunger Games, which is exacerbated by the fact that a new natural gas field is discovered. This has happened in one of Africa's poorest countries, Mozambique, and one of its poorest provinces, Cabo Delgado.

The theoretical basis of the study is the dependency principle, which is essentially Marxist in origin, but nevertheless determinant for the political economy and international relations of Third World states. This phenomenon first appeared in Paul A. Baran's 1957 book *The Political Economy of Growth*, after which a number of famous scholars have addressed this global problem, including Andre Gunder Frank, Samir Amin, Theotonia Dos Santos and Claude Ake (Ghosh, 2001). The starting point is the Dos Santos definition of dependence, which is „a situation in which the economy of certain countries is conditioned by the development and expansion of another economy to which the former is subjected" (Dos Santos, 1970:231). Dos Santos was basically looking at Latin America, but it is also true for Africa, but in the case of the latter we have to add the phenomenon of neo-colonialism, whereby the state is sovereign and autonomous in theory, but in practice its political and economic space is determined from outside. Its conceptualiser was Kwame Nkrumah, who first described it in his 1965 work, *Neo-Colonialism, the Last Stage of imperialism* (Enuka, 2018). A practical example of this is the incursion of transnational corporations, which will be discussed later in relation to the LNG project. This raises the question of whether the discovery of abundant natural gas in Mozambique will really bring about the economic and political empowerment of the country or whether it will widen the gap between the core and the periphery, namely the Western world and Mozambique.

The study also searches for answers to the question: can Mozambique, and especially Cabo Delgado, one of the most underdeveloped provinces, be a winner of the Russian-Ukrainian war? In other words, can the political leadership in Mozambique be able to take advantage of the huge amount of natural gas revenues available and strengthen the country? In order to answer this question, it is necessary to provide a detailed description of Cabo Delgado and the difficult circumstances in which it faces, given the serious security crisis in the region, which is a major obstacle to the implementation of natural gas exploitation projects. It is also necessary to describe the quantities of gas involved, the parties involved in the exploitation projects and the status of these projects at the time of writing.

2. Cabo Delgado

Cabo Delgado is Mozambique's northernmost province, bordered by Tanzania to the north, Niassa province to the west, Nampula province to the south and the Indian Ocean to the east (Matsinhe–Valoi, 2019). The region is covered in dense forests and shrubs, which are ideal for the establishment and activities of criminal organisations, as the impenetrable vegetation makes certain areas difficult to access. Small islands are sparsely populated or almost completely uninhabited (Gartenstein-Ross et al., 2021).

Figure 1. The map of Cabo Delgado

Source: Lister (2020)

In Mozambique, which has a population of almost 33 million, it is estimated that the instability and steadily deteriorating economic situation in Cabo Delgado, with a population of more than 2.5 million (Joshua Project, 2023a) is due to hostilities between two ethnic groups: the Makonde ethnic group of more than 500,000 (Joshua Project, 2023b), which lives in the interior of the region, and the Mwani ethnic group of around 160,000, which is located on the coast (Joshua Project, 2023c).

More than a third of Mozambique's Muslim population lives in the north of the country, while 54% of Cabo Delgado is Muslim, but there are also significant numbers of Christians. The Makonde ethnic group includes both Muslims and Christians who are adherents of the ruling FRELIMO party, while the Mwani ethnic group has a massive Muslim majority, known primarily for their support of the main opposition party, RENAMO. In both rival ethnic groups, the Muslim religion is dominant, only the Mwani youth hold more radical views and have moved from a peaceful version of Sufi Islam to Salafism and, within that, to the Wahhabi school of thoughts, thanks to the presence of radical Islamic preachers from abroad. The disparity between the two rivals is noticeable in the region, as the leaders of the political and economic elite in the FRELIMO party

are largely from the Makonde group, including the current Mozambican President Felipe Nyusi. As a result, the Mwani people struggle to integrate into society, rejecting the current state order and the regulatory and state redistribution system that has been in place since independence (El Ouassif–Kitenge, 2021).

In the Mozambican discourse, Cabo Delgado is known as Cabo Esquecido, or Forgotten Cape, as it is the birthplace of the FRELIMO party, the cradle of the nation, the birthplace of the independence and the birthplace of the prominent figures involved in the independence movements. However, it was the main base of the rival RENAMO in the Mozambican civil war, and since the signing of the General Peace Treaty of Rome in 1992, FRELIMO has been gradually excluding the population of Cabo Delgado economically and socially. Currently, infrastructure is poor and unemployment is high, especially among local youth, and the quality and number of social and health facilities are below the Mozambican average (Matsinhe–Valoi, 2019).

But the last decade or so has brought a new turning point in the life of Cabo Delgado. On February 18, 2010, Anadarko Mozambique, a branch of Anadarko Petroleum, discovered a huge natural gas field off the northern coast of Mozambique, which has become the most important economic project in the country's history. Some of the world's major energy companies have rushed to the coast of Cabo Delgado (Flanders Investment & Trade, 2021). Although the government of Mozambique stated in 2014 that natural resources are key to the country's economic growth, there has been little positive feedback from the local population. Despite the announcement, the discovery of gas fields in the Rovuma Basin has not led to new training or retraining programmes to integrate locals into exploitation projects. Instead, the oil companies are using skilled workers from abroad to secure their projects or, when advertising for jobs, they are applying criteria to locals that they cannot fulfil, such as fluency in English in a country where Portuguese is the state language, but Swahili is also common in Cabo Delgado. However, the coastal population is becoming increasingly disadvantaged and with the arrival of foreign companies, fishermen have been forced out of the area with disproportionate compensation, further widening the gap between the people of Cabo Delgado and the Mozambican government (Bekoe et al., 2020).

3. The crisis in Cabo Delgado until 2019

As political, ethnic and economic marginalisation gradually increased, dissatisfied radical youth increasingly identified with the messages of the radical doctrines. Rogo Mohammed was a leading figure in radical anti-state rhetoric throughout East Africa, gaining a considerable number of followers. Although he was killed in 2012, his teachings have spread through various platforms and followers to many East African countries, including Mozambique. The exact date is not known, but it is suspected that a radical religious sect was formed in the first half of the 2010s, some of whom had fled from Tanzania, demanding a purgation of Islam, as Sufi practices were seen as a new element that was unacceptable to them. In addition, hostility to the state was running rampant, as the group rejected state institutions such as schools and hospitals, refused to pay taxes, and instructed their followers not to vote in elections or not to send their children to state-run schools. The sect armed its members with firearms and began physically attacking state institutions and harassing local people. The organisation has

several names, including al-Shabaab, meaning the youth, but no relation to its Somali name relative, Ansar al-Sunna and Ahl al-Sunna wa al-Jamaa (Bukarti–Munasinghe, 2020:9). I am going to use the last abbreviation, ASWJ, in the following.

On 5 October 2017, the ASWJ attacked the police station in Mocímboa da Praia, leading to the temporary loss of police control of the city. The raid involved 30 armed rebels who killed 17 people. Among the dead were two police officers and a community leader. During the raid, the ASWJ looted weapons and ammunition and encouraged locals to refuse to pay taxes (Mapfumo, 2020). By 2019, ASWJ operations covered 9 out of 16 districts, i.e. more than half of Cabo Delgado's territory (Bukarti–Munasinghe, 2020). During the rest of 2017, the ASWJ escalated the violence mainly through night operations, with guerrilla attacks targeting small villages and the killing of local Sufi sheikhs. In 2018, it expanded its activities to include daytime attacks on isolated villages. In 2019, the number of violent attacks increased quickly and raids began to be carried out in the more populated coastal areas and on major roads (Hamming, 2021).

The government has described the combatants involved in the conflict as common criminals, saying that it is a domestic issue and that it is up to the local law enforcement forces to handle it. The government deployed first the police and then the particularly poorly trained military to prevent security in conflict zones, with little success (Nhamirre, 2021). As the escalation mounted, the government increasingly adopted a Janus-faced policy. The authorities began to restrict the activities of journalists. Absurdly high accreditation and broadcasting fees were imposed, but journalists reporting on the crisis were also arrested (Bekoe et al., 2020). Meanwhile, the government ordered the closure of three mosques suspected of being radicalisation centres, and by the end of November 2017, security forces had arbitrarily arrested more than 150 suspected extremists, a number that had risen to 300 by 2018 (Matsinhe–Valoi, 2019).

4. Escalation of the Cabo Delgado crisis from 2019

The reasons for the ASWJ's strengthening are the increase in revenues due to its geographical expansion and its affiliation to a larger network of organisations, which is none other than the Islamic State's vilayet system. The ASWJ pledged allegiance to the reigning caliph in 2018, but this was probably only accepted by the Islamic State in 2019, as the organisation officially became an ISIS affiliate in August this year (U. S. Department of State, 2021). Since 2019, ASWJ attacks have become increasingly advanced. This was due to an improvement in the quality of their weapons, as they were much better armed, as they also had machine guns, heavy machine guns, mortars, most of which were looted from government troops. They became increasingly brutal in their targeting of civilians who were part of the government's administrative system, often executing them by beheading. By 2020, the organisation had grown so strong that it was capable of simultaneous attacks, and was able to attack and, for a time, even invade major cities in the region (Lister, 2020).

The government was reluctant to call in intervention forces, so it turned to private military companies (PMCs) to mitigate the chaos in Cabo Delgado. The Wagner

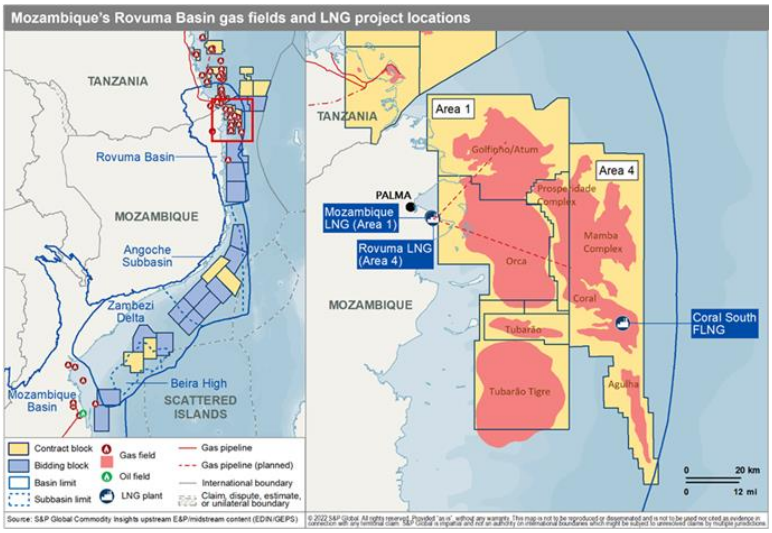
Group first appeared in September 2019, with around 200 armed men, but their losses in combat led them to withdraw from the region at the end of the year, without achieving any significant results (Sukhankin, 2020). In April 2020, the Dyck Advisory Group (DAG) soldiers landed for a year with some helicopters, helping the Mozambican army with air support. In February 2021, the Mozambican government hired a third company to supply military equipment, training and advice. This time, a consortium of South Africa-based Paramount Group and Dubai-based Burnham Global was selected (Nhamirre, 2021).

PMCs have not lived up to expectations, as evidenced by the fact that the peak of escalation was 2021. The ASWJ attacked and occupied the cities of Mocímboa da Praia and Palma, forcing sub-Saharan East African states to act. The attack on the latter was the most significant action, as the city is considered the gateway to the natural gas fields. The attack in March 2021 gave the ASWJ a huge popularity boost, but this move forced the Mozambican government to accept foreign military reinforcements. In the summer of 2021, a 1,000-strong Rwandan force arrived in Cabo Delgado, followed by the Southern African Development Community (SADC), as a SAMIM mission of around 2,000 troops from eight member states arrived in the region. These units are still located there, in larger numbers. They have forced the ASWJ to retreat and the scale and intensity of attacks has been reduced. But this does not mean the group has ended, they have restructured themselves. They broke up into smaller units and the new focus of their attacks became the western and southern parts of Cabo Delgado, and their influence spread to the neighbouring provinces of Niassa and Nampula (Columbo, 2023).

5. The natural gas project in Mozambique

Since the discovery of natural gas fields in 2010, Mozambique has been on the global map of the natural gas industry. Although there is currently regular natural gas production in the south, it is on a smaller volume and the final destination is South Africa, but the South African company Sasol is working on further developments that could make the Inhambane province in southern Mozambique even more important (International Trade Administration, 2022). In the north, the Rovuma Basin, part of Cabo Delgado, is currently undergoing huge investments. It is reported that the development of the liquefied natural gas (LNG) project will produce 30 million tonnes of natural gas per year. The LNG project, worth around $55 billion, is reportedly the largest investment of its kind in Africa, worth four times Mozambique's GDP (Flanders Investment & Trade, 2021).

Figure 2. The map of the natural gas fields in the Rovuma Basin: the Area 1 and the Area 4



Source: Piccoli et al. (2022)

The map in Figure 2 shows the division of the region into two areas. The main partner in Mozambique's Rovuma Offshore Area 1 is the French company Total Energies, which holds a 26.5% stake. Previously, Anadarko Petroleum (now Occidental Petroleum) was the concess operator. Total bought Anadarko's 26.5% operating stake in the Rovuma LNG project for $3.9 billion in September 2019, but there are also a number of Mozambican and foreign investors in the area. The gas fields in this area are located at a depth of 1,600 metres, about 40 kilometres off the coast of Cabo Delgado. The gas reserves in Area 1 are estimated at 2.1 trillion cubic metres (tcm). An LNG processing plant is being built on the coast, where the gas will be piped in, liquefied by the plant and contained in LNG storage tanks. Other supporting facilities for the LNG plant will include a material offloading facility and a marine terminal to receive large LNG carriers, which will be shared with the Area 4 LNG projects (NS Energy, 2019). The Cabo Delgado LNG development plan includes two 180,000 cubic metre LNG storage terminals, a condensate storage facility, a multi-port offshore terminal and associated utilities and infrastructure, bringing the two sites together. The onshore hub is located in Afungi Park, where all supporting infrastructure is located, including accommodation, port and airport infrastructure (International Trade Administration, 2022). However, the implementation of the project was affected by the ASWJ attacks. The 2021 attack on Palma was only a few kilometres from Total's planned facilities. As a result, the French company evacuated its workers reflected on vis maior situation and the project has been suspended since then. Total has conditioned its return on the restoration of peace and security and an improvement in the humanitarian situation. At the time of writing, Total had requested Jean-Christophe Rufin and his committee to assess the current circumstances in Cabo Delgado, which would make it possible to continue the project while respecting human rights. At the moment there is no result of the study, but if it is positive, Total

will return as soon as possible, but there is still no realistic chance of full LNG production coming on stream before 2028, even though the $20 billion project was originally due to be completed by 2024 (Exarheas, 2023).

The other zone is Area 4, where the main investors are Eni and ExxonMobil, with Eni leading all upstream activities and ExxonMobil building and operating the onshore LNG facilities at the Afungi LNG Park (International Trade Administration, 2022). The Coral South Floating LNG project should be highlighted here. Eni discovered an estimated recoverable gas reserve of 0.3-0.4 tcm in the Coral field in 2012. With a water depth of 2,000 metres, the Coral South project is the first FLNG facility to be deployed in deepwater offshore Africa and is the deepest FLNG production facility in deep water worldwide. FLNG technology offers Mozambique a short-term solution for the monetization of gas against a background of security challenges, but it is still a relatively new technology with uncertainties regarding project utilization rates, maintenance and operating costs in the changing ultra-deepwater and weather conditions. However, it is currently the most stable, as the project can progress and develop unaffected by the blocking effects of the security crisis on the coast (Piccoli et al., 2022). The FLNG project has been accelerated by the arrival of a floating plant for liquefying natural gas built by Samsung Heavy Industries in Area 4 in January 2022. This plant will be capable of liquefying nearly 3.4 million tonnes of natural gas per year when fully operational (Kedem, 2022). The stability of the FLNG project is demonstrated by the fact that the first shipment arrived in Croatia on the British Mentor on 23 January 2023 and left the Krk LNG terminal two days later. This was the biggest achievement of the Coral Sul floating LNG facility so far (Natural Gas World, 2023).

Table 1. List of the prominent companies in the LNG project in Cabo Delgado

List of the prominent companies in the LNG project in Cabo Delgado			
Area 1		Area 4	
Name	Origin	Name	Origin
Total Energies	France	Eni	Italy
Saipem	Italy	British Petroleum	UK
Mitsui	Japan	GALP	Portugal
ONGC Videsh Rovuma Limited	India	ExxonMobil	USA
BPRL Ventures	Mozambique	China National Petroleum Corporation	China
Beas Rovuma Energy Mozambique	Mozambique	Kogas / Samsung Heavy Industries	South-Korea
PTTEP – PTT Exploration & Production	Thalián	Empressa National de Hidrocarbonetos	Mozambique

Source: Exarheas (2023), Flanders Investment & Trade (2021) and Piccoli et al. (2022)

The question arises: how much gas is this and what does it mean internationally? It is safe to say that Mozambique has the majority of East Africa's reserves, with 2.8 tcm, which is third in Africa after Nigeria (5.4 tcm) and Algeria (4.3

tcm), and ahead of Egypt (2.4 tcm). This number is in line with other major gas producers such as Azerbaijan (2.8 tcm) and Kazakhstan (2.7 tcm). Mozambique has larger reserves than LNG exporters such as Norway (1.5 tcm), Australia (2.4 tcm) and Malaysia (0.9 tcm) (Nakhle, 2022). A másik összehasonlítási alap pedig az, hogy 2020-ban az uniós országok 155 milliárd köbméter orosz földgázt fogyasztottak, ami a teljes gázfogyasztásuk több mint egyharmadát tette ki. Another basis for comparison is that in 2020, EU countries consumed 155 billion cubic metres of Russian gas, more than a third of their total gas consumption. Mozambique accounts for 18 times the previous annual Russian consumption (Zhou et al., 2023).

6. Conclusion

The question asked in the introduction was: can Mozambique, and in particular Cabo Delgado, one of the most underdeveloped provinces, be a winner in the Russian-Ukrainian war? Or can the political leadership in Mozambique be able to take advantage of the huge amount of natural gas revenues available and strengthen the country? The answer is definitely yes, but the question is whether the Mozambican leadership can exploit this opportunity. It is clear that the Mozambican government could benefit from huge revenues in the future as the gas project gets under way.

The problem is the state redistribution system, because the country is full of contradictions. Firstly, the capital Maputo is located in the southern third of the country, so it is difficult for the government to reach the northern areas. Secondly, the FRELIMO party has deliberately tried to reduce the importance of Cabo Delgado because of its rivalry with RENAMO, which has led to a civil war and this kind of political conflict still affects the underdevelopment of the northern half of the country. Secondly, the escalating ethnic conflict in Cabo Delgado limits the full exploitation of the potential of natural gas. In my opinion, the ASWJ would remain an Islamist sect if it lacked such ethnic and, to a small extent, religious divisions. The discovery of natural resources has radicalised the masses of people by making it impossible for locals or the craftsman miners in the interior to live there or by resettling them, and the ASWJ has taken advantage of this to gain a strong local base.

The problem is worsened by the drastic decline in trust in the state in the northern regions. This is mainly due to the high level of corruption, being the 36th most corrupt country in the world (Transparency International, 2023), and the resulting ethnic marginalisation that we see in the case of the Mwani, or the opposite, ethnic favouritism that I have outlined in the case of the Makonde group. The other obvious problem is the underdeveloped condition of the army, as without the intervention force Mozambique would have been unable to de-escalate the conflict. Thus, a serious reform of the army would be necessary, which is a long-term process, while foreign forces can only provide superficial stability, which is just enough to implement the LNG project. In addition, fundamental social structural reforms are necessary, for which the first steps have been taken. The government has created the Integrated Development Agency of the North (ADIN), which provides socio-economic support to the northern provinces, including Cabo Delgado. Mozambique has also received financial support from USAID, the EU, the African Development Bank and the World Bank (Sany, 2021). But this will also be a long-term process.

Finally, the question is: how much does LNG investment reinforce the neocolonisation of Mozambique? It is difficult to give a clear answer, as this is the beginning of a long process, but there is evidence to suggest that the country could further increase its dependence. On the political side, its weak military forces mean that it relies on soldiers and trainers from neighbouring and developed countries. It is clear that Filipe Nyusi cannot fully implement his political will even within his country. Economically, there are two signs of this process. The most obvious is the emergence of multinational companies with multi-billion dollar LNG projects and cutting-edge extraction technologies, which Mozambique alone would be incapable of. On the other hand, the population does not directly benefit from the LNG project, with the result that the local political and economic elite gain the most, widening the social divide in economic and therefore political terms. Although the Russia-Ukraine war makes Mozambique an attractive partner with the world's growing hunger for natural gas, it also increases the dependency and neo-colonialist tendencies in the region as a side effect of globalisation and capitalism, based on current trends.

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Chapter II
Economic and Financial Dimensions of Green and Digital Transitions

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Analyses of the European Union and its member states' proposals on reforming the ISDS system under the UNCITRAL working group III

Muhammad Abdul Khalique

The European Union and its member states back the formation of a permanent investment tribunal and a Committee of the Parties that would handle different tasks, including the selection of adjudicators. According to the European Union and its member states, the members of the investment tribunal should work on a full-time basis, and the selection criteria should prioritize the most qualified and unbiased individuals, regardless of their nationality. To expand the pool of potential adjudicators and promote diversity, they suggest adopting the entire language of Article 2 of the ICJ Statute for the qualifications requirements. The European Union and its member states do not support the idea of tribunal members being appointed by States that do not recognize the tribunal's authority.
This paper delves into the European Union and its member States' positions on certain fundamental issues related to ISDS reform, along with a comprehensive analysis of varying positions held by other stakeholders, including some members of UNCITRAL working group III who share similar viewpoints with the European Union and its member states on some matters and have differing opinions on others.

Keywords: ISDS, Reform, the European Union, UNCITRAL working group III

1. Introduction

The United Nations Commission on International Trade Law (UNCITRAL) Working Group III (hereinafter the WGIII) was given a broad authority to work on the possible reform of investor-state dispute settlement (hereinafter ISDS) in 2017. The WGIII identified concerns regarding ISDS and found reform desirable. From its thirty-eighth to forty-third session, the WGIII discussed potential solutions for ISDS reform. The European Union and its member States were among the participants in these discussions (UNCITRAL, 2023).

The WGIII has been considering the selection and appointment of tribunal members for a standing multilateral mechanism. At its fortieth session, the WGIII requested the Secretariat to develop draft provisions on this matter, as well as on the establishment and functioning of the mechanism (UNCITRAL, 2023). At its fifty-fifth session in 2022, expressing satisfaction with the progress made by the WGIII, the Commission encouraged the WGIII to submit a code of conduct with commentary and texts on alternative dispute resolution mechanisms for consideration (UNCITRAL, 2023). Moreover, in different sessions, the WGIII discussed the possibility of establishing an appellate mechanism for investor-state dispute settlement (ISDS) based on various documents, including A/CN.9/WG.III/WP.185, A/CN.9/WG.III/WP.202, and A/CN.9/WG.III/WP.224. The Working Group recognized that there was a general interest in having an appeal mechanism, as it could

improve the coherence, consistency, and predictability of decisions made in ISDS proceedings. However, concerns were also raised about the additional costs and time that an appellate mechanism could entail for disputing parties (Waihenya, 2021). The Working Group also examined the experience of the WTO Appellate Body and raised questions about the financing of an appellate mechanism and the risk of further fragmentation (Muigua, 2021). The European Union and its member States participated in the discussions and expressed their positions (UNCITRAL, 2022a).

The establishment of a standing multilateral mechanism would require the preparation of a statute and rules or regulations, and various models could be considered for preparing the latter (Ngotho, 2021). The draft provisions related to "standing multilateral mechanism: selection and appointment of ISDS tribunal members and related matters" (UNCITRAL, 2021b) would need to be adjusted and completed to form part of such framework. Moreover, there are differences related to some of the key issues that are under consideration. Despite these differences, UNCITRAL Working Group III has made progress on developing a multilateral reform of ISDS, including the establishment of a code of conduct for arbitrators and the development of a framework for the selection of arbitrators. The Working Group is expected to continue its work in the coming years.

The European Union and its member states have been playing an active role in the WGIII discussions on ISDS reform, pushing for measures to enhance the accountability, transparency, and predictability of the ISDS system (Víg–Hajdu, 2020). The main position they have taken is that full-time, qualified, and independent individuals should make up the tribunal, regardless of their nationality, as opposed to the practice of some countries of nominating party-appointed arbitrators, which raises questions about impartiality and independence (European Commission, 2019). They have embraced this position due to several underlying factors. Among these, the presence of tensions arising from an uncoordinated investment policy between the EU's internal and external actions, coupled with the reluctance of EU Member States to release their investment agreements, has played a pivotal role in shaping this development. Above all, the paramount concern is to uphold the "autonomy of the EU legal framework," the ability to regulate public policy objectives, and the avoidance of jurisdictional conflicts (Finckenberg-Broman, 2022).

Although the European Union and its member states are actively involved in the WGIII and support ISDS reform, they have different positions than other stakeholders on some issues (Guillaume, 2023). Specifically, during discussions on the establishment of an appellate mechanism, the European Union and its member states expressed general interest in the idea but raised concerns about the additional costs and time that disputing parties would incur. They also highlighted the potential precedential effect of appellate decisions, which could impact similar provisions in other treaties and affect the control of states over the interpretation of investment treaties, particularly for those that did not participate in the appellate mechanism. Overall, the European Union and its member states have played an active role in the discussions of the WGIII, where they have been advocating for ISDS reforms aimed at enhancing transparency, accountability, and predictability (European Parliament, 2020).

In this paper, the author analyzes the works of the WGIII on standing multilateral mechanism and evaluate the positions of different stakeholders including the European Union and its member States. The author intends to employ the legal analysis methodology to examine the issues at hand.

2. The establishment of an investment tribunal and committee of the parties

The WGIII must take into account fundamental issues regarding the creation of a multilateral investment tribunal and its governing system. The draft provisions 1 to 3 related to "standing multilateral mechanism: selection and appointment of ISDS tribunal members and related matters" provide a basic structure for establishing the tribunal and governance, there are other matters that the WGIII must address in the future (UNCITRAL, 2021b). The draft provisions 1 to 3 read as follows:

> "Draft provision 1 – Establishment of the Tribunal
> A Multilateral Investment Tribunal is hereby established […] It shall function on a permanent basis.
> Draft provision 2 – Jurisdiction
> The Tribunal shall exercise jurisdiction over any dispute arising out of an investment […], which the parties consent to submit to the Tribunal.
> Draft provision 3 – Governance structure
> 1. There shall be a committee of the Parties composed of representatives of all the Parties to this Agreement establishing the Tribunal...
> 2. The Committee of the Parties […] establish its own rules of procedure and adopt or modify the rules of procedure for the first instance and the appellate level, [the Advisory Centre], and the Secretariat.
> 3. The Tribunal shall determine the relevant rules for carrying out its functions. In particular it shall lay down regulations necessary for its routine functioning." (UNCITRAL, 2021b; 3)."

Draft provision 1 establishes the tribunal as a permanent institution, while draft provision 2 specifies that it will exercise jurisdiction over any investment dispute between contracting states and nationals of other contracting states, subject to consent. Future investment treaties could contain provisions related to consenting to the jurisdiction of the multilateral investment tribunal. The WGIII could also explore incorporating a mechanism in the multilateral instrument on ISDS reform that would facilitate the inclusion of consent-related provisions related to the tribunal in current investment treaties. The Committee of the Parties, composed of representatives of all parties to the agreement, is introduced in draft provision 3 as the governing body responsible for carrying out various functions, including establishing rules of procedure for the tribunal. The tribunal itself will develop rules for its routine functioning. The provisions may be further clarified in future investment treaties, and

the term "parties" may refer to either states or disputing parties depending on the situation (UNCITRAL, 2021b).

The WGIII needs to work on the matters associated with the procedural framework of a permanent multilateral body. Although the agreement creating the tribunal could set out general procedural rules, the group should also consider whether detailed procedures should be defined in secondary legislation. This secondary legislation could be developed and amended by the Committee of the Parties and, when necessary, the tribunal itself. By defining procedures in secondary legislation, it will allow for future modifications and updates to the procedural rules. This method would be similar to other international organizations such as the ICJ, ITLOS, and ECHR (UNCITRAL, 2021b).

The European Union (EU) and its member states as active participants in UNCITRAL Working Group III on Investor-State Dispute Settlement (ISDS) Reform, have been working on developing a multilateral reform of ISDS. The EU has been advocating for the establishment of a multilateral investment court, which would replace the existing ISDS system with a permanent court to resolve investment disputes (European Commission, 2019). In March 2020, the EU and its member states submitted a joint paper to UNCITRAL Working Group III outlining their proposal for a multilateral investment court. The paper emphasized the need for a court system that is independent, impartial, and of high quality, and suggested several mechanisms to enhance the accountability and transparency of the court. The EU and its member states have argued that a multilateral investment court would provide greater transparency, accountability, and consistency in resolving investment disputes, and would also address some of the concerns raised by civil society groups and trade unions regarding the potential for ISDS to undermine the ability of governments to regulate in the public interest (European Parliament, 2020).

The European Union and its Member States have expressed their preference for a modified version of provision 2. They prefer covering state-state disputes (UNCITRAL, 2021c). This might be a unique and useful innovation to the investment-related arbitration. Several countries are not interested in an investor-state dispute settlement system. This might create an acceptable option for them to mitigate their dispute through state-state dispute settlement system.

Moreover, the EU suggested avoiding the term "investment" to prevent probable double "investment test" under the relevant agreements. They maintain that the focus should be on the element of consent to jurisdiction, regardless of the type of consent instrument used (UNCITRAL, 2021c). They propose the following text for provision 2:

> "The Tribunal shall exercise jurisdiction over any dispute which the parties have consented to submit to the Tribunal." (UNCITRAL 2021c:4)."

Regarding draft provision 3, The EU and its member states support the creation of a Committee of the Parties and suggest that decisions should be made by qualified majority, e.g. the specific nature of a decision may determine the required majority, which could be a 3/4 majority or distinct majority (UNCITRAL, 2021c).

Canada also supported the proposal for a governance structure composed of a Committee of the Contracting Parties but suggested further guidance on its role and relationship with the Tribunal (UNCITRAL, 2021d). Colombia thinks that the decision-making process should strike a balance between requiring consensus for critical matters and allowing for decisions to be made by a simple majority vote for less significant issues (UNCITRAL, 2021e). The author is of the view that requiring consensus should be avoided as it created difficulties in the WTO system, rather two-third majority should be required for critical matters and simple majority on others. Moreover, regarding the selection of arbitrators, simple majority should be the decider to fasten the process.

3. The selection and appointment of members of the tribunal

3.1. Selective representation and number of tribunal members

3.1.1. Number *of tribunal members and adjustments*

The WGIII has expressed a preference for selective representation on the international investment tribunal, instead of having a full representation. This is because a high number of members could be expensive and complex to manage. The approach they suggest is to have a broad geographical representation and a balance of genders, levels of development, and legal systems. The agreement establishing the tribunal should be flexible enough to adjust the number of tribunal members as the number of participating states and caseload changes over time. To ensure balanced representation over time, draft provision 8 will address the necessary considerations. Draft provision 4 reads as follows:

> "1. The Tribunal shall be composed of a body of [--] independent members in [full][part] time office, [elected regardless of their nationality][nationals of Parties to this Agreement, elected] [...]
> 2. Option 1: The number of members of the Tribunal may be amended by a [two-thirds] majority of the representatives in the Committee of the Parties[.]
> Variant 1:[, based on the case load of the Tribunal as follows: (to be completed)]
> Variant 2: [, based on the increase or decrease of the Parties to this Agreement, as follows: (to be completed)]
> Variant 3: [, based on the evolution of case load and of the Parties to this Agreement, as follows: (to be completed)
> Option 2: The Presidency of the Committee of the Parties, […] may propose an increase in the number of members of the Tribunal indicated in paragraph 1, [...] The number of members of the Tribunal may then be amended by a [two-thirds] majority of the representatives in the Committee of the Parties.
> 3. No two members of the Tribunal shall be nationals of the same State [...]" (UNCITRAL, 2021b: 5)"

The question of whether tribunal members should work full-time or part-time depends on the number of members and the tribunal's workload. If there are many members to increase diversity, part-time employment may be considered, which could require rules prohibiting parallel activities.

Paragraph 2 addresses the matter of adjusting the number of tribunal members over time. The Working Group recommends determining the number of members based on a projected caseload, and then making changes as the number of States parties changes. If there is a two-tier mechanism, it is anticipated that fewer cases will be heard in the second tier, and thus fewer tribunal members may be required there than in the first tier. Paragraph 2 presents two alternatives for modifying the number of tribunal members. The first option entails having fewer members that correspond to the projected caseload, with the possibility of adjusting the number as needed. The second option involves having a greater number of members, including some who may work part-time, in order to promote greater diversity (UNCITRAL, 2021b).

In paragraph 3, it is suggested that the Working Group should deliberate on whether nationality should be a factor in determining the makeup of the tribunal. Additionally, the possibility of implementing a provision that would prohibit two tribunal members from sharing the same nationality is suggested. This provision is reminiscent of some court statutes that permit the selection of judges without regard to nationality but prohibit two judges from the same state from serving simultaneously. If the composition of the tribunal were to be influenced by nationality, it could be guaranteed that each member State has the chance to have one of its own nationals appointed to the tribunal by instituting a system of rotation among the member States (UNCITRAL, 2021b).

According to the European Union and its Member States, the impartiality and independence of tribunal members can only be ensured through full-time employment (UNCITRAL, 2021c). Canada also supports appointment on a full-time basis (UNCITRAL, 2021d). However, according to the EU, they may allow part-time employment as a transitional measure initially. The adjudicators' nationality is not a determining factor; instead, their competence and independence should be the primary consideration, following the ICJ Statute's Article 2. The qualifications required for the highest judicial positions in their respective countries and expertise in international law should both be considered when selecting potential adjudicators, expanding the pool and enhancing diversity (UNCITRAL, 2021c). On the other hand, Colombia suggested that the parties without a representative judge in the Tribunal may be able to appoint an ad hoc judge in cases where they are involved in order to ensure that all parties' legal systems are comprehended. However, the EU do not support appointing ad hoc judges (UNCITRAL, 2021e). The author is of the view that tribunal members should be primarily full-time employed based on geographical diversity.

The European Union and its Member States recommend selecting option 2 due to its clear procedural framework, and variant 3 of option 1 regarding its substance. As a result, they propose the following provision:

> "2. The Presidency of the Committee of the Parties, acting on behalf of the Tribunal, may propose an amendment in the number of

> members of the Tribunal indicated in paragraph 1 based on the evolution of case load and of the Parties to this Agreement, giving the reasons why this is considered necessary and appropriate. The Secretariat shall promptly circulate any such proposal to all Parties. The number of members of the Tribunal may then be amended by a [two-thirds] majority of the representatives in the Committee of the Parties" (UNCITRAL 2021c:8)."

The European Union and its Member States have concerns that the provision outlined in paragraph 3 of the draft provision may be inflexible if there is a need to adjust the number of adjudicators, such as due to an increase in caseload or the need for additional adjudicators (UNCITRAL, 2021c).

3.1.2. Ad hoc tribunal members

Draft provision 5 addresses the need to propose options for the participation of ad hoc tribunal members with some flexibility in forming chambers for specific cases with parties' consent. This flexibility is present in the statutes of international courts, for instance, the International Court of Justice. Different methods for appointing ad hoc tribunal members are also suggested, including direct appointment by parties or selection from a defined roster (UNCITRAL, 2021b). The draft provision 5 reads as follows:

> "1. The parties to a dispute may choose a person to sit as Tribunal member, […] composed of three or more members as the Tribunal may determine, for dealing with particular categories of cases in accordance with article (--); for example, (to be completed).
> 2. Such person shall be chosen preferably from among those persons who have been nominated as candidates as provided in article 6." (UNCITRAL 2021b:5).

It is important to note that the WGIII needs to consider whether to retain paragraph 2 and should note that the ad hoc judge system may have disadvantages in the inter-State context, and it may not be suitable for the investor-State context. Draft provision 5 brings up the matter of nationality, and it is important to note that in some court statutes, a State involved in a case can appoint an ad hoc judge, even if they do not have a judge of their own nationality on the tribunal. An ad hoc judge can be chosen from any country, and they are usually not a national of the State that appoints them (UNCITRAL, 2021b).

The Working Group could explore the possibility of involving a less senior person in the ISDS tribunal or as an observer to promote competence and inclusivity over time. However, as this role is not currently provided for in existing mechanisms, it would need to be created specifically for this purpose.

The European Union and its Member States hold reservations about the appointment of ad hoc judges and are considering alternative options to ensure that adjudicators have a comprehensive understanding of respondents' legal systems.

These alternatives include appointing experts and translators, as well as gathering evidence on domestic law's interpretation. In addition, legal counsel representing the case could provide further assurance in this regard. The appointment of ad hoc judges raises several concerns as research indicates that such judges, like those in the ICJ and IACtHR, often favor the state that appointed them. This similarity to party-appointed arbitrators in ISDS has been noted in Larsson et al. (2022:8-9). Moreover, enabling only the host state to appoint an ad hoc adjudicator may raise concerns about due process. This may prompt the investor to also request the appointment of an ad hoc adjudicator, resulting in the presence of two ad hoc adjudicators alongside the permanent body. This would be counterproductive and could compromise the permanent body's efforts to establish consistency, predictability, and legitimacy. Ad hoc adjudicators are more prone to ethical issues than permanently appointed adjudicators (UNCITRAL, 2021c). However, Colombia suggested appointment of ad hoc judges to ensure that the laws and legal system are understood (UNCITRAL, 2021e).

3.2. Nomination, selection and appointment of candidates

3.2.1. Nomination of candidates

The Working Group has emphasized that the appointment methods of tribunal members in ISDS should prioritize fairness, quality, transparency, neutrality, accountability, and high ethical standards. The diversity in gender, geographic, linguistic, and legal systems is essential in the ISDS system, as it can ensure a more balanced decision-making process and enhance the quality of justice. The Working Group has highlighted that lack of diversity can threaten the legitimacy of the ISDS regime.

To prioritize expertise and integrity over political considerations in ISDS tribunal member appointments, the Working Group recommended a multi-layered, transparent, and stakeholder-inclusive selection process. They suggested that selection panels and consultative committees should conduct candidate screenings before the appointment is made by the States Parties to the agreement establishing the tribunal.

The Working Group should take note that draft provisions 6 to 8 propose the common method of selecting tribunal members by an intergovernmental body from a list of nominated candidates. The group should explore if draft provision 8, which proposes seat allocation to geographically defined groups of States, can create a selective representation tribunal that ensures fair regional and legal system representation. This approach may be an effective means of achieving representation in the tribunal.

To avoid the selection process from becoming blocked, it is preferred to conduct elections through voting rather than consensus. States can cast their vote for multiple candidates to ensure diversity and balance. Generally, a qualified majority rule is applied to ensure that the appointed tribunal members are acceptable to most States. If no qualified majority is reached, less demanding majorities are often provided to avoid a deadlock in the election. Some courts use a system where tribunal members are chosen by treaty parties or a collective body of States, even if the

membership is greater than the group of States that accept the court's jurisdiction (UNCITRAL, 2021b). The draft provision 6 reads as follows:

> "Option 1:
> 1. Nomination of candidates for election to the Tribunal may be made by any Party to the Agreement establishing the Tribunal. […] The Tribunal members shall be elected from the list of persons thus nominated.
> 2. Before making these nominations, each Party shall encourage the participation of, and is recommended to consult […] in the process of selection of nominees.
> Option 2:
> Any person who possesses the qualifications required under article 4, paragraph 1 may apply to the selection process following an open call for candidacies to be issued in accordance with a decision of the Committee of the Parties." (UNCITRAL, 2021b:9)"

Option 1 for choosing tribunal members involves the Parties nominating individuals, like in some courts. However, this approach has been criticized for its uneven national processes, lack of transparency in selecting candidates, and political influence in nominations. The WGIII thinks that this option might ensure gender balance in the makeup of the tribunal. Under this option each party would be asked to propose submit two nominations. Option 2 proposes to remove the nomination process from the parties. Instead, it suggests self-nomination by any eligible individual after an open call. However, it is necessary to have a separate body for screening and filtering candidates to ensure fairness of the selection process (UNCITRAL, 2021b).

The European Union and its Member States oppose the selection of tribunal members by states that do not accept the tribunal's jurisdiction. Such a scenario could cause issues if those states were allowed to influence the tribunal's operations (UNCITRAL, 2021c). Canada is also has similar views (UNCITRAL, 2021d). The author is of the view that all states should be given power to participate in all of the matters as the system will likely influence all and the stakeholders will ensure that their positions are counted through the process.

The European Union and its Member States advocate for a robust nomination and appointment system that prioritizes qualified and independent candidates and ensures diversity in geography and gender. Their proposal involves a combination of open calls for direct applications and a transparent nomination process that involves stakeholders. This approach combines the first two options of draft provision 6. Direct application appointments would prevent political nominations. To ensure gender balance in the tribunal's composition, the EU suggests each party should nominate more than just one or two candidates (UNCITRAL, 2021c).

3.2.2. Selection process

The guidelines for the use of selection panels or committees in the appointment process is provided in the draft provision 7. The provision outlines the establishment and function of a selection panel based on a submission received (A/CN.9/1050, para. 33). It is noteworthy that some international courts have utilized screening committees, consultative appointment committees, and appointment committees (A/CN.9/1004/Add.1, para. 118) (UNCITRAL, 2021b). The draft provision 7 reads as follows:

> "Draft provision 7 - Selection Panel
> a. Mandate
> A selection panel (hereinafter referred to as "Panel") is hereby established. Its function is to give an opinion on whether the candidates meet the eligibility criteria stipulated in this Agreement…
> b. Composition
> 1. The Panel shall comprise [five] persons chosen from among former members of the Tribunal, current or former members of international or national supreme courts and lawyers or academics of high standing and recognised competence. […] The composition of the Panel shall reflect in a balanced manner the geographical diversity, gender and [the different legal systems of the Parties] [the regional groups referred to in article 8].
> 2. The members of the Panel shall be appointed by the Committee of the Parties by [qualified][simple] majority from applications [submitted by a Party][received through the open call referred to in paragraph 3].
> 3. Vacancies for members of the Panel shall be advertised through an open call for applications published by the Tribunal.
> 4. Applicants shall disclose any circumstances that could give rise to a conflict of interest...
> 5. Members of the Panel shall not participate as candidates in any selection procedure to become members of the Tribunal during their membership of the panel and for a period of three years thereafter.
> 6. The composition of the Panel shall be made public by the Tribunal.
> […]
> f. Tasks
> 1. The Panel shall act at the request of the secretariat, once candidates have been nominated by the Parties pursuant to article 6, paragraph 1 or have applied pursuant to article 6, paragraph 2.
> 2. The Panel shall: (i) review the nominations or applications received […] (ii) verify that the candidates meet the requirements for appointment as members of the Tribunal; […] and, on that basis, establish a list of candidates meeting the requirements.
> 3. The Panel shall complete its work in a timely fashion.

> 4. The chair of the Panel may present the opinion of the Panel to the Committee of the Parties.
> 5. The list of candidates meeting the requirements shall be made public.
> 6. The Panel shall publish regular reports of its activities." (UNCITRAL, 2021b:10).

Screening committees evaluate potential tribunal members before their selection to confirm their qualifications, expertise, and eligibility. They are responsible for eliminating candidates who do not meet the requirements, resulting in the appointment of more qualified and independent tribunal members, even if the States are responsible for appointing them. Generally, screening committees do not consult with non-state entities (UNCITRAL, 2021b).

The European Union and its member states strongly advocate for a screening process to select qualified and independent adjudicators to prevent the politicization of state nominations. The selection panel should consist of independent individuals, including former tribunal judges, current or former members of supreme courts, and highly competent lawyers or academics who can apply directly through an open call. The panel's independence should be ensured by an external entity, like the President of the International Court of Justice, who confirms that the members meet necessary requirements. The committee of the parties must guarantee geographical diversity, gender balance, and different legal systems when appointing members to the selection panel. The panel's appointment should be by a qualified majority to prevent politicization but should remain independent from the committee. The panel must screen all candidacies to ensure only vetted and approved adjudicators are appointed. The author is of the view that chairman of the committee of parties should oversee the activities of the panel and handing responsibility to other international body will complicate the matter (UNCITRAL, 2021c).

3.2.3. Appointment process

The appointment process is provided in the draft provision 8, which reads as follows:

> "Draft provision 8 - Appointment (election)
> 1. The Panel shall publish the names of the candidates who are eligible for election […] based on the nationality of the country which nominated them for the election: Asia, Africa, Latin America and the Caribbean, Western Europe and others, and Eastern Europe.
> 2. The Panel shall recommend [--]members to serve on the appellate level of the Tribunal based on the extensive adjudicatory experience of such candidates.
> 3. The Members of a particular regional group in the Committee of the Parties will vote on the candidates eligible for election from their regional […]

> 4. The Committee of the Parties shall only appoint members of the first instance and appellate level Tribunal […]
> 5. At every election, the Committee of the Parties shall ensure the representation of the principal legal systems of the world, and equitable geographical distribution as well as equal gender representation in the Tribunal as a whole.
> 6. The members shall elect a President of the Tribunal by a confidential internal voting procedure with each member having one vote. The President shall be elected for a term of three years with the possibility of one re-election." (UNCITRAL, 2021b:12)"

Paragraph 1 outlines a strategy for promoting diversity in the selection of tribunal. The proposition is that each regional group would exclusively vote for their regional candidates to appointment the candidates against their regional quota but not for the candidates from other regions (UNCITRAL, 2021b).

The WGIII should clarify the election or allocation of tribunal members to the first-instance and appellate level. If necessary, the WGIII can choose from three options: (i) establish a common pool of nominees who are qualified for both levels and hold a single election, (ii) conduct a separate election for the first-instance and appellate members, or (iii) have the Committee of the Parties elect all judges without distinction, and then let the tribunal organize itself based on the recommendation of the selection panel into first-tier and appellate levels.

The European Union and its Member States support the goal of achieving equitable geographical and gender representation in the tribunal. However, they suggest that the specific details regarding this matter, such as formulas, should be determined by the Committee of the Parties rather than included in the statute, allowing for more flexibility. They also propose separate tracks for nomination, selection, and appointment of members for the first instance and appellate level, with the committee deciding on appointments for each level through separate elections. In addition, they suggest that the qualification criteria for appellate-level adjudicators should be expanded beyond adjudicatory experience to include seniority in other relevant areas (UNCITRAL, 2021c). Finally, they recommend some clarifications to the draft text:

> "The Panel shall publish the list of candidates established pursuant to [Article 7(f)(2)(iii)] who are eligible for election as members of the Tribunal by classifying them in one of the following regional groups based on the nationality of the country which nominated them for the election or, in case of direct applications, based on the nationality of the candidates: Asia, Africa, Latin America and the Caribbean, Western Europe and others, and Eastern Europe" (UNCITRAL, 2021c:17).

The author is of the view that primary and only concern of the tribunal should be to ensure geographical diversity, other type of representation should be left to the

stakeholders to keep in mind. Because, not every stakeholder is in the same developmental stage to nominate as such.

4. Terms of office, renewal and removal

4.1. Terms of office and renewal

The Working Group should take into account that longer terms for tribunal members that are non-renewable may prevent them from being influenced unduly. However, not having reappointment opportunity, may result in a loss of valuable experience. This might be mitigated by appointing for longer and staggered judicial terms. The draft provision 9(a) discusses about terms of office and renewal. It reads as follows:

> "a. Terms of office and renewal
> 1. The Tribunal members shall be elected for a period of [nine years] [without the possibility of re-election][and may be re-elected to serve a maximum of one additional term].
> 2. Of the members elected at the first election, the terms of [--] members shall expire at the end of [three] years and the terms of [--] more members shall expire at the end of [six] years…
> They will, however, continue in office to complete any disputes that were under their consideration prior to their replacement unless they have been removed in accordance with section (b) below" (UNCITRAL, 2021b:14).

The WGIII was advised to consider the duration of resolving ISDS cases and balancing the workload among tribunal members when deciding on appropriate term lengths. Some proposed a term of 6 to 9 years with staggered replacements to ensure stability and jurisprudential continuity. Other international courts have set terms from 4 to 9 years, with one court having no term limit. A gradual turnover of new members could be achieved by staggering appointments at three-year intervals (UNCITRAL, 2021b).

The European Union and its Member States support the idea of appointing adjudicators for long, non-renewable, and staggered terms of office. They favor the option of "without the possibility of re-election" and support the current drafting of paragraphs 1 and 2 of draft provision 9(a). Non-renewable terms of office protect adjudicators from pressure to secure re-election, thereby enhancing their independence and impartiality. Longer terms of office decrease worries about job security and foster independence. Finally, long and staggered terms help establish institutional memory, expertise, and collegiality, leading to a more consistent development of case law (UNCITRAL, 2021c). The author is of the view that the terms of office should be renewable and it is up to the stakeholders to decide if the adjudicators are independent or not. All the members should trust the democratic nature of the selection process.

4.2. Resignation, removal, and replacement

The draft provision 9(b) discusses about resignation, removal and replacement. It reads as follows:

> "b. Resignation, removal, and replacement
> 1. A member may be removed from office in case of substantial misconduct or failure to perform his or her duties by a unanimous decision of all members except the member under scrutiny. A member may resign from his or her position through a letter addressed to the President of the Tribunal. The resignation shall become effective upon acceptance by the President […]
> 2. A member who has been appointed as a replacement of another member under this article shall remain in office for a duration of [nine] years except for members who are appointed as replacements for members elected with a shorter period of [three] years or [six] years after the first election. Members who are appointed as a replacement for a member with a shorter-term period will be eligible for reelection for a full term" (UNCITRAL, 2021b:14).

Majority of international court statutes establish misconduct and inability to perform duties as the grounds for removal of tribunal members. These provisions are intended to maintain the independence of tribunal members by preventing States Parties from interfering with the removal process. The suggestion was made that the president of the tribunal, with the involvement of other members, should be responsible for making decisions regarding removal. It was also recommended that the threshold for removal should be high. This was discussed in paragraphs 41 and 42 of document A/CN.9/1050 (UNCITRAL, 2021b).

The European Union and its member States' proposal is to add more details about the removal process of permanent adjudicators in paragraph 1 of draft provision 9(b). The suggestion is that other adjudicators can remove them based on a recommendation from the President, or the Vice President if the President is the one being scrutinized. It is suggested that a qualified majority (e.g., three-fourths) should be required instead of unanimous agreement for the decision to remove a permanent adjudicator. This change would prevent a single adjudicator from blocking removal in cases where it is necessary. The author is of the view that stakeholders also should be able to recommend for removal. The requirement might be getting signature of one-tenth of the members States (UNCITRAL, 2021c).

5. Conclusion

The draft provisions and explanations related to "standing multilateral mechanism: selection and appointment of ISDS tribunal members and related matters" and comments of different stakeholders provide insights into the ongoing discussions and debates surrounding the establishment of a multilateral investment tribunal or court. While there is support for the establishment of a permanent multilateral body to

resolve investment disputes, there are still concerns and issues that need to be addressed, such as the procedural framework, governance structure, and potential impact on sovereignty and the ability to regulate in the public interest. Moreover, these matters may include whether the tribunal should be established under an existing international organization such as the United Nations or as an independent body. As a recognized international organization, the tribunal would have legal standing under both national and international law, making it possible for it to enter into agreements such as seat agreements, granting the necessary privileges and immunities. Furthermore, the WGIII should consider the governance structure of the tribunal and which organs should be created under the agreement establishing the tribunal.

The creation of a Committee of the Parties has been supported by the EU and its member states, as well as other stakeholders. However, there are differences of opinion on the method of decision making. The EU and its member states have advocated for a qualified majority decision-making process, while Colombia has suggested a balance between requiring consensus for critical matters and allowing simple majority votes for less significant issues. The author recommends avoiding consensus as it has created difficulties in the past and suggests requiring a two-thirds majority for critical matters and a simple majority for others. The author also proposes that the selection of arbitrators be decided by a simple majority to expedite the process.

The WGIII should enfranchise every State and provide voting rights so that balance and trust can be intertwined from the beginning. Ensuring diversity would be another key steps to eliminate discrimination towards the developing countries, and to achieve this, representation based on geographical regions would be most productive. This would ensure that every region has a voice in the decision-making process, and that the interests of the developing countries are adequately represented. The voting of the geographical region can only be given to members of the same geographical region only. This way, the selection would be prompt, and there would be scope for less influence by the bigger players.

The EU and Canada hold the position that allowing states outside of the tribunal's jurisdiction to influence its operations could lead to conflicts and other issues that may undermine the tribunal's effectiveness. However, in line with the views of other stakeholders, the author believes that it is important to ensure that all states have a voice in the decision-making process to guarantee inclusivity and fairness. This approach can help ensure that all relevant perspectives are considered, which could ultimately strengthen the legitimacy of the tribunal's decisions.

The impartiality and independence of tribunal members are of utmost importance, and the EU and Canada believe that this can be ensured by appointing them on a full-time basis. However, the EU has suggested that part-time employment may be allowed as a transitional measure initially. The selection process should prioritize the potential adjudicators' competence and independence, along with their qualifications and expertise in international law, rather than their nationality. While Colombia proposed appointing ad hoc judges in cases where parties do not have a representative judge, the EU does not support this idea. The author maintains that tribunal members should primarily be full-time employees selected based on geographical diversity. Moreover, the representation of the countries is an important

element to make the arbitration more acceptable and sustainable. Regarding the appointment of ad hoc judges, Colombia's suggestion can be taken seriously and find ways to adopt this. Because, it is ultimately the countries who should be represented in the dispute settlement system and not the investor. In addition, the understanding of the legal system and constitutional law principles of the defending countries are crucial not to insert unwanted interpretations and to respect their positions. Furthermore, the author is of the opinion that the selection of tribunal members should prioritize geographical diversity. Although other types of diversity, such as gender and cultural representation, are important, stakeholders should nominate candidates based on their respective developmental stages.

In addition to geographical representation, the qualifications of the adjudicators should be uniform and transparent. All the qualifications, such as age, educational background, experience, etc., should be mentioned explicitly so that every candidate is evaluated on the same criteria. This would ensure that the selection process is fair, objective, and merit-based, rather than being influenced by factors such as political affiliations, personal connections, or biases.

Regarding terms of office, the EU and its Member States advocate for long, non-renewable, and staggered terms of office for tribunal members to enhance their independence and impartiality. The author, however, suggests that terms should be renewable and that the trust in the democratic selection process should be the primary factor in determining adjudicators' independence. Regarding the removal from office, the European Union and its member States suggest changes to the removal process of permanent adjudicators, including the possibility for other adjudicators to recommend removal based on a qualified majority. The author believes that stakeholders should also have the ability to recommend removal, with the requirement of obtaining signatures from a certain percentage of member States. In addition, there might be an option to held voting by the committee of parties to remove an adjudicators with qualified majority.

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Macroeconomic processes and expectations

Brigitta Tóth-Bozó

The study focuses on the problem of introducing expectations, as a subjective factor, into economic theoretical models. The basis of the model presented here is the well-known conventional Keynesian IS-LM model. It also follows that the concept of the IS-LM model can be approached as a problem or task in several ways. Also used was a discretized model encompassing three distinct categories of expectations, namely, simple, adaptive, and rational. It can be concluded that the type of expectation affects the number of stable cases in the model. The inclusion of the adaptive expectation results in the highest number of stable cases within the range of economically relevant values of the parameters studied. Numerical examples illustrate the results.

Keywords: Expectation, IS-LM model, dynamic

1. Introduction

There is no doubt that it is very important to take expectations into account in economic models. But opinions are divided on how to do it. Rational expectation[1], which was dominant for decades, has lost its luster in recent years and alternative types of expectation have come to the fore in models. Today it is much more accepted to consider alternative mechanisms for expectation formation than some years ago. In this paper, however, I return to the "old classics", even though in recent years there has also been a substantial number of papers on other types of expectation that seek to replace rational expectation.

An approach to aggregating single-value models is to assume that agents each have an individual expectation and follow a non-uniform method of constructing the expected value. That is, the environment of the agents determines not only the type of expectations, but also the method of their creation, see e.g. Curtin (2019). Due to this and similar approaches I see some problems. First of all, the problem of aggregating the expectations – as well as the aggregation of other heterogeneous individual data – is not yet solved. The second point is the context dependency of expectations. The context, the circumstances – but first and foremost their assessments – are subjective and individual elements in the process of creation of expectations. The latter depends also on a lot of other personal factors (preferences, etc.). Thus, finally there are individually colored contexts determining together with other elements related to the same individual's heterogeneous expectations. The uncertainty of uncertainties is essentially just uncertainty; therefore, the introduction of context dependency appears to be a more

[1] But it does not make anyone rational to have rational expectations. The two concepts are different. It is one thing to have a rational expectation and another to use a rational expectation type in modelling.

or less futile step – at least until the mechanisms behind the mentioned processes are more thoroughly identified. Recent research conducted by Curtin and others (for example, Fuhrer, 2017; Rots, 2017) can be considered as the beginning of new analyses.

The above ideas led to the main question for this study: what is the effect of including alternative expectation types for the same model while keeping the other assumptions based on the literature. Since expectations result from individual judgement, i.e. they can be considered subjective. I treat them as subjective factors in the models. One of the major challenges in economic modelling is how to represent the expectations of economic agents in a modelling environment. In this study, I introduce the types of expectations mostly used in the literature into the discrete, dynamic and linearized versions of the IS-LM model. In addition, I focus on aggregate expectations, i.e. I do not look at how expectations for the national economy are derived from individual expectations. Applying expectations into economic modelling raises the issue of dynamics. This means going beyond temporal statics. However, this change brings further difficulties: the dynamic IS-LM model is, even in its simplest version, quite complicated. Therefore, I examine the properties of the dynamic case first and then proceed to apply expectation types. One might ask why I work with a dynamic IS-LM model: of course, I am aware that – especially after behavioral economics' impressive results – there are a lot a complex macroeconomic models with different kinds of expectations, however, first of all, I was looking here for a model whose basic version is widely known. Second, it is a model very close to Keynes' fundamental idea that psychology is an important element of almost all economic decisions, implying that expectations have to be taken in account not only when financial decisions are made but also in the cases of deciding any other economic problem (Keynes, 1937). Moreover, we should not forget that there are many studies and theories that incorporate expectations into such a dynamic IS-LM model (Navarro–Tomé, 2022; Altar, 2008; Szomolányi et al., 2016). A dynamic macro model requires simplifications to make it easier to use. Nevertheless, at the societal level, the subjective factor – expectations – can be included in the model and its impact on the whole economy can be assessed. Our study demonstrates how the Keynesian IS-LM model can deal with expectations in its discrete, dynamic version. Then, I examine how expectations affect the stability properties of the system. The 20th century brought significant changes in economics. As a result of social and economic changes, it became necessary to take into account factors in economic models that had previously been present had either been ignored or part of a simplistic, two-dimensional caricature which did not affect the properties of the system. A milestone in the field was the inclusion of expectations and, at the same time, dynamics.

I consider the types of expectations accepted and used in the literature to show whether the choice of expectation type affects the behavior of the model. Finally, I conclude our study with a numerical example where I derive the parameter values from the literature and the available dataset. Section 2 contains the literature review. I examine the basic, linear discrete dynamic IS-LM model in Section 3. In Section 4, I expand the basic model with expectations, then in Section

5 I demonstrate a numerical example. I summarize and indentify further research goals in Section 6.

2. Literature review

"The General Theory of Employment is a useful book; but it is neither the beginning nor the end of Dynamic Economics." (Hicks, 1937:159)

We owe the creation of the IS-LM model based on Keynesian principles to Hicks (1937). The model still exists today, although it has changed. Its success is due to the ease with which its relationships can be applied into econometric models (De Vroey, 2004a; De Vroey, 2004b). Hicks' original model was static, suggesting that he did not intend to make it dynamic. His original model is the textbook version of the IS-LM model, with some minor modifications, and has been refined over the decades to apply the aggregate production function of Modigliani, who also introduced the labor market (Modigliani, 1944).

The inclusion of an increasing number of new factors and perspectives led to the expansion of the model. The remaining equilibrium of the commodity and money markets is represented by these two relationships. At the same time, several extensions were added, including the Phillips curve (Phillips, 1958), the inclusion of rational expectations (Lucas, 1976), and the AS curve (Rule et al., 1975). Despite the fine-tuning, theoretical macroeconomists have criticized the model's lack of microeconomic foundation and behavioral consistency (King, 2000). Applied macroeconomists have criticized the model for requiring the correlation between output and capacity to be zero. The central bank rejected the notion of policy irrelevance in the model. I will focus on the dynamic version of the model and review the literature. There are several versions of the dynamic IS-LM model, one of the earliest being Torre's (1977), which includes Kaldor's investment function, meaning that the level of investment depends on both the interest rate and income. However, in the classic textbook example, the investment function depends on the interest rate and the expectations of economic agents (allowing for autonomous investment demand).

As a starting point, consider the following discrete model, based on De Cesare and Sportelli (2005):

$$Y_t - Y_{t-1} = \alpha[I(Y_{t-1}, r_{t-1}) + G_{t-1} - S(Y_{t-1}^D) - T_{t-1}]$$

$$r_t - r_{t-1} = \beta[L(Y_{t-1}, r_{t-1}) - M_{t-1}] \quad (1)$$

where

Y_t	income in the t[th] period
r_t	nominal interest rate in the t[th] period
$I(Y_t, r_t)$	investment function (Kaldor-type)
G_t	government expenditure in the t[th] period
T_t	tax revenue in the t[th] period
Y_t^D	disposable income in the t[th] period
$S(Y_t^D)$	savings function, which is related to the disposable income
M_t	nominal money supply in the t[th] period
$L(Y_t, r_t)$	money demand function in the t[th] period
α	coefficient of adjustment of the commodity market, expressing how strongly interest rate changes respond to money market imbalances
β	the money market adjustment coefficient, expressing how strongly income changes respond to commodity market imbalances

In some cases, other equations are added to the above, depending on the aspects of macroeconomics that modelers emphasize on the basis of the literature. Shinashi (1981) extends the above relationships to include the Phillips curve and the government budget balance, and another study (Shinashi, 1982) works with Kaldor's non-linear investment function. In the model of Rajpal et al. (2022), in addition to the two basic equations above, the investment function, the saving function, the money demand function, and government expenditure are non-linear, and the two basic equations show the time evolution of capital accumulation and restrictions on government funds. Sportelli et al. (2014) apply the lag to the public sector but introduce the fiscal balance as a third equation. Bifurcation analysis is quite common in the continuous version of the dynamic IS-LM model, as illustrated by Cai (2005). Neri and Venturi (2007) also studied bifurcation in a nonlinear fixed price model based on Shinashi's model. The classical extensions of the original IS-LM model include the assumption of an open economy, the inclusion of the consumption function, the consideration of portfolio decisions and the incorporation of the micro-foundations of investment timing into the basic model (De Vroey, 2004a; De Vroey, 2004b).

3. The basic dynamic linear IS-LM model

I consider a closed economy and use the classical linear equations used in textbook models. Suppose that the endogenous values are income and the nominal interest rate. The other values are exogenous. I_0 is the autonomous investment and a represents the interest rate sensitivity of investment. By definition, $a \leq 0$. This means that interest rate movements and changes in the value of the investment are in opposite directions. To determine the saving function in relation to disposable income, I apply the following relations: $S_t(Y_{t-1}) = S_0 + \hat{s}Y_{t-1}^{DIS} = -C_0 + \hat{s}Y_{t-1}^{DIS}$, $Y_{t-1}^{DIS} = Y_{t-1} - T_{t-1}$, where I suppose that T_{t-1} is a net tax, i.e. this is corrected for transfers and $T_t = T_{t-1} = T_{t-2} = \cdots = T_0$. In addition, $\hat{s}$ is the savings rate, which

measures the share of income that is allocated to save, $0 \leq \hat{s} < 1$. a represents the interest rate sensitivity of investments.

The equation presenting the equilibrium points in the goods market is as follows, where $0 \leq \alpha$:

$$Y_t = Y_{t-1} + \alpha[I_0 + ar_{t-1} + G_{t-1} + C_0 - \hat{s}(Y_{t-1} - T_0) - T_0] \quad (2)$$

The equilibrium points of the money market are determined by the following equation, assuming a linear money demand function: $(Y_{t-1}, r_{t-1}) = mY_{t-1} + kr_{t-1}$, where k is the slope of the money demand function, which shows how much a unit change in nominal interest rate results in a change in money demand ($k \leq 0$). It means that the interest rate movements and changes in the value of the money demand are in opposite directions. m shows how much a unit change in income results in a change in money demand, i.e. the slope of the money demand function $(0 \leq m < 1)$. I have the following money supply function, $\frac{M_{t-1}}{P_{t-1}}$, where M_{t-1} is the nominal money supply in the $(t-1)^{\text{th}}$ period and P_{t-1} is the price level in the $(t-1)^{\text{th}}$ period. So the equation representing the equilibrium points in the money market is as follows:

$$r_t = \beta m Y_{t-1} + (1 - \beta k) r_{t-1} - \beta \frac{M_{t-1}}{P_{t-1}} \quad (3)$$

So $\hat{s} = \frac{\partial S}{\partial Y} \geq 0, k = \frac{\partial L}{\partial r} \leq 0, m = \frac{\partial L}{\partial Y} > 0, a = \frac{\partial I}{\partial r} \leq 0$. In addition, similarly to the equation of the commodity market, $0 \leq \beta$.

The system of difference equations is then the following:

$$\begin{bmatrix} Y_t \\ r_t \end{bmatrix} = \begin{bmatrix} 1 - \alpha\hat{s} & \alpha a \\ \beta m & 1 + \beta k \end{bmatrix} \begin{bmatrix} Y_{t-1} \\ r_{t-1} \end{bmatrix} + \begin{bmatrix} \alpha(I_0 + G_{t-1} + C_0 + (\hat{s} - 1)T_0) \\ -\beta \frac{M_{t-1}}{P_{t-1}} \end{bmatrix} \quad (4)$$

Below I calculate the conditions for the stability of the steady state equilibrium. The steady state vector is considered to be stable if two conditions are satisfied simultaneously.

First condition is that $|I - A| \neq 0$ (Galor, 2005) is the condition of the uniqueness of the steady state equilibrium, where $I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ and A is the coefficient matrix. In this case the condition is $\hat{s}k \neq -am$. The inequality is satisfied whenever the parameters are allowed to vary within the intervals specified in the model.

The second condition is that the eigenvalues of the matrix A are strictly less than 1 in absolute value (Galor, 2005). If the absolute value of either eigenvalue is greater than 1, then the steady state is unstable. If one of the eigenvalues is equal to 1, then further analysis is required to determine stability. The eigenvalues of the coefficient matrix are (λ_1, λ_2) of $A = \begin{bmatrix} 1 - \alpha\hat{s} & \alpha a \\ \beta m & 1 + \beta k \end{bmatrix}$ matrix, i.e. $(1 - \alpha\hat{s} - \lambda)(1 + \beta k - \lambda) - \alpha a \beta m = 0$. So

$$\lambda^2 + \lambda(\alpha\hat{s} - \beta k - 2) + (1 + \beta k - \alpha\hat{s} - \alpha\hat{s}\beta k - \alpha a \beta m) = 0 \quad (5)$$

When solving the quadratic equation, I get the following eigenvalues:

$$\lambda_{1,2} = \frac{\left[(2 - \alpha\hat{s} + \beta k) \pm \sqrt{[(2 - \alpha\hat{s} + \beta k)^2 - 4(1 - \alpha\hat{s} + \beta k - \alpha\hat{s}\beta k - \alpha a\beta m)]}\right]}{2}$$

The key factors about stability are $\alpha, \hat{s}, \beta, k, m, a$. I can conclude that the problem is very complex and that stability depends on a considerable number of parameters. The dynamic IS-LM model becomes so complicated, even with linear relationships, that it is only possible to examine stability after estimating the parameters or providing concrete values. I will return to this issue in the numerical example.

4. Expanded IS-LM model with expectations

The inclusion of expectations in the IS-LM model added dynamism, as the consideration of expectations is only possible with the consideration of time. While Friedman assumed systematic, costly and easily correctable errors in the expectations of economic agents, Sargent and Wallace's new-classical model emphasized immunity to systematic errors through the incorporation of rational expectations (De Vroey, 2004a; De Vroey, 2004b). According to Krugman (1991), the structure of the economy plays an important role in determining the importance of expectations in the economic process. Agreeing with King (1993) – that incorporating expectations into a dynamic IS-LM model makes sense from the commodity market side – I apply expectations into the investment demand through the following equation: $I_t = I_0 + ar_{t-1}$. I expand the original equation by considering the autonomous investment, which refers to the investment value that does not depend on the interest rate. Let the autonomous investment – i.e. one independent from the interest rate – be a function of expected income, that is $I_0 = f\left(Y_t^{exp}\right) = I_{00} + \mathrm{z}Y_t^{exp}$, where I_{00} represents the investment independent of expected income and $0 < z \leq 1$. z is the expected income sensitivity of autonomous investment. Y_t^{exp} is the expected income for the tth time-period. This factor influences the amount of investment in the t[th] period, $I_t(I_{00}, r_{t-1}, Y_t^{exp})$. The more favorable the sentiment, the higher the investment demand will be. Conversely, the worse the sentiment, the lower the investment demand. Thus, autonomous investment has a component that depends on expected income and a component that is independent of income, namely

$$I_t = I_{00} + ar_{t-1} + zY_t^{exp} \tag{6}$$

Below, I examine how different types of expectations influence the outcome of the system. The various types of expectations, focusing on our model with expected income, are as follows[2]:

[2] Although the equations seem clear, the literature suggests that there is no uniform interpretation of each type of expectation.

1. Rational: $Y_t^{exp} = E_{t-1}(Y_t \mid \Omega_{t-1})$, where Ω is the information set.
2. Adaptive: $Y_t^{exp} = Y_{t-1}^{exp} + \delta\left(Y_{t-1} - Y_{t-1}^{exp}\right)$, where $0 < \delta < 1$.
3. Simple: $Y_t^{exp} = Y_{t-1}$

Including expectations only changes the IS equation as follows:

$$Y_t = Y_{t-1} + \alpha\left[I_{00} + ar_{t-1} + zY_t^{exp} + G_{t-1} + C_0 - \hat{s}(Y_{t-1} - T_0) - T_0\right] \quad (7)$$

Let us examine how the listed types of expectations modify the original linear dynamic IS-LM model. In all cases I examine the conditions for the existence of the steady-state vector and the stability of the steady-state equilibrium, i.e. I investigate whether it holds that $|I - A| \neq 0$ and the eigenvalues of the A matrix are between -1 and 1. In this section, I present the analytical analysis of the problems, and later, during the numerical tests, I shed light on the practical applicability.

4.1. Rational expectation

Rational expectation is an approach to economic modelling that assumes that economic agents form their expectations based on all available information. There is a large amount of literature on different interpretations of rational expectation, and the challenge for the modeler is to select the most relevant version of it. Rational expectations theory assumes that economic agents use the information available to them rationally and optimally to forecast future outcomes. As stated in King's article, "expectations about the future require that the long run and the short run are treated jointly" (King, 1993:75.) In my opinion, there is one weak point of using rational expectations in the model: the time horizon. In the case of the long run in economic terms, the concept of perfect foresight is the most appropriate one for rational expectations (in line with Dornbusch's claim that perfect foresight is the deterministic equivalent of rational expectations (Dornbusch, 1976). In this sense, perfect foresight is actually a special case where economic agents are aware of the long-term equilibrium value of the variable under consideration. However, this does not imply that they will also expect it for every period.

In this model applying rational expectations of the economic agents means that $Y_t^{exp} = Y_t$, i.e. I apply the short-run perfect foresight case of the rational expectation. This is the most common case in modelling. This version of the model is a good example of how rational expectation also has an impact, in our case on the stability of the steady state equilibrium. With this addition, the model looks as follows, where only the equation of the IS curve changes in the 2x2 case, where I must conclude that (αz) cannot be equal to 1:

$$\begin{bmatrix} Y_t \\ r_t \end{bmatrix} = \begin{bmatrix} \frac{1-\alpha\hat{s}}{1-\alpha z} & \frac{\alpha a}{1-\alpha z} \\ \beta m & 1+\beta k \end{bmatrix} \begin{bmatrix} Y_{t-1} \\ r_{t-1} \end{bmatrix} + \begin{bmatrix} \frac{\alpha}{1-\alpha z}(I_0 + G_{t-1} + C_0 + (\hat{s}-1)T_0) \\ -\beta\frac{M_{t-1}}{P_{t-1}} \end{bmatrix} \quad (8)$$

1st condition: $|\mathrm{I}-\mathrm{A}| = \begin{vmatrix} \frac{\alpha(\mathrm{z}-\hat{\mathrm{s}})}{1-\alpha \mathrm{z}} & \frac{\alpha a}{1-\alpha \mathrm{z}} \\ \beta \mathrm{m} & -\beta \mathrm{k} \end{vmatrix} = \frac{\alpha(\mathrm{z}-\hat{\mathrm{s}})}{1-\alpha \mathrm{z}}(-\beta \mathrm{k}) - \frac{\alpha a}{1-\alpha \mathrm{z}} \beta \mathrm{m} \rightarrow \mathrm{k}(\mathrm{z}-\hat{\mathrm{s}}) \neq am$. The inequality suggests that it is a necessary condition for stability and that it is rather complicated, as household sector saving ($\hat{s}$), money market developments (k, m), the interest rate sensitivity of investment (a) and the – newly introduced – parameter (z) all play a role in the inequality.

2nd condition: For the stability, the eigenvalues of the matrix A are strictly less than 1 in absolute value. The eigenvalues are the solution of the following equation:

$$\lambda^2 + \lambda\left(\frac{1-\alpha\hat{s}}{1-\alpha z} + \beta k + 1\right) + \left(\frac{1+\beta k - \alpha\hat{s} - \alpha\hat{s}\beta k - \alpha a \beta m}{1-\alpha z}\right) = 0$$

$$\lambda_{1,2} = \frac{\left[(-1)\left(1+\beta k + \frac{1-\alpha\hat{s}}{1-\alpha z}\right) \pm \sqrt{\left[\left(1+\beta k + \frac{1-\alpha\hat{s}}{1-\alpha z}\right)^2 - 4\left(\frac{1+\beta k - \alpha\hat{s} - \alpha\hat{s}\beta k - \alpha a\beta m}{1-\alpha z}\right)\right]}\right]}{2}$$

Is summary, applying rational expectation into the discrete dynamic IS-LM model causes changing in the stability conditions of the steady-state equilibrium. It can be concluded that the inclusion of expectations in the base model is capable of changing the dynamics of the model, but in different ways. As can be seen, the conditional systems have become more complex with the inclusion of different types of expectations. For this reason, the properties of the model are further investigated by means of a numerical example.

4.2. Adaptive expectations

The adaptive expectation type is an expectation-theoretic approach to economic modelling, according to which economic agents form their expectations based on the experience of previous periods. This means that agents consider not only the current situation but also the changes observed in previous periods. In case of adaptive expectation, economic agents use past data to judge what changes will occur in the future. The model is extended to three equations, as follows.

$$\begin{bmatrix} Y_t \\ r_t \\ Y_t^{exp} \end{bmatrix} = \begin{bmatrix} 1-\alpha\hat{s}+\alpha z\delta & \alpha a & \alpha z(1-\delta) \\ \beta m & 1+\beta k & 0 \\ \delta & 0 & 1-\delta \end{bmatrix} \begin{bmatrix} Y_{t-1} \\ r_{t-1} \\ Y_{t-1}^{exp} \end{bmatrix} + \begin{bmatrix} \alpha(I_{00}+G_{t-1}+C_0-(\hat{s}+1)T_0) \\ -\beta\frac{M_{t-1}}{P_{t-1}} \\ 0 \end{bmatrix} \qquad (9)$$

Here I will also focus on the stability conditions of the steady-state equilibrium.

1st condition:

$$|I-A| = \begin{vmatrix} \alpha\hat{s}-\alpha z & \alpha a & \alpha z(1-\delta) \\ \beta m & -\beta k & 0 \\ \delta & 0 & \delta \end{vmatrix} =$$
$$(\alpha\hat{s}-\alpha z)(-\beta k)\delta + \alpha z(1-\delta)\beta k\delta - \alpha a\beta m\delta =$$
$$\alpha(\hat{s}-z)(-\beta k)\delta + \alpha z(1-\delta)\beta k\delta - \alpha a\beta m\delta.$$

So the condition is $(\hat{s}-z)(-k)+z(1-\delta)k-am \neq 0$. The interpretation of the condition is complicated because all parameters in the model affect its value.
2nd condition: The eigenvalues $(\lambda_1, \lambda_2, \lambda_3)$ are the solution of the following equation:

$$(1-\alpha\hat{s}+\alpha z\delta-\lambda)(1+\beta k-\lambda)(1+\delta-\lambda)$$
$$-\alpha z(1-\delta)(1+\beta k-\lambda)\delta-(\alpha a\beta m(1-\delta)-\lambda)=0$$

The above relation can also only be further analyzed if I apply a numerical example to it. The equation is of degree three, so I cannot find its roots parametrically using analytical methods.

4.3. Simple expectation

The next special case is the simple expectation, i.e. $Y_t^{exp} = Y_{t-1}$. In this type of expectation, economic agents determine their expectations for the next period by observing the current value of the variable in question and expecting it for the next period. It concludes that $I_t = I_{00} + ar_{t-1} + \mathrm{z}Y_{t-1}$. The discrete difference equation system is, where $Y_t^{exp} = Y_{t-1}$:

$$\begin{bmatrix} Y_t \\ r_t \end{bmatrix} = \begin{bmatrix} 1-\alpha\hat{s}+\alpha z & \alpha a \\ \beta m & 1+\beta k \end{bmatrix} \begin{bmatrix} Y_{t-1} \\ r_{t-1} \end{bmatrix} + \begin{bmatrix} \alpha(I_{00}+G_{t-1}+C_0+(\hat{s}-1)T_0) \\ -\beta\frac{M_{t-1}}{P_{t-1}} \end{bmatrix} \quad (10)$$

1st condition:

$$|I-A| = \begin{vmatrix} \alpha\hat{s}-\alpha z & \alpha a \\ \beta m & -\beta k \end{vmatrix} =$$
$$(\alpha\hat{s}-\alpha z)(-\beta k)-\alpha a\beta m \rightarrow\ k(z-\hat{s}) \neq am.$$

The stability properties are influenced not only by the parameters of the original model, but also by the weight of the expected income of economic agents in the value of the autonomous investment (z).
2nd condition: The eigenvalues are the solution of the following equation:

$$\lambda^2 + \lambda(\alpha\hat{s}-\alpha z+\beta k-2)+(1+\beta k-\alpha\hat{s}-\alpha\hat{s}\beta k-\alpha a\beta m+\alpha z+\alpha z\beta k)=0$$

$$\lambda_{1,2} = \frac{\left[(2-\alpha\hat{s}-\alpha z+\beta k) \pm \sqrt{[(2-\alpha\hat{s}-\alpha z+\beta k)^2-4(1-\alpha\hat{s}+\beta k-\alpha\hat{s}\beta k+\alpha a\beta m+\alpha z+\alpha z\beta k)]}\right]}{2}.$$

The result is a similarly complicated relationship as for the previous model versions. We need to further investigate the numerical examples in order to show the properties of the simple expectation type.

In this section I have shown analytically the effect on the stability of the steady state vector of including a subjective factor in the dynamic IS-LM model via the investment function: this factor is the expectation of income. I have seen that the conditions for the stability of the steady state equilibrium are already complicated in the case without expectations and with expectation too. Since no general relationships between the parameters has been discovered, I will now examine the systems of differential equations using a numerical example.

5. Numerical examples

In the first step I focus on the stability conditions of the model. For further examining the model, I present its operation through a numerical example. First, I examine the stability of the basic model where the parameters belong to the following intervals with 0.1 step-spacing: $\alpha = [0.1: 0.1: 0.9]$, $\beta = [0.1: 0.1: 0.9]$, $\hat{s} = [0.1: 0.1: 0.9]$, $z = [0.1: 0.1: 0.9]$, $\delta = [0.1: 0.1: 0.9]$, $m = [0.1: 0.1: 0.9]$, $a = [-0{,}9: 0.1: -0.1]$, $k = [-0{,}9: 0.1: -0.1]$. By using simulation, parameter combinations can be determined that ensure the stability of the system, using Matlab software. In the simulation, all possible combinations of parameters that satisfy both the first and the second condition were tested.

The aim of the simulation is to investigate, with the same parameter intervals, how much the steady-state equilibrium of the basic dynamic IS-LM model and its variants extended with different types of expectations changes. Table 1 shows, for parameter combinations that satisfy the first and second conditions, the percentage of stable cases in which the system remains stable as the parameter intervals begin to narrow to the economically relevant range.

Table 1. Stable cases in the basic and in the extended models

Model	1st and 2nd conditions satisfied (number of cases)[3]	$\hat{s} = [0.1,0.2]$ (as a percentage of stable cases)	$\hat{s} = [0.1,0.2]$ $m = [0.1, 0.2, 0.3, 0.4]$ (as a percentage of stable cases)	$\hat{s} = [0.1,0.2]$ $m = [0.1, 0.2, 0.3, 0.4]$ $k = [-0.1, -0.2, -0.3, -0.4]$ (as a percentage of stable cases)	$\hat{s} = [0.1,0.2]$ $m = [0.1, 0.2, 0.3, 0.4]$ $k = [-0.1, -0.2, -0.3, -0.4]$ $a = [-0.1, -0.2]$ (as a percentage of stable cases)
Basic	121256	17.9	11.9	1.5	0.8
Rational expectation	83108	48.2	22.0	5.3	1.4
Adaptive	117436	51.9	14.5	14.54	14.54
Simple	16855	0.2	0.1	0.1	0

Source: own construction
Note: When narrowing the parameter ranges, I show the number of cases as a percentage of stable cases

[3] The total number of simulations run depended on the number of parameters included in the model version.

The first column shows the number of cases found in the simulation where the parameter combinations satisfy the first and second conditions simultaneously. The second column shows the percentage of stable cases, where I have narrowed the range of values that can be taken up by the savings rate when the first and second conditions are satisfied simultaneously. The third column shows the restriction of the value of the parameter of the money demand function. In the fourth column, I also restrict the value of the other parameter of the money demand function. In the fifth column, I also restrict the interest rate sensitivity of investment to the economically relevant range. Restricting the parameters to the economically relevant range resulted in the simulation that there are significantly fewer stable cases in the numerical example when expectations are included in the model. In addition, it can be seen across all model variants that restricting the parameters to the appropriate interval reduces the number of stable cases in each variant. At the highest percentage, the incorporation of the adaptive expectation type results in stable cases even after the narrowing.

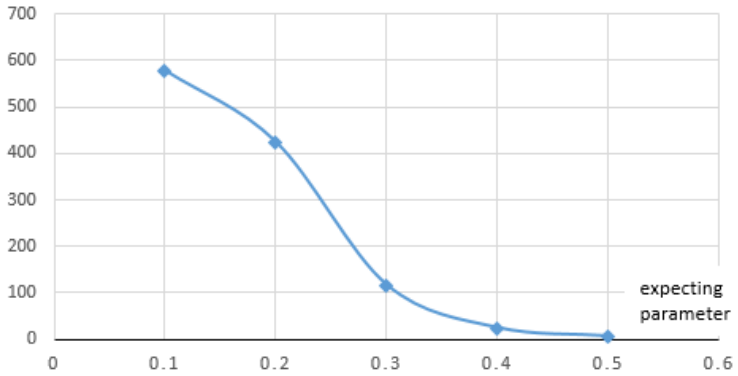
5.1. Basic model

Running a simulation with the conditions, I found 121,256 cases where both conditions are met within the specified intervals, which do not contain economic inconsistencies. I adjusted these case numbers by narrowing the interval of parameters to an economically relevant range, which is $\hat{s} = [0.1; 0.2]$, $m = [0.1: 0.1: 0.4]$, $k = [-0.1: 0.1: -0.4]$, is $a = [0.1; 0.2]$ The points were obtained in intervals that are realistic for an empirical study, for example, Oblath and Palócz (2020), Árvai and Menczel (2001), Reichel (2022). Hence, only 0.8% of the cases are economically relevant and consistent with the empirical literature. Below, I perform a simulation study of the dynamic IS-LM model augmented with certain expectation types for the same parameter intervals.

5.2. Rational expectations

During the simulations I tested all parameters which I presented above and found 83,108 cases when the first and second conditions satisfied in the same time. The economically relevant ranges mentioned in the base case are adjusted for the interest rate sensitivity of investment, money market parameters, and the savings rate. The fact that z could range between 0.1 and 0.9 during the simulation, the stable cases have values between 0.1 and 0.5. It can be shown that the higher the value of z, the fewer stable cases are found. This means that the higher share of expected income in the investment that is independent of the interest rate, the fewer stable cases can be identified.

Figure 1. In case of applying rational expectation formula in the dynamic IS-LM model



Source: own construction
Note: The expected income sensitivity parameter (z) can change the number of stable cases

Hence, the more weight given to expected income, the more unstable the equilibrium. 1.38% is the proportion of cases that were validated in the simulation based on the economics literature.

5.3. Adaptive expectations

In this case, expected income is now part of the model and can be determined based on the model's internal equations and variables. I extend the parameter intervals previously given to include the parameter for adaptive expectations, which can take values between 0 and 1. This parameter is a value that ranges from 0.1 to 0.9 with 0.1 steps and is used to represent how individuals adjust their expectations based on new information. The simulation was run by first defining the parameter combinations that satisfy the second condition within the parameter interval. Then the cases were narrowed down to those combinations that satisfy the first condition. This yielded the 117,436 stable cases. Compared to the stable cases in the base model, this number of cases is not much lower, and in fact the number of stable cases in the economically relevant parameter range is significantly higher than in the base and other extended cases. The reason for this is not only the perceived efficiency of the learning process, but it should also be noted that for this model variant the expected income is also an endogenous variable, the introduction of which has changed the properties of the baseline model.

5.4. Simple expectations

In the analytical analysis I have seen that the simple expectation case modifies the stability conditions of the steady state equilibrium compared to the baseline model. I have found significantly fewer stable cases compared to the other model variants. Moreover, in the economically relevant range, the steady state equilibrium is not

stable for the given parameter intervals. The message is that this formulation almost always results in an unstable economy within economically relevant parameter ranges.

6. Conclusion

In this study, I have aimed to investigate how to apply subjective factors into an economic model; this subjective factor is the expectation. I have used the IS-LM model, its discrete, dynamic, linear version to show the effect of applying different types of expectations. The inclusion of dynamics has been justified due to the temporal evolution of expectations. First, I wrote down the basic model and examined the steady-state equilibrium conditions. Then I examined the conditions for rational expectation, adaptive expectation and simple expectation cases. To account for the large number of parameters and the complexity of their combination, simulations were carried out. I have found the most stable cases for the base model, although the number of stable cases decreased significantly as the parameters were reduced. Then, for the models augmented with each type of expectation, I have looked at how the number of stable cases evolved as the interval of parameters narrowed. The reason for the narrowing was to approximate the parameter range to the economically relevant on. For the simple expectation, I have not found stable cases within the economically relevant parameter intervals. The learning process proved to be the most efficient, i.e. the application of the adaptive expectation type. It is interesting to note that varying the expecting parameter of adaptive expectation produced roughly the same number of stable cases within the economically relevant intervals. Using adaptive expectation has resulted in a higher percentage of stability than using the most common type of expectation, rational.

The research reported on here has uncovered many new areas for investigation, which can form the basis for further studies investigating the question how the model can be tested in the case of an open economy. In addition, an empirical test of the parameters can also be carried out, possibly for a specific country. Finally, researchers can look for cases that may be relevant for economic decision-making.

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Comparison of the TiVA and traditional data based on income groups in the gravity models application

Mahammad Kheyirkhabarli

This article continues the line of research by Fertő et al. (2022) and aims to find if there are any differences between Trade in Value-Added (TiVA) data and traditional data of international trade in the gravity model application when 66 OECD and non-OECD countries are grouped by income level. In addition, the paper also examines differences in gravity model factors between high-income vs. low- and middle-income countries in international trade. In the gravity model application, fixed effects and PPML methods are applied with a 3-year interval. According to the results, the differences between TiVA and traditional data are still minor for both income groups. Additionally, it is found that distance and language have a greater influence on the exports of low and middle-income countries, while shared borders, colonial history, and regional trade agreements are the factors that exert more impact on the exports of high-income countries.

Keywords: global value chains, trade in value-added data, gravity models, high-income countries, low-income countries, middle-income countries

1. Introduction

In recent years, there have been significant changes in the structure of global economy, which have led to the emergence of Global Value Chains (GVCs) as a means of analyzing these changes. GVCs are a series of processes involved in the production of a product or service, with each step adding value to the final output and taking place in different countries. GVCs have resulted in an increase in the use of intermediate inputs in cross-border transactions, as opposed to final goods, which increase has traditionally been emphasized in international trade frameworks. This has led to the development of a new method for analyzing trade based on value added, which is different from the traditional method of measuring trade value based on gross value. Researchers have combined data from customs agencies with domestic input-output tables to form worldwide input-output tables to track the movement of value-added trade across nations. The use of value-added data can provide valuable insights into the generation of domestic value added through the export of goods or services, which is essential for development strategies and industrial policies.

The aim of this study is to investigate the potential differences between traditional data and value-added data in the application of gravity models. The paper also examines the differences in gravity model trade cost factors between high-income vs. low- and middle-income countries. Panel data of 43 high-income and of 23 low- and middle-income countries are used to conduct the research through structural gravity models in OLS fixed effects and PPML methods. The paper is structured as follows: after the introduction in the present section, the second section

reviews the previous literature on this topic, the third section examines the methodology, and the fourth section presents the results. Finally, the fifth section concludes the paper.

2. Literature review

Nowadays, labels that indicate the country of origin on manufactured goods have become obsolete symbols of a former period, and the majority of products in certain industries are identified as being "Made in the World" (Antràs, 2020). Initially proposed by Gereffi et al. (2001), the notion of Global Value Chains (GVCs) was originally designed to examine the governance arrangements of industries that manufacture for international markets. Nowadays, examining the structural transformations taking place in the world economy has gained widespread popularity as a tool, as stated by Gereffi (2019). Global value chains refer to a sequence of activities involved in manufacturing a product or providing a service, which is at the end of the process sold to customers. Each step adds value to the final product, and at least two steps are completed in different countries. When a company carries out at least one step in a GVC, it is said to be participating in the GVC. Meanwhile, Buckley and Ghauri (2004) define GVCs as networks that are dispersed globally and created by companies with varying goals. These networks collaborate to perform tasks that have traditionally been completed by a single organization.

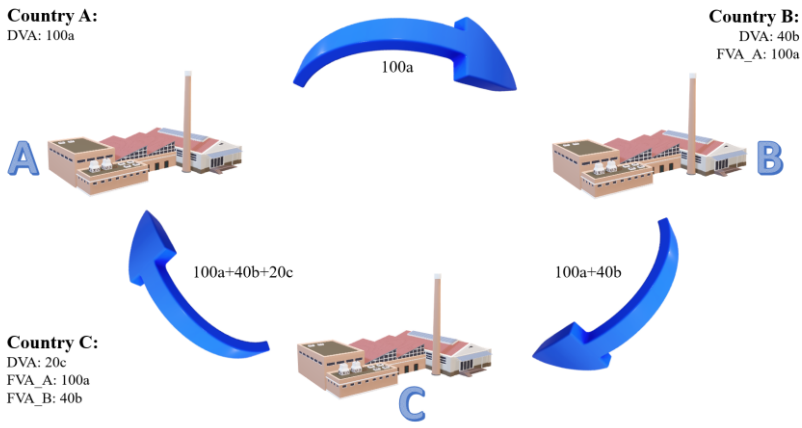
One way to view the rise of GVCs is to see it as an increase in the use of intermediate inputs for transactions across borders rather than final goods, as traditionally emphasized in international trade frameworks. If a nation imports a small number of intermediates and exports a significant portion of intermediate exports to third countries, it is concentrating on upstream activities. Examples of relatively upstream activities are the creation of raw materials and intangibles like research and development or the design of industrial products. Conversely, downstream activities refer to the assembly of processed products or post-sales customer services and are characterized by high importation of intermediates and low exportation of intermediate exports to third countries. Furthermore, the global economy can be divided into two types of economies: "headquarter" economies, which have a small number of imported intermediates in their exports, and "factory" economies, which have a high proportion of imported intermediates in their exports. Moreover, based on the participation of countries, GVC trade can be divided into two categories: backward participation and forward participation. Backward participation involves a country exporting products that contain value from imported materials. Forward participation, on the other hand, happens when a country exports products that are not entirely consumed by the importing country, however, are included in their exports to other countries.

In the present day, the inclusion of imported intermediate goods in exports is a significant aspect of the manufacturing procedure, resulting in a substantial increase in gross exports compared to domestic value-added counterpart (Amador–Cabral, 2017). The concept of trade analysis based on value added is a

relatively new method that has gained significance in studying international economic cooperation. This approach differs greatly from the traditional method of measuring trade value based on gross value and has become essential in empirical research. Javorsek and Camacho (2015) argue that analyzing trade value only in terms of finished goods does not paint an accurate picture of global relationships since the importance of intermediate product trade has increased, while trade in finished goods has decreased.

To understand how this concept works, Figure 1 illustrates trade in value added. According to the figure, country A exports a product that has a value of 100. Thus, 100a is the domestic value added of country A on a product that is exported to country B. Furthermore, country B imports a product that has 100a value and adds its own 40b value, and exports it to the country C. In this export, 40b is the domestic value added of country B, while 100a is the foreign value added. Finally, country C imports a product from country B with 140 values in total, of which 100 of them belongs to country A, and only 40 of them belongs to country B. Moreover, country C adds its final 20c domestic value and exports the product to the country A. Conventional measures of trade show total global exports and imports as 400 (100+140+160), however only 160 (100+40+20) of value added has been generated in the production. Conventional measures also show that country A has a trade deficit of 160 with country C, despite the fact that A is the chief beneficiary of country C's consumption. Furthermore, the figure also depicts that protectionist measures of country A on imports from country C could harm its own exporters and hence competitiveness. Thus, trade in value-added data can prevent any mistakenly accepted policies that can harm local industries. Moreover, by providing information at the level of specific industries, it is possible to provide insights into other areas too, such as the contribution of the service sector to international trade, which in traditional data their contributions could be underestimated.

Figure 1. Illustration of trade in value added



Source: own construction

What has been lacking is a systematic attempt to mainstream the development of statistics in this area. To track the movement of value-added trade across nations, a group of researchers has combined data from customs agencies with domestic input-output tables to form worldwide input-output tables. The recently introduced databases provide a comprehensive and uniform account of the interdependence of production in numerous nations on imports, which are frequently subjected to additional processing and then exported. The most commonly used global input-output tables, abbreviated as WIOTs, include the World Input-Output Database (WIOD), spearheaded by a team of researchers at the University of Groningen; the OECD TiVA database; and the Eora Global Supply Chain Database, which was created by a group of researchers at the University of Sydney. On March 15, 2012, the OECD and WTO joined forces to develop a database of Trade in Value-Added (TiVA) indicators and to mainstream their production within the international statistics system. The first preliminary results from this initiative were released on January 16, 2013 (Ahmad, 2013). In essence, the TiVA method provides insight into the intensity of the relationship between domestic and foreign markets in terms of the value-added content of traded goods. Furthermore, the database provides statistics on both gross trade and value-added trade of selected OECD and non-OECD countries from 1995 to 2018. The database includes data on both total trade and trade in specific goods and services. The usage of the database can help us better understand how much domestic value-added is generated by the export of goods or services in a country is crucial for development strategies and industrial policies. Furthermore, looking at trade from a value-added perspective also allows to better reveal how upstream domestic industries contribute to exports, even if those same industries have little direct international exposure. Gross trade statistics, for example, reveal that less than one-quarter of total global trade is in services, however, in value-added terms, the share is significantly higher (Ahmad, 2013).

There are several authors who employed TiVA data in their research. For example, according to the research on value-added trade in the chemical industry in Poland and Hungary conducted by Folfas and Udvari (2019), both countries actively engage in production fragmentation and the global value chain. However, they depend more on intermediaries from wealthier nations rather than on domestically produced semi-products with high domestic value-added content. Moreover, according to Escaith and Gaudin (2014), where value-added data from 53 countries was included, there is a relatively strong relation between GDP and several trade in value-added indicators. Conversely, there is a marked negative correlation between total gross exports' foreign content and foreign value added in both services and manufacturing exports. In contrast, the total domestic content in total gross exports exhibits the highest correlation coefficient, particularly regarding domestic value added in primary and manufacturing exports, as anticipated. On the other hand, some researchers applied both traditional and domestic value-added data and compared them. For instance, Power (2012) observes that in several developed countries, the ratio of exports to GDP is similar to the ratio of domestic value-added exports to GDP. In contrast, in emerging economies, there is a substantial gap between these two ratios, indicating that their exports have a higher proportion of foreign value-added content. Furthermore, Fertő et al. (2022) compared these two data sets in a gravity model application for the 66 OECD and non-OECD countries and found that there is no great difference between obtained coefficients. In

the next section, I will continue their line of research and try to find if we can observe any difference between traditional and TiVA data when 66 countries are divided into two categories based on their income level.

3. Methodology

In international trade, the "Gravity Equation" has been remarkably consistent throughout time and across a diverse sampling of nations and methodologies. It is one of the most reliable and consistent empirical regularities in economics. The notion of gravity models was first proposed by Tinbergen (1963). The first article that delivered a micro foundation of the gravity equation was Anderson (1979), where the theoretical base of the equation emerged. The classic gravity equation of international trade is a model that describes trade flow by the GDP of the home and partner nations, which are directly proportional, as well as a trade barrier in the form of distance between them, which is inversely proportional.

In recent decades, the gravity model has been developed further, and nowadays, mainly the structural gravity model is used. The structural gravity equation is expressed as follows:

$$X_{ij} = \frac{Y_i E_j}{Y}\left(\frac{\varphi_{ij}}{\Omega_i P_j}\right)^{(1-\sigma)} \quad (1)$$

where X_{ij} describes exports from countries i to j, while Y_iEj/Y represents the theoretical level of smooth trade between countries i and j if there were no trade costs, and $(\varphi_{ij}/\Omega_i P_j)^{(1-\sigma)}$ represents the comprehensive effects of trade costs that cause a difference between realized and smooth trade.

According to Baldwin and Taglioni (2014), the gravity model works well for bilateral trade in all goods, final goods, and intermediate inputs when the evaluation encompasses a large number of countries. Furthermore, Greaney and Kiyota (2020) also observe that the structural gravity equation functions very well in representing bilateral trade in final goods and intermediate inputs.

The most common method of calculating the gravity model is to make it linear by taking logarithms, then estimating the resultant log-linear model using Ordinary Least Squares (OLS). This strategy, while being simple to construct, in the existence of heteroskedasticity, the log-linearized model's OLS estimator can be both biased and inefficient. Another issue with log-linearization is that it is inconsistent with the presence of zeros in trade data, which has resulted in a number of undesirable solutions, such as removing the zero-trade pairs from the sample, adding small numbers, and further nonlinear modifications of the dependent variable.

To solve these problems, Silva and Tenreyro (2006) recommended employing the Poisson Pseudo Maximum Likelihood (PPML) estimation approach to estimate the gravity model straight from the multiplicative form. Silva and Tenreyro (2006) show significant evidence that estimate methods based on the log-linearization of the gravity equation suffer from serious misspecification, which makes it difficult to discuss the findings, regardless of whether fixed effects are employed in the model specification,

as Anderson and Van Wincoop (2003) recommended. Meanwhile, PPML-estimated models exhibit no symptoms of misspecification. This method was used on cross-sectional data at first, and, afterward, using panel data, Westerlund and Wilhelmsson (2011) investigated the impact of using both OLS and PPML techniques on gravity equation estimates on simulated and actual data. They also come to the conclusion that Poisson estimation is preferable; furthermore, they specifically recommend using Poisson fixed effects estimation to estimate the gravity equation.

The primary objective of the present study is to determine whether the use of TiVA data instead of gross trade data in gravity model applications produces different outcomes, especially when categorizing countries based on their income levels. Another aim is to explore the extent to which trade from these two country groups responds to cost factors in the gravity model. To achieve these objectives, two major databases were utilized in this study. The first one is the CEPII database, which provides data on trade cost variables used in the gravity model estimations. The second one is the TiVA database, jointly created by the OECD and WTO, which contains data on both gross trade and value-added trade from a total of 66 countries, including 38 OECD and 28 non-OECD nations, covering the period from 1995 to 2018. In this study, these 66 countries were grouped into two income categories, namely, high-income countries (HIC) vs. low- and middle-income countries (LMIC), resulting in two panel data covering the period from 1995 to 2018, with 43 (43 exporters, 66 importers) and 23 (23 exporters, 66 importers) nations in the HIC and LMIC groups, respectively. Table 1 represents the list of variables and their sources.

Table 1. List of variables and sources

Variable	Name of variable	Source of variable
X	Export	OECD-TiVA
DIST	Distance	CEPII
CNTG	Contiguity	CEPII
LANG	Language	CEPII
CLNY	Colony	CEPII
RTA	Regional Trade Agreement	CEPII

Source: own construction

In this study, I follow the recommendations of Yotov et al. (2016) and employ the methodology used in Fertő et al. (2022). Thus, first, the panel data with a 3-year interval were utilized in OLS estimations with fixed effects as the initial step to overcome outward and inward multilateral resistance terms, as described in formula (2):

$$lnX_{ij,t} = \pi_{i,t} + \chi_{j,t} + \beta_1 lnDIST_{ij} + \beta_2 CNTG_{ij} + \beta_3 LANG_{ij} + \beta_4 CLNY_{ij} + \beta_5 RTA_{ij} + \varepsilon_{ij,t} \quad (2)$$

where the natural logarithm of bilateral trade from exporting country *i* to importing country *j* at time *t* is shown as $lnX_{ij,t}$. Additionally, the natural logarithm of the geographical distance between the two countries is represented as $lnDIST_{ij}$, while the presence or absence of a shared border, official language, historical colonial ties,

and regional trade agreement are captured through dummy variables known as $CNTG_{ij}$, $LANG_{ij}$, $CLNY_{ij}$, and RTA_{ij}, respectively. In the meantime, the exporter- and importer-time fixed effects, denoted as $\pi_{i,t}$ and $\chi_{j,t}$ respectively, serve to manage both observed and unobserved characteristics associated with exporters and importers that can influence bilateral trade. Finally, $\varepsilon_{ij,t}$ is error term. In addition, I used the PPML approach, which is the most recommended, as depicted in equation (3):

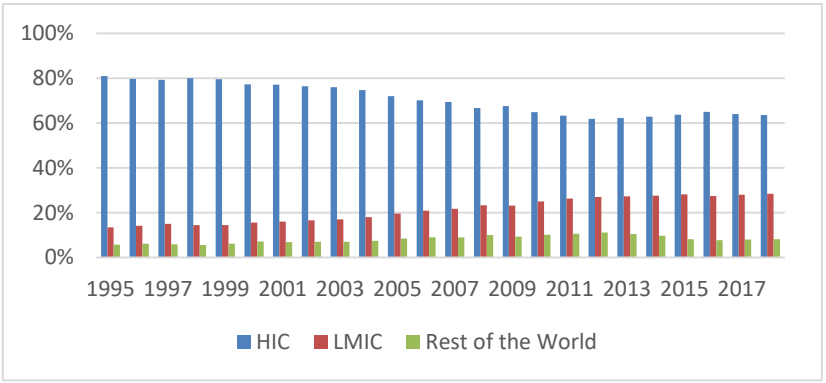
$$X_{ij,t} = exp(\pi_{i,t} + \chi_{j,t} + \beta_1 lnDIST_{ij} + \beta_2 CNTG_{ij} + \beta_3 LANG_{ij} + \beta_4 CLNY_{ij} + \beta_5 RTA_{ij}) \times \varepsilon_{ij,t} \quad (3)$$

PPML method is employed due to its ability to address heteroscedasticity and the challenges of zero trade flow in bilateral trade. In order to apply this method, exporter- and importer-time fixed effects are included in estimation (3), in a multiplicative form. Additionally, to ensure the robustness of the results, the same procedures were repeated using a 5-year interval.

4. Results

Prior to analyzing the calculation results, it is worth examining the extent to which sample countries are represented in global trade. Proportions of total domestic value-added exports of HIC, LMIC, and the rest of the world countries in international trade from 1995-2018 are illustrated in Figure 2. Despite HICs having the largest share of global trade throughout the period, their proportion dropped gradually from 81% to 62% by 2012 and then remained stable at around 64%. On the other hand, the share of LMICs in international trade increased steadily from 13% to 28%, with China playing a crucial role in this increase. Meanwhile, the proportions of exports from the rest of the world, which includes more than 130 countries, fluctuated between 6% and 11% during the given period. Thus, the chosen sample in this study represents the overwhelming majority of the world trade.

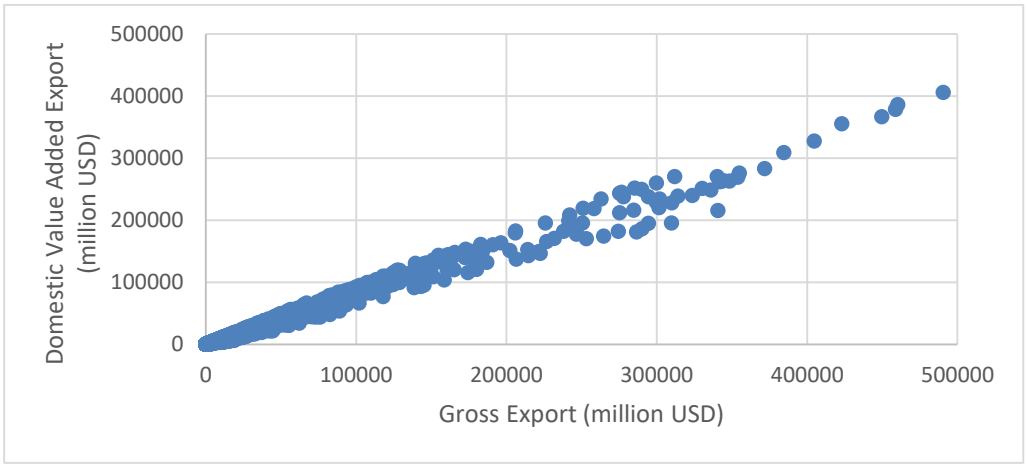
Figure 2. Shares of total domestic value-added exports of HIC, LMIC, and rest of the world in international trade from 1995 to 2018



Source: own construction based on OECD-TiVA database

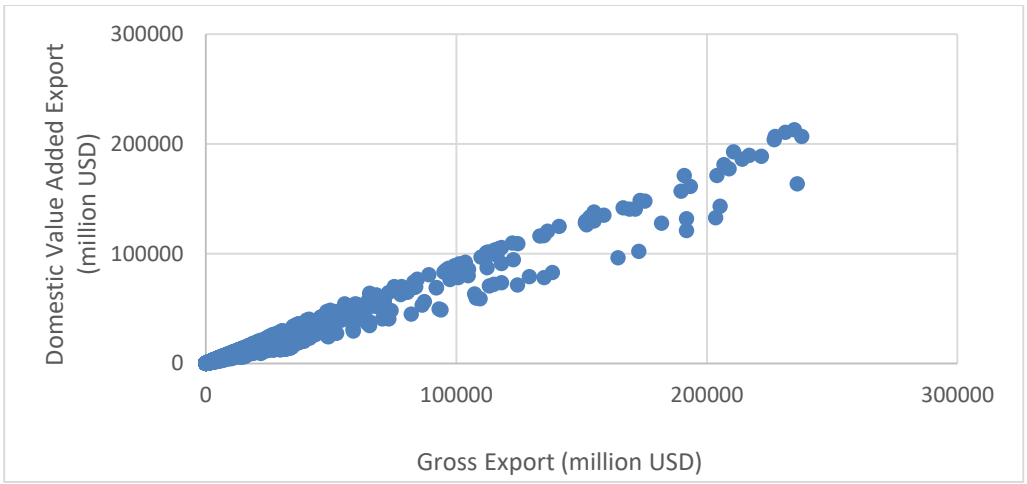
The relationship between domestic value-added export data and gross export data for both HICs and LMICs is depicted in Figures 3 and 4, respectively. As shown in both figures, there is a robust and positive correlation between the two types of data. This implies that value-added exports and gross exports move closely together in both country groups. However, there is a noticeable discrepancy in the export data for HICs in the middle range, as depicted in Figure 3, while in the case of LMICs, it is observable in the lower range, as seen in Figure 4.

Figure 3. Relationship between domestic value-added exports data and gross exports data for HICs, 1995-2018



Source: own construction based on OECD-TiVA data

Figure 4. Relationship between domestic value-added exports data and gross exports data for LMICs



Source: own construction based on OECD-TiVA data

Table 2 presents the findings of my research in comparison to the study conducted by Fertő et al. (2022). The first four columns of the table showcase the results of Fertő et al. (2022) for a total of 66 countries, whereas the following four columns display my findings for 43 high-income countries and the final four columns depict the results for 23 low- and middle-income countries. The results in the table aim to determine whether there are any differences between the traditional gross export (GE) data and the domestic value-added exports (DVA) data of TiVA when used in gravity model estimations employing OLS fixed effects (FES) and PPML methods.

Table 2. Research results for the 3-year interval in comparison to the results of Fertő et al. (2022)

	Fertő et al. (2022)				HIC and LMIC with 3-year interval							
	GE		DVA		HIC GE		HIC DVA		LMIC GE		LMIC DVA	
	FES	PPML	FES	PPML	FES	PPML	FES	PPML	FES	PPML	FES	PPML
Distance	-0.950**	-0.674**	-0.945**	-0.655**	-0.944**	-0.629**	-0.941**	-0.611**	-1.021**	-0.748**	-1.010**	-0.739**
	(0.011)	(0.012)	(0.011)	(0.012)	(0.013)	(0.013)	(0.013)	(0.014)	(0.019)	(0.022)	(0.019)	(0.023)
Contiguity	0.305**	0.224**	0.312**	0.238**	0.367**	0.354**	0.373**	0.359**	0.348**	0.078+	0.363**	0.108*
	(0.035)	(0.025)	(0.034)	(0.026)	(0.042)	(0.028)	(0.041)	(0.029)	(0.058)	(0.043)	(0.058)	(0.044)
Language	0.446**	0.185**	0.449**	0.194**	0.385**	0.124**	0.389**	0.146**	0.497**	0.227**	0.500**	0.227**
	(0.022)	(0.027)	(0.022)	(0.028)	(0.026)	(0.031)	(0.026)	(0.032)	(0.038)	(0.041)	(0.037)	(0.042)
Colony	0.519**	-0.026	0.518**	0.009	0.616**	0.088	0.604**	0.099	0.471**	0.008	0.479**	0.087
	(0.048)	(0.074)	(0.047)	(0.072)	(0.060)	(0.087)	(0.059)	(0.083)	(0.075)	(0.117)	(0.075)	(0.111)
RTA	0.174**	0.244**	0.171**	0.253**	0.191**	0.300**	0.191**	0.304**	0.127**	0.174**	0.117**	0.185**
	(0.018)	(0.026)	(0.018)	(0.027)	(0.025)	(0.030)	(0.025)	(0.032)	(0.029)	(0.048)	(0.029)	(0.051)
Constant	5.004**	7.067**	5.061**	6.659**	5.322**	11.622**	5.146**	11.295**	5.535**	11.668**	6.188**	11.434**
	(0.334)	(0.278)	(0.361)	(0.283)	(0.423)	(0.417)	(0.430)	(0.424)	(0.431)	(0.349)	(0.366)	(0.345)
Observations	34180	34320	34135	34320	22280	22360	22261	22360	11900	11960	11874	11960
R2	0.900	0.916	0.900	0.915	0.905	0.925	0.904	0.923	0.901	0.944	0.902	0.946
Exporter-time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Importer-time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
RESET test (p-value)	0.0000	0.1127	0.0000	0.1582	0.0000	0.0002	0.0000	0.0009	0.3377	0.0000	0.6146	0.0000

Standard errors in parentheses

*+ p<0.10, * p<.05, ** p<.01"*

Source: own construction based on Fertő et al. (2022) and own computation

In view of the data in Table 2, it is evident that the differences between the two datasets are negligible for both categories of countries based on their income levels. Additionally, the signs of variables align with expectations: distance negatively impacts exports, while factors such as contiguity, language, colonial history, and regional trade agreements positively affect exports for both country groups. Apart from the colony in PPML, the results are statistically significant. The insignificant result for the colony can be attributed to the declining influence of colonial impact. My findings are consistent with those of Fertő et al. (2022). Moreover, it is worth mentioning that, aside from the RTA variable, the variable coefficients obtained through the PPML approach are lower compared to those of the OLS FES method. To further test the robustness of the results, the calculations are repeated at 5-year intervals, and the results are presented in Table 3. The recalculation affirms that the differences remain minor. However, this time not only the colony but also the contiguity indicator in the PPML method for LMICs produced insignificant results, while all the signs remained as expected when it is calculated in a 5-year interval.

Furthermore, this investigation provides insights into the impact of cost variables on the exports of countries belonging to various income categories. As per

the findings presented in Table 2, LMICs are more sensitive to distance and language factors than HICs. Specifically, the exports of LMICs display a greater negative response to increasing distance and a more positive response to sharing the same language than those of HICs. In contrast, HICs benefit more from sharing a border, having a shared colonial history, and being part of a regional trade agreement, all of which have a more favorable impact on their exports than on those of LMICs.

Table 3. Research results for the 5-year interval

	HIC GE		HIC DVA		LMIC GE		LMIC DVA	
	FES	PPML	FES	PPML	FES	PPML	FES	PPML
Distance	-0.937**	-0.634**	-0.933**	-0.615**	-1.008**	-0.761**	-0.995**	-0.753**
	(0.016)	(0.017)	(0.016)	(0.018)	(0.024)	(0.028)	(0.024)	(0.029)
Contiguity	0.365**	0.349**	0.370**	0.354**	0.355**	0.052	0.376**	0.083
	(0.052)	(0.036)	(0.052)	(0.037)	(0.074)	(0.054)	(0.073)	(0.056)
Language	0.372**	0.128**	0.379**	0.150**	0.494**	0.239**	0.499**	0.239**
	(0.032)	(0.040)	(0.032)	(0.041)	(0.047)	(0.052)	(0.047)	(0.054)
Colony	0.624**	0.104	0.611**	0.115	0.482**	0.022	0.481**	0.109
	(0.075)	(0.111)	(0.075)	(0.107)	(0.092)	(0.156)	(0.092)	(0.146)
RTA	0.208**	0.302**	0.210**	0.309**	0.133**	0.133*	0.122**	0.143*
	(0.031)	(0.039)	(0.031)	(0.041)	(0.037)	(0.059)	(0.037)	(0.062)
Constant	13.575**	11.670**	5.166**	11.328**	13.020**	12.004**	6.059**	11.773**
	(0.271)	(0.436)	(0.432)	(0.445)	(0.315)	(0.520)	(0.389)	(0.526)
Observations	13925	13975	13919	13975	7445	7475	7426	7475
R2	0.905	0.922	0.905	0.920	0.903	0.943	0.904	0.944
Exporter-time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Importer-time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
RESET test (p-value)	0.0000	0.0006	0.0000	0.0024	0.739	0.0000	0.3126	0.0000

Standard errors in parentheses

** p<.05, ** p<.01"*

Source: own computation

5. Conclusion

To conclude, the concept of Global Value Chains has gained widespread popularity as a tool to examine the structural transformations taking place in the world economy. Incorporating imported intermediate products into exports is a crucial element of the manufacturing process, leading to gross exports being significantly higher than their domestic value-added counterpart. The concept of trade analysis based on value added is a relatively new method that has gained significance in studying international trade. Meanwhile, the concept of gravity models in international trade has been consistent over time and across nations. The models have been developed from the basic notion of trade flow between countries that is directly proportional to their GDP and inversely proportional to the trade barrier in the form of distance between them. Nowadays, the structural gravity model is the most commonly used method to calculate gravity models.

The study aims to determine whether the use of TiVA data instead of gross trade data in gravity model applications produces different outcomes, especially when categorizing countries based on their income levels, and explores the extent to which

trade from these two country groups responds to cost factors in the gravity model. The study employs panel data with 3-year and 5-year intervals and uses OLS estimations with fixed effects to overcome outward and inward multilateral resistance terms, and the PPML method to overcome heteroscedasticity and the challenges of zero trade flow in bilateral trade. In general, the results show that high-income countries had the largest share of global trade, while their proportion decreased gradually over time, while the share of low- and middle-income countries in international trade increased steadily, with China playing a crucial role in this increase. The study has also found that there is a robust and positive correlation between the two types of data, and the differences between the two datasets are negligible for both categories of countries based on their income levels. These results coincide with the findings of Fertő et al. (2022). The findings have further revealed that LMICs are more sensitive to distance and language factors than HICs, while HICs benefit more from sharing a border, having a shared colonial history, and being part of a regional trade agreement. Overall, the study provides valuable insights into the impact of various factors on the exports of countries belonging to different income categories. It is possible that greater differences may emerge when examining results at the industry level, and further research in this area could be fruitful.

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The future of banking or the concept of sustainability in the banking sector

Veronika Siklósi – Zsuzsanna Széles

Hungarian commercial banks have been required to publish their sustainability report since 2017. The research topic focuses on the analysis of ESG disclosure at international commercial banks in Hungary based on the data of the annual reports published from 2019 to 2021. This study reports on empirical research using the method of detailed reading and manual coding after reviewing the literature. The concept of sustainability is introduced, focusing on the banking sector and the quality level of disclosures, the changes, and the progress from 2019 to 2021 as the result of the research is discussed. The European Green Deal Investment Plan and the Just Transition Mechanism was announced in January 2020. The effect of the European Green Deal and the opportunity of green investments within the framework to the ESG disclosure quality level are also discussed in the paper.

Keywords: ESG performance, sustainability, sustainable finance, sustainability-related disclosure, bank
JEL Codes: G21, G32, O16

1. Introduction

Sustainability has become the key word of the banking sector nowadays. Given that Hungarian commercial banks have been required to publish their ESG report since 2017, the concept of sustainability in banking sector has received a lot of coverage recently. Since 2020, more emphasis has been placed on bringing ESG disclosures to the public. The appearance of the "green viewpoint" is quite different in the different economic areas, but a significant transformation can be seen in the case of financial institutions (Baranyi et al., 2022).

The primary goal of sustainability reports is to present quality information for both internal and external stakeholders, to help their investors, customers, shareholders etc. make substantial decisions. Based on the examination, the ESG factors had a positive impact on profit as well, therefore it can be considered as an aspect which the banks, the investors and the regulators should also address (Tóth et al., 2021). Considering the result of the research by Lupu et al. (2022), the financial stability of European banks listed on stock exchanges are influenced by their ESG scores (Lupu et al., 2022).

The topic of this study is the analysis of ESG disclosure at international commercial banks in Hungary, based on the data of the annual reports published from 2019 to 2021. We apply content analysis methodology on international commercial banks in Hungary subject to mandatory reporting under the European Union (EU) Directives and the Hungarian Accounting Act (HAA).

The research methodology is structured in three main subsections. The first relates to the data collection and sample process, the second corresponds to the ESG

score computation based on content analysis, and a third section refers to the empirical approach, how the ESG reporting quality measured by a combined index was determined by the authors.

One of the authors worked at an international bank for more than 20 years. She aimed to examine the sustainability efforts of the banks and the development of the ESG disclosures. In what direction has the quality of ESG disclosures changed in the banking sector since 2019? What impact has the Green Deal Investment Plan and the Just Transition Mechanism had on ESG disclosures in the banking sector? Our hypothesis is that the quality of the international commercial banks' ESG disclosure in Hungary improved from 2019 to 2021.

2. Literature review

The United Nations (UN) World Commission on Environment and Development, i.e. the Brundtland Commission, was the first to deal directly with the issue of sustainability, to draw attention as early as 1987 to the need to protect the environment and to generate solutions, to achieve economic growth both socially keeps environmental sustainability in mind (Gyulai, 2013). By the concept of environment we mean the place where we live, and development is the totality of all the processes by which we try to improve our situation and make our environment more livable (Clark–Harley, 2020). On the one hand, the United Nations Educational, Scientific and Cultural Organization (UNESCO) determined 4 main areas of sustainability: society, environment, culture, and economy, on the other hand, the Sustainability report of Budapest Stock Exchange (BSE) described it from the acronym ESG, Environmental, Social, and Governance. According to Table 1, we interpret the main areas of sustainability primarily from the point of view of a business manager, which is not far from the concepts accepted internationally and, in our country, Hungary as well.

Table 1. Definition of sustainability

Environmental	**Social**	**Governance**
Climate change	Employees	Management board composition
Air pollution	Communities	Working culture
Dearth of sources	Diversity	Legal compliance
Energy consumption	Integrity	Information sharing
Waste management	Health (care)	Business operations

Source: own construction based on BSE (2021)

Before the ESG intentions were launched, the financial reports were the basis for economic decisions of the internal and external actors of a company. The quality of the financial statements was very important even then (Tóth–Széles, 2018). The primary goals of companies were mainly driven by business interests until the 1980s.

Maximization of return on assets and equity and responsibility for economic, social and governance efforts were put into a framework by Carroll in 1999. Carroll's pyramid imposes a four-part definition of corporate social responsibility (CSR) which is to be socially responsible, a business must meet economic, legal, ethical, and philanthropic expectations given by society at a given point in time. Organizational innovation as a mediator and corporate image as a moderator were incorporated in the modified conceptual model of Carroll's pyramid later.

The study of Lu et al. (2020) examined Carroll's pyramid model in small and medium-sized enterprises (SMEs) as an effective business strategy for organizational performance enhancement in industry of developing countries which are in the initial phase of Industry 4.0 advance. They conducted a study among small and medium-sized enterprises (SMEs) operating in the Pakistani manufacturing sector in 2020, based on a total of 888 valid responses, using a process modelling approach, and concluded that the dimensions of the modified Carroll's CSR pyramid have a reinforcing and positive effect on the industrial on the organizational performance of small and medium-sized enterprises, if they define these dimensions in their innovation strategy (Lu et al., 2020).

Based on the research conducted in 2020, Clark and Harley have identified six capacities necessary to support such interventions in guiding development pathways toward sustainability. These are capacities to (a) measure sustainable development, (b) promote equity, (c) adapt to shocks and surprises, (d) transform the system into more sustainable development pathways, (e) link knowledge with action, and (f) devise governance arrangements that allow people to work together in exercising the other capacities (Clark–Harley, 2020).

Whose responsibility is it to consider competitiveness and sustainability within the company? Whose responsibility is the responsibility attributed to the company? According to Friedman (1970), because of the fact that the manager is an employee of the owner, they must follow the owner's values, so their responsibility can only extend to the maximization of shareholders' possessions. We agree with Friedman, but we would not define return on asset and equity as the only goal of the shareholders. Sustainable efforts are included in the policy of the companies by more and more managers, these goals are displayed in the annual non-financial reports of both the public-interest entities (inclusive banks considering NFRD Directive 2014/95/EU) and SMEs.

In 2018, Hoffmann et al. examined the ESG reports of 522 German companies published in 2014, 2015 and 2016. They concluded that the quality of ESG information improved when the company presented it in a separately published non-financial report, compared only in the audited report. According to them, a stricter selection and linking of financial and non-financial information is needed. Based on research, the description of the policies about monitoring of the relevant cases and about risk management was defined as one of the additional development areas (Hoffmann et al., 2018).

The research conducted by Cosma et al. (2020) is the basis for exploring the relationships between the European financial sector and sustainable development. The non-financial disclosure analysis of 262 European banks pointed out that the country of origin, the legal system and the adoption of the integrated report have a significant

impact on the banks' ESG disclosure, while the business model and the stock exchange listing do not seem to represent the realization of the banks' Sustainable Development Goals (SDGs) (Cosma et al., 2020).

Based on the analysis of 37 large corporate non-financial reports highlighted an additional problem however certain activities of companies can affect sustainable development in both positive and negative directions, the reports show only the positive aspects (Zsóka–Vajkai, 2018). The Alliance for Corporate Transparency examined thousand companies in 2019, and they shed light on significant differences of ESG disclosures in the non-financial reports according to what subtopics and how detailed form are provided the main topics. Analysis by The Alliance for Corporate Transparency also highlights that 36.2% of all companies report climate-related objectives, and only 36.4% set specific targets. Only 20.5% of the companies in the financial sector published specific goals related to climate change according to this analysis, which means the lowest ratio is in this sector (Boros et al., 2022).

Based on the content analysis of non-financial reports, ESG risks are not integrated into the risk management process, and there is no dedicated department within organigram of the banks. Since there are variable integrated standards, and their content is not clearly defined, the information in the reports is multivarious and heterogeneous according to a Hungarian study published in 2020. The biggest problem is the lack of determining of the framework, according to the authors of the study (Tamásné Vőneki–Lamanda, 2020).

Akomea-Frimpong et al. reviewed existing studies on green finance in the context of the banking sector, using the content analysis approach to critically analyze and summarize forty-six relevant studies. According to the results, green securities, green investments, climate financing, carbon dioxide financing, green insurance, green credit, and green infrastructure bonds are a part of key green finance products of banks (Akomea-Frimpong et al., 2022).

However, the investors may not be able to identify a clear link between the green bond issued by a financial institution and a specific green investment project at the time of issue, according to another study (Fatica et al., 2021). Hungarian authors note that banks do not set the ESG aspects in their lending policy (Tamásné Vőneki–Lamanda, 2020).

Rannou et al. (2021) show that power firms have used the green bond market as a complement to the carbon futures market used for their short-term hedging or speculative activities. Instead, they have employed the green bond market as a substitute for the carbon futures market used for their long-term hedging activities since 2018, and their results shed light on a pivotal change in the behavior of European power firms that progressively abandon the carbon market to issue more green bonds in order to finance their transition to clean energy production systems.

Another study, Chang et al. (2022), explores the asymmetric green finance-environmental quality nexus in the top 10 countries that support green finance. Green bonds and ecological footprint are used as proxies for green finance and environmental quality, respectively. Past studies employed panel data approaches, yielding typical results regarding the relationship between green finance and the environment, even though many countries did not establish such a correlation on their

own. Green financing improves environmental quality in 8 out of 10 selected economies according Chang et al. (2022).

3. Data collection and sample

3.1. Specifying of the data

Based on the Non-Financial Reporting Directive (NFRD), EU Directive 2014/95/EU (on amendments to EU Directive 2013/34/EU), we defined the banks to be investigated. The analysis is focused on the international commercial banks in Hungary. A requirement for public-interest entities (with more than 500 employees) based on the above regulations that they have to share specific information about their operations, and how they manage social and environmental challenges in order to make it easier for investors, consumers, political decision-makers and assist other stakeholders in evaluating the non-financial performance of these companies. The Hungarian Accounting Act (HAA) C. of 2000 regulates the disclosure of non-financial reports to be published by local entities based on the above-mentioned EU Directives. The HAA requires firms to disclose environmental information.

In the study, we focused on the subsidiaries of international banks specifically, excluding companies with only Hungarian owners. Based on the 2020 audited reports, we examined the banks with more than 500 employees. Hence, of the 34 banks considered at first, only 6 were left in the final sample used for the ESG score analysis. First, banks with less than 500 employees were excluded, because our aim to observe the ESG scores subject to NFRD, second, the Hungarian-owned banks were excluded, and, finally, banks operating as Hungarian Branches were excluded. We are focusing the Hungarian foreign-owned commercial banks, but we would not exclude OTP Bank from the sample because of its cross-border services and considerable role both in Hungary and the CEE Region.

After applying the selection criteria, the remaining banks are listed in Tables 2 and 3. Based on the above, Table 2 shows the remaining banks by name, by number of employees, and by total assets. Table 3 shows bank groups related to the examined Hungarian subsidiaries by name.

Table 2. The examined banks

Name of the bank in Hungary	Number of employees	Total Assets (billion HUF)
CIB Bank Zrt.	2,133	2,415.67
Erste Bank Zrt.	2,984	4,178.20
Kereskedelmi és Hitelbank Zrt.	3,118	5,248.42
Raiffeisen Bank Zrt.	2,374	3,825.23
UniCredit Bank Hungary Zrt.	1,689	4,580.54
OTP Bank Nyrt.	10,189	11,492.95

Source: own construction based on the audited reports of the banks (2020)

Table 3. The examined bank groups

Name of the bank in Hungary	Name of the bank group in the EU
CIB Bank Zrt.	Intesa Sanpaolo Group
Erste Bank Zrt.	Erste Group
Kereskedelmi és Hitelbank Zrt.	KBC Group
Raiffeisen Bank Zrt.	Raiffeisen Group
UniCredit Bank Hungary Zrt.	UniCredit Group
OTP Bank Nyrt. (OTP Core)	OTP Group

Source: own construction based on the audited reports of the banks (2020)

We focus on the time frame of 2019–2021. After identifying the banks, several screens were applied in selecting the final sample. First, we checked for the availability of the banks' reports in English or in Hungarian on their websites. To this respect, all types of reports were considered, from sustainability, CSR and TCFD reports to annual financial and non-financial reports published on their websites. Second, if individual data were not available, the group reports were used instead.

ESG Score computation based on content analysis was a big challenge because of the manual coding. Research of ESG disclosure shows similarity to research into brain capital' disclosures. Brain capital is a subset of non-financial information (Stolowy–Paugam, 2018). On one hand, an advantage of this method is the final interpretation of explicit content by the researcher, whereas on the other hand, it is time-consuming due to the large number of written documents, as is shown in Table 4.

Table 4. Processed disclosures

Year	Number of pages of ESG disclosure (Group level)	Number of pages of ESG disclosure (Hungarian institution)	Total number of pages of ESG disclosure
2021	1,234	230	1,464
2020	976	214	1,190
2019	712	84	796
Total	2,922	528	3,450

Source: own construction based on the ESG reports of the banks (2019-2021)

Many authors argue for the detailed reading and manual coding and against software coding in case of content analysis (Beattie–Thomson, 2007; Elshandidy et al., 2018). First, however, it is objective and fast to use software solutions, but it is better to interpret company-specific terms and ambivalent words (Dumay–Cai, 2014; Guthrie, 2014; Kovács et al., 2021) in case of manual coding. Second, we have no software to provide the same accuracy as the detailed reading and manual coding.

Nevertheless, we investigate the documents by detailed reading instead of using software solutions.

3.2. ESG Score computation

First, we defined two indices based on the assigned score and the maximum number of points per category, as follows I1=(P1/2) x 100, I2=(P2/3) x 100, where P is the number of points assigned to the entities in the respective categories. The maximum score was 1 per item in I1 and I2 indices. After the received records, we decided to define another new index. The maximum score was four per item in I3 indices as follows I3=(P3/16) x 100.

So a maximum score is 21 per report in this alternative scoring method, which meant that the entity provided narrative, qualitative and graphic information on all 9 items from the list.

Following Li et al. (2008), the scoring is calculated as follows: 0 no presentation, 1 narrative presentation and/or presentation using KPIs and/or other numerical/quantitative data and/or graphic illustration.

Index 1, which takes the value of 1 if the banks' ESG disclosure's audit was conducted by one of the so-called Big Four companies (Manes-Rossi et al., 2018), and 1 if the bank has ESG report on group level, takes the value of 2 if both of these conditions are right, and 0 otherwise. Several ESG reporting requirements, including frameworks, national and international regulations, and voluntary standards were published in recent years. Two of the most important ESG standards are the Global Reporting Initiative (GRI) Standards, and the Sustainable Accounting Standard Board (SASB) Standards. We would like to highlight the importance of Task Force on Climate-related Financial Disclosures (TCFD) framework, related on the environmental risks, which is another aspect to consider during the decision-making processes. That is the reason why Index 2 measures the disclosure of these standards and TCFD framework. Index 2, which takes the value of 1 if the bank published GRI standard, and 1 if the bank published SASB standard, and 1 if the bank published risks based on TCFD framework, takes the value of 2 if two of these conditions considering the standards are right, and takes the value of 3 if three of these conditions considering the standards are right and 0 otherwise.

Index 3 takes the maximum value of 16 if the bank published all of the 4 chosen sustainability rating by authors (MSCI, CDP, Sustainanalytics, FTSE) and all of the rating are in the top category.

The detailed scoring defined generally as follows: the first item takes the value of 1 if the bank provides the information about its listing by the rating organization but without published rating, or the rating is in the fourth quartile; it takes the value of 2 if the published rating is in the third quartile; it takes the values of 3 if the published rating is in the second quartile; and it takes the values of 4 if the published rating is in the first quartile.

To evaluate the overall ESG disclosure quality, we calculated the following combined index, Icombined = (I1+ I2+ I3)/3, which is the ESG reporting quality (Q) in our research.

3.3. Empirical approach

We applied four levels of reporting quality based on Avram et al. (2018) and Agostini et al. (2022): 0 is no disclosure, 1–30% is low-quality disclosure, 31-70% is medium-quality disclosure, and 71–100 is high-quality disclosure. Our results are shown in Tables 5 and 6.

Table 5. ESG reporting quality of the examined banks based on our specified indices

2021	**Bank 1**	**Bank 2**	**Bank 3**	**Bank 4**	**Bank 5**	**Bank 6**	**Average**	**Deviation**
Index 1	100.00	100.00	100.00	50.00	100.00	100.00	91.67	20.41
Index 2	100.00	100.00	66.67	100.00	66.67	66.67	83.33	18.26
Index 3	50.00	62.50	62.50	87.50	18.75	37.50	55.21	22.51
Combined index	83.33	87.50	76.39	79.17	61.81	68.05	76.74	9.04
ESG reporting quality	High	High	High	High	Medium	Medium	High	

2020	**Bank 1**	**Bank 2**	**Bank 3**	**Bank 4**	**Bank 5**	**Bank 6**	**Average**	**Deviation**
Index 1	100.00	100.00	100.00	50.00	100.00	100.00	91.67	20.41
Index 2	100.00	66.67	66.67	100.00	33.33	66.67	72.22	25.09
Index 3	50.00	62.50	62.50	87.50	0.00	37.50	50.00	29.58
Combined index	83.33	76.39	76.39	79.17	44.44	68.06	71.3	14.07
ESG reporting quality	High	High	High	High	Medium	Medium	High	

2019	**Bank 1**	**Bank 2**	**Bank 3**	**Bank 4**	**Bank 5**	**Bank 6**	**Average**	**Deviation**
Index 1	100.00	100.00	100.00	50.00	100.00	100.00	91.67	20.41
Index 2	100.00	33.33	33.33	66.67	33.33	66.67	55.56	27.22
Index 3	31.25	6.25	25.00	62.50	0.00	31.25	26.04	22.16
Combined index	77.08	46.53	52.78	59.72	44.44	65.97	57.75	12.43
ESG reporting quality	High	Medium	Medium	Medium	Medium	Medium	Medium	

Source: own construction

Table 6. ESG reporting quality based on our combined index on bank group level

Year	Intesa San Paolo Group	UniCredit Group	Raiffeisen Group	KBC Group	Erste Group	OTP Group
2019	High	Medium	Medium	Medium	Medium	Medium
2020	High	High	High	High	Medium	Medium
2021	High	High	High	High	Medium	High

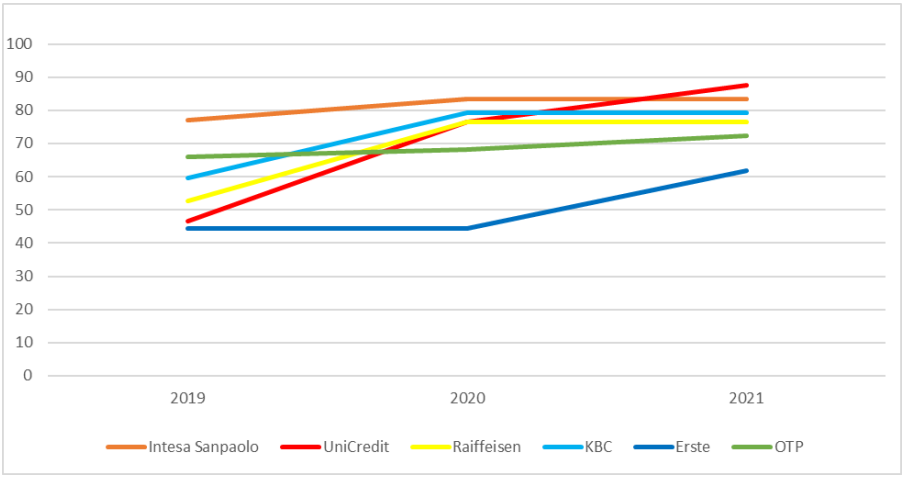
Source: own construction based on the ESG reports of the banks between 2016 and 2021

4. Results and discussion

Our hypothesis that the quality of the international commercial banks' ESG disclosure in Hungary improved from 2019 to 2021 was right based on our findings.

In 2020 was a supereminent point when the ESG disclosure average quality of the examined banks increased significantly, cf. Figure 1.

Figure 1. Quality of the ESG disclosure of international commercial banks in Hungary (2019-2021)



Source: own construction based on the ESG reports of the banks (2019-2021)

The European Green Deal Investment Plan and the Just Transition Mechanism were presented in January 2020. Climate change and pollution are a great threat to the world and to the EU as well. Overcoming these challenges will transform the EU into a modern, resource-efficient, and competitive economy, ensuring no net emissions of greenhouse gases by 2050, economic growth decoupled from resource use and no person, and no place left behind with the help of the European Green Deal framework. Our point of view is that the effect of the European Green Deal and the opportunity of green investments in amount of EUR 1.8 trillion within the framework contributed a visible increase in the average quality in 2020. The results can be interpreted as evidence for business efforts to achieve the ESG efforts. Entities

provide considerably more environmental information in the reports than earlier. 3 banks out of 6 increased ESG information quality, from medium to high-level from 2019 to 2020. Only two of the 6 have medium-level quality, four of the 6 are on high-level quality in 2020, and only one out of 6 has medium-level quality and five of the 6 are on high-level quality in 2021. Our hypothesis was right, there is an increase in the quality of ESG information in case of the examined banks from 2019 to 2021.

While roughly 80% of the examined banks published their ESG rating or ESG ratings given by rating organizations in 2020 (Siklósi, 2023), in 2021 all the groups we monitored already published at least one ESG rating given by an ESG organization.

Based on the results of the research by Korca et al. (2021), non-financial disclosure significantly increased in quantity after the regulation. However, the improvement in quality is fairly low, with the exception of themes relevant to the company under investigation. Looking at it hrough the lens of institutional theory, it emerges that an interplay of institutional mechanisms co-existed within the bank, during two periods of reporting for different topics of disclosure. Based on our research we can confirm that non-financial disclosure of the examined bank increased in quantity after regulation, so we agree with Korca et al. in this aspect, but we can strengthen the quality shows improving trend from 2019 till 2021 contrary to the above statement.

Nevertheless, there are more and more efforts to simplify the used standards in the non-financial reports, analysis and comparability remain difficult. The comparability of the international commercial banks' ESG disclosure in Hungary is not simple either after the first regulation or in 2021. As a retail client (as a consumer of a bank) we have to read and evaluate more than 1,400 pages to decide between 6 banks in 2021, which is a big challenge and not a simple task. But our combined index could help users to simplify the comparability process. Some of the conclusions found in the literature were confirmed and supplemented in some places based on our research, but during our work more and more questions arose in our minds. Our goal is to continue the research and explore further correlations based on the ESG reports of the examined financial institutions.

Like all empirical research, our study has several limitations which have to be considered while interpreting its results. First of all, the study is based on a limited sample, which was a consequence of concentrating on international banks subject to EU Directives in Hungary. This was also related to the fact that the sample selection did not take into account the companies, which have Hungarian Branches and the banks, which have mostly Hungarian owners. However, we covered the entire international banking community in Hungary subject to the EU Directives, nevertheless, domestic banks with mostly Hungarian owners and non-bank community should be considered as subjects of further research since they may become prominent participants in promoting sustainable practices by monitoring non-financial impacts. Second, subjectivity is an issue in any approach that involves textual or content analysis as a research method. This is also the case when dealing with data collection by hand, which is prone to biases. Further studies might focus on expanding the number of the banks within the EU.

Keeping in mind both economic and social development, only that which is sustainable in the long term can be competitive and vice versa. The concepts of sustainability and the concept of competitiveness have in common essentially that they cannot be based on quantitative growth but only on qualitative development and structural change (Matolcsy, 2020).

The quote by David Brower is timeless. "We don't inherit the earth from our ancestors, we borrow it from our children." We are confident that managers of companies including Board members of banks, in agreement with their owners will continue to keep their sustainability aspirations in mind, despite the challenges of the current economic environment, in line with the ESG regulations, and through the trend towards harmonization, with the aim to understand better and to compare easily for the stakeholders their non-financial reports (Siklósi, 2023).

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Difficulties and advantages of internationalization in the Hungarian SME sector

Daniel Simon – Regina Reicher

With globalization and the technological advancements of the 21st century, more and more organizations are utilizing the advantages of cross-border operations and global value chains. However, despite the fact that the SME sector forms the backbone of the Hungarian economy, the sector often faces difficulties of survival as smaller, only locally operating business are outperformed by large multinational companies flooding the market with more optimal, highly cost-effective supply chains. Research conducted within the Hungarian SME sector shows that internationalized small and medium sized businesses also outperform the only locally operating SMEs. Their performance and employment growth are, on average, higher, and they tend to be more resilient toward environmental difficulties as well. Despite the presumed advantages of internationalization, SMEs are facing critical challenges when it comes to cross-border activities. The aim of this study is to synthesize, on a comprehensive level, the available literature on the Hungarian SME sector and to provide a clear picture on the advantages and difficulties small and medium sized businesses are facing when it comes to foreign operations. The results of the synthetization provide a base for future research aiming to assist small and medium sized enterprises to improve their supply chains and to search for opportunities to easier access foreign markets.

Keywords: SME; internationalization; Hungary; efficiency

1. Introduction

Small and medium sized enterprises (SME) around the world are widely apparent and are contributing to the economy significantly (Chikán, 2008; Johanson, 1990; Kovács et al., 2017). Accelerating technological advancements and globalization pose a great challenge for smaller businesses as multinational organizations appear on the markets with highly optimized supply chains and lower production costs. Foreign market expansion is a lengthy, risky process that requires a prominent level of orientation. During this cross-border process the business tries to enter a previously completely unknown market, with an unfamiliar customer base, and a different culture (Éltető–Antalóczy, 2002a). Conquering a foreign market is a difficult, challenging process, which only a very small percentage of operating companies embark on. Despite the difficulties and apparent risks, the available literature claims that foreign activities of small and medium sized enterprises are leading to positive factors such as better performance and overall faster development compared to only locally operating SMEs. The experience gained on foreign markets provides higher experience which also leads to better, more thoughtful management, and higher resiliency during recession periods (Antalóczy

et al., 2000). Therefore, considering these positive aspects proves to be relevant to research the constraining factors which can hold back smaller and medium sized enterprises from entering foreign markets. Highlighting these limiting factors could later lead to critical information in determining the exact requirements of SMEs to help them access cross-border activities, increase their efficiency and possibly further develop the Hungarian economy.

The aim of this study is to perform an extensive literature review of the already existing research on the Hungarian SME sector in order to discover how small and medium-sized enterprises are thinking about possible cross-border activities. The goal of the study is to understand the difficulties, risks and restraining forces of internationalization in the Hungarian SME sector while also exploring the achievable positive aspects of foreign activities as well. The study aims to synthesize the factors which argue for and against international operation and to conclude the aspects in which the Hungarian smaller business sector would need more help to be able to execute foreign activities more confidently. The main research question of the paper, therefore, is what the main difficulties are which are holding back smaller and medium sized enterprises from entering foreign markets.

2. Literature review

The empirical literature review aims to discover and highlight the unique attributes of SMEs in Hungary, searching for evidence that would provide sufficient information towards highlighting the positive and constraining aspects of stepping out to a foreign market while understanding and synthetizing the difficulties and fears SMEs are experiencing towards foreign activities.

2.1. Methodology and constraints

The construction of the chosen research methodology is approached based on Mark Sunders' Research Onion (2009). The study utilizes the view of the research philosophy of interpretivism. The aim of the study is to draw synthesizing conclusions based on small samples, in-depth investigations, and qualitative measures. The study focuses on details of given situations and aims to explore the root causes of given constraining factors. The field in this article is viewed from a deductive point of view. The territory is processed based on a comprehensive literature review and synthetization of previously performed in-depth data gatherings of researchers highlighted through the text (Saunders et al., 2009).

The comprehensive, systematic literature review is performed by the utilization of the prism literature reviewing technique. The approach was chosen to ensure an extensive overview of the high-quality literature available on the researched field both in English and Hungarian. During the literature review Elsevier's Scopus was utilized as a baseline. Keywords of "SME" and "Internationalization" searched in article title, abstract, and keywords provides a base number of 779 publications published between 1990 and 2022. While the common literature on internationalization is rather broad, the search could be further limited to publications highlighting positive and constraining factors especially for SMEs in regards of

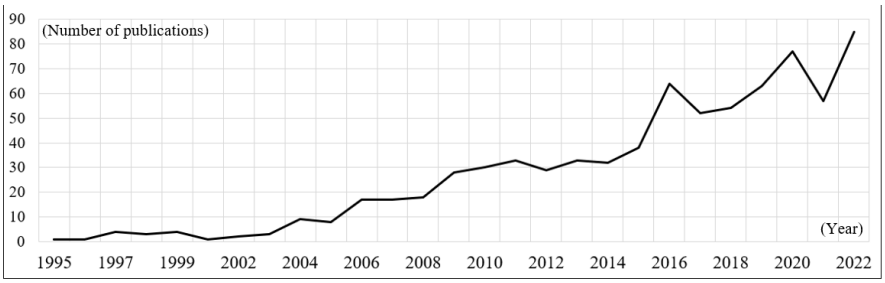
stepping out to foreign markets. Following the steps of the prism model, removing the duplicates, performing keyword, title, and abstract screening the number of strictly connecting articles could be reduced to 13 publications in Scopus.

The constraints of the literature review are the accessibility of the Hungarian literature on the researched field. Utilizing Google Scholar with a snowball technique from the first 250 most matching publications, 18 were chosen to be contributing to the research question in Hungarian language. While the snowball methodology outlines the most common, overall conclusions of the researched field, it cannot be claimed that the totality of the publications on the field were successfully accessed and synthesized.

Therefore the following sections provide a synthetization of the international literature accessed from Scopus and results of Hungarian researchers performed especially amongst the Hungarian SME sector. The literature review briefly highlights the most common concerns regarding internationalization and cross-border activities followed by the review of difficulties of stepping out to foreign markets based on experience gathered from the Hungarian SME sector.

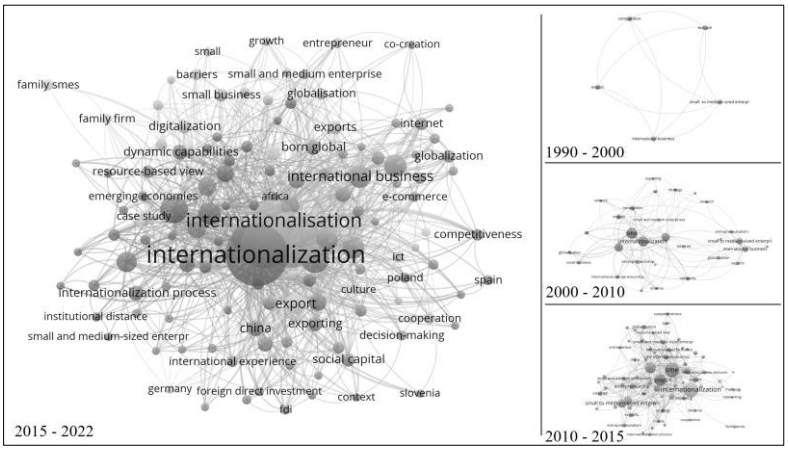
The given positive opportunities provided by the possible exploration and utilization of international value chains is a more and more commonly researched field which can be highly important for the SME sector as well. The relevance of the researched topic is also showcased by the increasing number of publications apparent in the field in the recent years. Figures 1 and 2 show analytics of the database of Scopus highlighting the growing number of researches and the connection system between keywords used in publications on the field of internationalization of the SME sector.

Figure 1. Number of articles published on the field of SME internationalization between 1990 – 2022



Source: own construction based on Scopus database

Figure 2. Development of key words used on the field of SME internationalization between 1990 – 2022 (Scopus)



Source: own construction by VOS viewer based on Scopus

2.2. Common approaches to internationalization

The Ansoff matrix is commonly used to determine the four possible ways of approaching a given market with a product or a service. Based on the Ansoff matrix, a company can expand in four ways. It is possible to tap into the existing market with the product they already sell. They can develop a new product, which then they sell to an already existing client base. Or, in addition to all this, it is possible to aim for a new, previously unconquered market with the goal of reaching a wider customer base. Market expansion is fundamentally a riskier and more challenging activity for companies, since the organization must convince a previously unknown group of customers to buy its products and services. Market development and diversification beyond one's own ordinary territory may present previously unexperienced challenges, and companies must make an extremely well-considered decision when they plan to internationalize (Chikán, 2008).

Organizations can therefore decide to target a new segment of customers with their activities beyond the borders of their own foundation country. In this case, the company must develop a strategy for entering the international market, which in any case requires extensive research work and analysis of the target area. In the future, the organization may have to operate in a completely new environment, under completely new rules, competing against previously unknown competitors, along with different customer market habits. It is important to realize that the targeted international market may be far from the company not only geographically, but also in terms of cultural values (Hofstede–Minkov, 1991). Organizations may decide to expand beyond the borders of their own nation for several reasons. These objectives can greatly influence the research activity that the company must carry out before entering the foreign market (Twarowska–Kąkol, 2013).

2.2.1. Environmental analysis

The basic conditions for successful operation, long-term survival, and development of companies in the right direction especially on a foreign market are the monitoring of the corporate environment, its familiarization, mapping and executing the right changes. In many cases, however, for only regional operating companies, knowledge of certain customer behaviors, national values, mindsets, political, economic, technological, legal environments, and many other factors may seem self-evident. The owner, employees and customers basically believe in similar values, the entrepreneur has lived their whole life in a well-accustomed environment, in which they know the competitors, market rules and customers very well. Therefore, unexpected surprises usually do not occur. That is why the critical importance of environmental analysis should be emphasized when the structure of the company's international strategy is discussed. The organization is planning to enter a completely unknown environment that it does not know. During the market and environmental analysis even the smallest deviations must come to light in order for the expanding company to be able to stand its ground later on (Chikán, 2008).

Companies have countless analytical methods at their disposal to assess the characteristics of the market they want to conquer. By following the simplest, most widely used Pestel, Porter's 5 forces, Porter-diamond model, Strategic group, Stakeholder, SWOT and risk analyses, the organization can already get an idea of which markets may be worth expanding into, and which are the market expectations that must be met (Dunning, 1993; Kotter, 2012).

Within the framework of the Pestel analysis, the company must be able to explore in detail the political and legal environment that may affect the organization by entering the given market: what are the legislation, laws, standards that limit the company's operation, and what is the attitude of the political system towards the company's industry? The organization must map the economic situation of the targeted area, the rate of inflation, the speed of economic development. Social factors are one of the most important areas that the company needs to examine if it wants to operate successfully in the future. This may include the qualifications of the employable workforce, expected wage demands, the average standard of living, age, social expectations, national characteristics, and foreign languages. The expanding company practically must get to know the habits, expectations, traditions and brand loyalty of the population of the selected country and especially the targeted segment. The company wants to appear as a foreign competitor on the domestic market of the selected nation, and thus it will presumably have a much more difficult task in gaining the trust of potential customers. In the same way, knowledge of the expected behavior, communication and negotiation traditions with negotiating parties can also be classified under the social category. In this case, the incoming company must adapt and meet social expectations in all areas (Johanson–Vahlne, 1977). It is important for the company's management to be aware of the technological development and the built infrastructure of the selected area.

Porter's 5 forces and strategic group analysis helps organizations to learn about its future partners, competitors, customers, bargaining position, expectations, and market strength from a structured point of view. Porter's diamond model points

out that the company must also be aware of the availability of production factors in the given area, how well the company's current strategy can work in a new, completely different type of environment, how well the company can compete with its current strategy, and the extent to which industries related to and supporting the company's operation are present in the area set as the goal of expansion.

By following the principles of the SWOT analysis the organization must be able to explore the internal and external company strengths and advantages that can help the organization perform on a foreign market. Also, the understanding of potential weaknesses is key so the company can prepare for challenges that it may not have had to face previously, in a solely local environment (Child, 1997).

It can be clearly seen that it is rather difficult to summarize all the aspects that the organizational leaders must be able to know in detail before the management begins to develop the expansion strategy and calculate the expected profitability. In summary, the organization must be able to ignore the environmental and national factors that are considered to be fundamentally true in its own working environment, and assuming that these may differ on the international market, it must carry out an analysis starting from the most elementary level, to ensure that the company can successfully understand the environment in which it operates. While the organizations have a clear repertoire of techniques and mindsets to analyze a targeted foreign market, it is mentioned a great number of times in the processed literature that this task is often easier said than done. Understanding a completely different environment and gaining knowledge of all the necessary nuances from the outside proves to be a greatly challenging step of internationalization. The fact is also concluded that smaller companies unfortunately often overestimate the potential of market expansion due to the difficulties of extensive data gathering (Török–Gray, 2003).

2.2.2. The goal of expansion

Enterprises can have different goals when deciding on cross-border activities. These reasons can vary considerably in terms of the size and form of expansion, so it is important for the company to carry out its environmental analysis and search for potential countries for expansion, depending on the exact objective.

The most commonly utilized reason for expansion is market acquisition. The company hopes to enter a new cross-border market in the hope of a larger customer base. In this case, the company plans to sell its products and services in the designated region. As a result, getting to know the company's potential customer market and competitors is essential. The understanding of foreign traditions and the ability to win customers from other nations play a huge role. The organization has the opportunity to execute the expansion in several forms, but it is clear that the company hopes for a higher profit from the expansion. It is therefore important to carry out calculations related to profitability, sales, and possible production after the environmental assessment, which already considers local regulations, taxes and accounting laws. The organization must be able to carefully determine the forms of costs that may appear in connection with expansion abroad (Dunning, 1993).

The next two reasons for expansion can be the acquisition of resources and the increase of efficiency. In these special cases, the company does not necessarily

wish to sell its products or services in the selected area. This situation of expansion can be made relevant by the presence of cheaper, more easily available resources, a more favorable tax or operating environment, or even a cheaper, more precise, more qualified workforce. From this point of view, we also call corporate expansion the precedent in which the organization carries out its production or the extraction of its raw materials necessary for its production in a country other than the parent company. Nowadays, in 2023, more and more multinational companies are moving their factories and office hubs to countries in which tax conditions are more favorable for them, and in which labor is cheaper and less restricted. In these cases, too, the organization must take into account the environmental challenges associated with the expansion. At this point it is worth mentioning the company's prestige as well. In many cases, consumers now separate the country of origin of large companies from their production centers. The production, its physical location and the living conditions of the workforce used for production can leave a mark on the organization's reputation.

The fourth and last reason can be defined as strategic motivation. In this case, the company expands the sale of its products and services, starts the production process in the territory of another country, in order to keep up with its competitors or to gain a market advantage over its strategic adversaries. An example of this can be the expansion as a result of a cost efficiency competition, or the appearance in a market with the company's products after the appearance of a competing organization. Strategic motivation includes all three previously mentioned forms as a possibility of expansion. In this case, it is very important that the company should not make hasty decisions but realistically perform an environmental analysis and financial calculations, also possibly taking into consideration the expected presence of competitors that have entered the targeted market which is fought over. Another reason for the company's strategic expansion can be the globalization of its customers. If the company's target group is for some reason spread over several countries or travels a lot, it can be an advantage for the organization if its products or services are available in obvious, high-priority nodes, at several key locations (Twarowska−Kąkol, 2013).

2.2.3. Common approaches to entering foreign markets

Organizations can approach cross-border activities with several types of highly differing strategies. Weighing these options is crucial, as they may differ in both investment and long-term costs, as well as risk (Roque et al., 2019).

The organization can implement the expansion strategy in the form of exports or franchises. In this case, the company does not need foreign investment. It ships its products from the founding country to the selected territory, where the product is then sold. Production still takes place in the mother country. In the case of a franchise, the company sells its brand, reputation and the right to provide the services it offers. In this case, it is not necessary for the company to invest abroad. It is the responsibility of the company or person buying the franchise to create the conditions required by the founding organization. Export activity can be beneficial for the company, as it can continue its production in a well-known environment. Successful expansion in the

target market can only be achieved by shipping. However, it is possible that in the future, the high logistics costs can already be replaced by the creation of a local production facility, if the circumstances are right.

The second solution for companies to enter the international market is the formation of a strategic alliance. The company selects an institution already operating in a similar category in the target market, which is capable of manufacturing the organization's product, and entrusts this third, external party with the production of the product. This can be beneficial for the company, since it can produce its products in a factory that already operates in the selected area and complies with political and environmental requirements, saving on logistics costs. However, as a disadvantage, it is important to mention that in this case the costs of producing the product will be clearly higher than if the company were to carry out production in its own facility, and commissioning parties outside the company appears as a risk to the successful operation of the organization. The performance of the employed third party organization is more difficult to review, the quality of their production and the guidelines of their operation are questionable. When choosing this strategy, the organization becomes more dependent (Kaynak, 2014).

The company's third option is to establish a subsidiary in the target destination. This requires the largest amount of investment on the part of the founding organization. However, the company can set up and distribute its products and services using its own branch office, operating entirely in the environment of the target area. This is a long-term solution for entering the international market. In most cases, for large companies, this is not the first step they take to enter a market. It is worth considering as an advantage that the company can better integrate into the cycle of the country it wants to conquer through the local facility, the possibly appointed local management can manage the company's subsidiary much more successfully, meeting social expectations. The company's prestige can increase if it provides work for the local population and carries out appropriately emphasized CSR activities. The subsidiary company can be founded Green field, i.e. entirely along the lines of new investment or through acquisition (Roque et al., 2019).

A clear consequence of globalization, the disappearance of borders, and the acceleration of transportation is that organizations can increasingly optimize their production and sales processes around the world. Organizations can have a clear advantage in optimizing their supply chains on an international scale, but building a highly effective system proves to be a greatly difficult task requiring great knowledge, determination, and preparedness (Chikán, 2008).

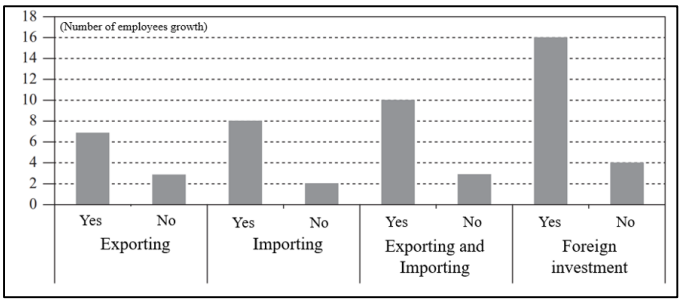
According to the Uppsala model, which is often mentioned in the literature, companies go through the process of exporting, building international alliances and subsidiaries during their entry into the international market. However, thanks to globalization and technological development, it is now easier for organizations to realize their opportunities for expansion (Johanson–Vahlne, 1977). In many cases, the availability of modern technology leads to the possibility of skipping the steps of internationalization considered to be classical. An increasing wide spread of "Born Global" organizations is apparent which already operate specifically on the international market at the moment of their foundation (Almor, 2000).

2.3. Internationalization in the Hungarian SME sector

Based on the results of the Hungarian Central Statistics Office from the year 2018, the Hungarian SME sector is the backbone of the country's economy. Overall, 99.1% of the operating businesses fall in the category of small and medium sized enterprises. SMEs contribute 46% to the overall GDP and employ 64.9% of the working population (Kincses et al., 2022; Mikesy, 2013). The Hungarian SME sector is a heterogeneous sector with two well distinguishable groups that evolve fast, the so-called gazelle organizations and stuck businesses that only aim to survive. Overall, the Hungarian SME sector is undercapitalized, lacks digitalization and falls behind the European average of both GDP contribution and foreign activities (Berko–Gueullette, 2003; Major, 2003; Mikesy, 2013).

The literature review highlights that the number of companies present on the international market increased significantly after the 20th century in Hungary (Kincses et al., 2022). Driven by globalization and activities of multinational companies, capital flows between countries have increased and market expansion has become easier. It can be stated that businesses that appear and expand on international markets are more successful, flexible in their growth and innovative compared to their competitors that do not participate in cross-border activities (Török–Gray, 2003). Figure 3 also shows the employee growth of SMEs between 2007 and 2008. The difference in work force expansion is significant between SMEs performing and not performing cross-border activities. After 1997, the appearance of capital investments aimed at foreign markets also began to increase in Hungary, as a result of which the country became a significant investor in the Central and Eastern European region. It is important to emphasize, however, that the vast majority of these fast-growing businesses were already operating successfully even before the regime change, had free capital for investment and many years of operational experience. In Hungary, it is therefore very important to examine the internationalization opportunities of the SME sector separated from the expansion of capital-intensive, often foreign-owned larger companies. The available skillsets, capital, and opportunities are often very different in the case of a small organization (Éltető–Antalóczy, 2002b).

Figure 3. Effects of entering a foreign market on the number of employee growth between 2007 and 2008



Source: own construction based on EC (2010)

> In-depth interviews conducted by Antalóczy and Éltető, with 51 successfully operating companies with strong capital concluded that, of the studied businesses, 34 operated subsidiaries in Romania, Germany, Ukraine, Slovakia, and Russia. Half of the surveyed companies established their subsidiaries for sales purposes, while the other half expanded with the goal of more optimal production in the indicated neighboring countries. 67% of the products produced by the established branches were sold in the given region. The answers revealed that in the case of foreign investments, a significant reason for motivation (82%) was the acquisition of the given market or the expansion of the already existing market. Cross-border activities in Hungary were not triggered with the goal of exploiting cheaper labor or resources (Éltető–Sass, 1998). According to the findings of empirical research conducted in the field, Hungarian companies typically chose the gradual path of internationalization, first utilizing the additional opportunities of importing or exporting products (Ács et al., 2010). 64% of the organizations participating in the interviews stated that the intensification of regional competition formed a strong basis for their expansion (Éltető–Antalóczy, 2002a).

A key aspect of international expansion is the determination for growth and the completion of appropriate environmental analyses. The importance of personal relationships building on the foreign market during the pre-phase of internationalization is highlighted by all the interviewed business owners. It is also highlighted that already existing connections, relationships, or family members living in foreign countries can greatly accelerate the implementation of cross-border activities and provide crucial data on the foreign market, often having a greatly motivating role for the expansion (Csákné, 2012). The need for personal, first-hand information for successful strategic planning of cross-border activities appears to be crucial. The asked business owners did not find the information provided by governments, ministries, and banks sufficient. The real attributes of a foreign market cannot be explored solely from officially posted data (Welch–Luostarinen, 1993). Inquiring about the company's experiences and the knowledge needed for expansion, organizations mostly felt their high-level marketing knowledge and managerial know-how to be highly useful and needed during expanding periods (Antalóczy et al., 2000).

The companies participating in the interview study were able to report on the overall success of the expansion. In the case of 72% of them, their market share increased, and in the case of 60% of them, the company's income increased significantly after the installation of a subsidiary. Only one of the asked organizations reported negative experiences and the failure of the subsidiary. The managers of the surveyed large organizations mostly mentioned the difficulties of obtaining relevant, life-like information, the lack of political support and of lobbying assistance as factors limiting expansion. Financial difficulties of the parent company, inappropriate selection of the target country, an overly optimistic assessment of the target market, and the instability of the political environment are common risks that were highlighted by the interviewed business owners (Holicza, 2016).

In the study by Gubik and Karajz (2014), the problem arises pointing out that the examination of companies cannot be separated from the analysis of the people who lead the company or are authorized to make decisions. The professional knowledge, experience, and mindset of the business owner and managers are highly decisive in the success of internationalization (Gubik–Karajz, 2014). The conducted and analyzed survey contains the answers of 104 companies, of which 74 are already present in some form on the international market. The survey fundamentally differs from the in-depth interview research by Antalóczy and Éltető, as 77% of the surveyed companies operate in the SME sector in this case. 51% of the companies participating in the survey cross the country's borders with imports, 25% with exports and 12.5% with abroad cooperation. Gubik and Karajz's research sheds light on two previously unexplored relationships. Based on their survey, a significant relationship can be found between corporate environmental awareness and the choice of time to enter a foreign market. In addition, it is important to emphasize again that the attitude of owners, managers, and employees can fundamentally limit the company's openness towards change and expansion. The literature highlights that the achievement of a correct mindset (i.e. a change in the attitude of the managers) will be always a critical condition for the successful expansion of the organization (Gubik–Karajz, 2014; Kotter, 2012).

The study by (Kozma–Sass, 2019) concludes that the Hungarian small and medium-sized business sector, which serves as the backbone of the Hungarian economy, is much less present on the international market. Previously highlighted research showed that in Hungary, mostly larger companies with years of experience and successful operation history, owned by foreign investors have took the opportunity of stepping on the path of foreign activities. However, from this point of view, Hungary does not differ from the neighboring European countries examined in the analyses. Small and medium-sized businesses are facing difficulties regarding cross-border activities across all European countries (Johanson–Vahlne, 1977).Therefore, it is important to examine what are the inhibiting factors that arise in the SME sector and prevent companies from expanding on the international market (Mikesy, 2015).

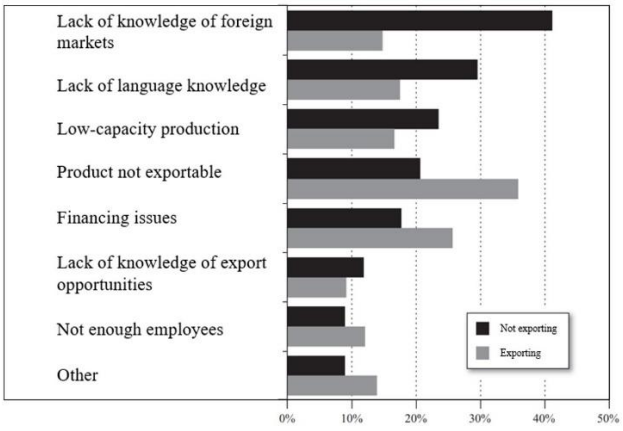
Mikesy's 2013 study, performed on the Hungarian SME sector, concludes that SMEs with cross-border activities like exporting are tend be more successful, faster growing and more resilient towards recession periods with the acquired experience in decision making from foreign markets as well (Mikesy, 2013). Németh's 2017 research results display that from a 200+ SME interview sample, family businesses tend to look more for exporting opportunities than non-family-owned SMEs. Difficulties, however, can be presented with the lack of trust towards external experts, lack of knowledge of foreign markets and language, fear from losing family control, and the lack of digitalization. However, it was concluded that family members living in foreign countries are a great motivational aspect of cross-border operations and can be a great advantage for family owned businesses (Czakó et al., 2016; Németh, 2017; Wąsowska, 2017).

2.4. Difficulties of entering foreign markets

The first step in the relevance of international expansion is to examine its potential positive impact. It is clear that if a company could not gain additional value during its

entry into the international market, it would certainly reject this form of expansion. However, companies performing cross-border activities surveyed in previously performed studies show a faster increase in the overall profit and the number of employees. Based on surveys carried out in four rounds in 2010, profit before taxes of SMEs that performed foreign activities was on average 8% higher compared to businesses that only operated within the boundaries of Hungary (Mikesy, 2013). Of the companies participating in the survey, 40.8% import, 32.5% export, and 3.4% are present in the international environment (Mikesy, 2015). According to previously conducted studies in Hungary, SMEs therefore have an interest in striving for cross-border expansion, but despite this opportunity small and medium sized businesses often face difficulties to step out of their well-known environment. The lack of planning is a fundamental difficulty of the SME sector that appears in many cases. The basis of the problem is the management's workload, limited capacity, and circle of acquaintances, on the basis of which they do not have the time or knowledge to plan the entry into a new, unknown market realistically and with adequate quality (Hofstede–Minkov, 1991). The owners of the company need foreign language skills and comprehensive knowledge of the target market in order to be successful. In many cases, the catalyst for entering the international market can be a rare opportunity, which, however, requires up-to-date knowledge of the economic and market developments of the given area. Figure 4 displays the most common difficulties and restraining factors of internationalization which SME leaders mention during a qualitative research published by the MFB-Indikátor in 2012.

Figure 4. Difficulties of utilizing the opportunities of exporting – Comparison between exporting and non exporting SMEs



Source: own construction based on MFB-INDIKÁTOR (2012), Mikesy (2013)

The impossibility of exporting the manufactured product abroad due to additional expenses or lack of production capacity was often mentioned by the interviewed companies. The additional expenses would often lead to uncompetitive prices on foreign markets (Török–Gray, 2003). Based on the 2009 OECD survey, SMEs often consider the company's internal factors, like capacities, and competences

to be a bigger obstacle when entering a foreign market than the external, environmental elements affecting the expansion. Naturally, as the expansion progresses, the emphasis on external constraints also increases, but initial steps towards cross-border activities are limited mostly by factors found in the company's internal structure. The lack of experience and the fear of unknown risks are often the root problems of avoiding the idea of foreign activities. Many small and medium-sized enterprises have never operated in a foreign market before, so the fear of company managers is understandable (Éltető–Antalóczy, 2002a).

Encouraging the internationalization of Hungarian SMEs could greatly help the profitability of small businesses. Based on the highlighted research more foreign activities would further increase the employment and would lead to an overall higher GDP contribution rate of SMEs in Hungary. It is clear that small and medium-sized businesses require assistance in taking steps towards activities connected to foreign markets (Losoncz–Nagy, 2020).

2.5. Discussion

The performed literature review concludes that the more rapid technological advancements and globalization created a fiercer and faster paced environment for small and medium sized organizations to operate in. Internationalization became apparent in Hungary as well at the end of the 20st century, however, the literature review highlighted that mostly already well performing, larger, foreign owned companies could step out on the foreign markets. Organizations with cross-border activities show faster growth in profitability and the number of employees. Businesses stepping out to foreign markets tend to perform better overall, acquire additional managerial skills, relationships and show better resiliency during recession periods. However, it is clear that small and medium sized enterprises, despite the possible advantages, are afraid of cross-border activities and often lack the necessary knowledge and optimal supply chains to perform well outside of their local market. It is also clear that performing the necessary market analysis on a previously unknow environment proves to be a greatly difficult challenge. The most commonly mentioned constraints businesses must face are the lack of language and strategic knowledge, the difficulties of understanding and exploring foreign markets, optimizing transport costs, and increasing production quantity. The below conclusive summary shows a brief synthetization of the most common motivating and constraining factors of internationalization based on the processed literature and qualitative studies performed previously on the researched field.

Motivating aspects of internationalization

- Average 8.0% revenue growth development in exporting SMEs compared to locally operating SMEs from 2010 to 2012 (Mikesy, 2013).
- Average 10.1% employee number growth development in exporting SMEs compared to locally operating SMEs from 2010 to 2012 (Mikesy, 2013).
- Average 7.1% investment growth development in exporting SMEs compared to locally operating SMEs from 2010 to 2012 (Mikesy, 2013).

- International entrepreneurial experience gathering on foreign markets (Győri–Czakó, 2019)
- Better resiliency towards challenging environmental events (Antalóczy et al., 2000).
- Further development of the Hungarian economy (Losoncz–Nagy, 2020).

Constraining factors of internationalization

- Difficulties of reliable information gathering on the target market (Antalóczy et al., 2000).
- Overestimation of the foreign potential target segment (Török–Gray, 2003).
- Lack of entrepreneurial skills and knowledge (Éltető–Antalóczy, 2002a).
- Language and cultural barrier (Czakó et al., 2016).
- Lack of trust towards previously unknown foreign connections (Németh, 2017).
- Production capacity restrictions (Mikesy, 2013).
- Not exportable product (Mikesy, 2013).
- Financing issues, high logistics cost (Holicza, 2016).

The study demonstrates overall the advantages of cross-border activities and highlights the difficulties that holds back SMEs from stepping out to foreign markets, but also opens up questions for further exploration, how SMEs could be assisted in achieving the right mindset, the necessary knowledge and optimizing their supply chains so they have better and realistic chances of expanding.

3. Conclusion

Overall, the study concludes that globalization led to a wide range of opportunities which allowed companies to expand their activities beyond their regional market more and more easily. Although globalization and the unification of the world can be beneficial, its spread is also criticized from other angles. Today, entering the international market is increasingly a base requirement of maintaining market competition for large companies. Thanks to technological, infrastructural, and informational development, companies can even decide to expand internationally for the purpose of optimizing their operations, accessing hard-to-reach resources, and employing cheaper labor.

Assessing the situation in Hungary, it has become clear that a relatively small number of small and medium sized organizations enter the foreign market. Hungary's internationalized businesses are mostly larger, long operating, successful organizations which are foreign owned. These companies are mostly interested in selling their products on cross-border markets and establishing subsidiaries in the target country. From this point of view, the parent companies operating in Hungary are not motivated to exploit resources or to expand to reach cheaper labor. Looking at the SME sector, Hungary is not lagging behind in entering the international market, considering the neighboring countries. In contrast, it can be stated that only a small percentage of SMEs extend their activities beyond the border. The reviewed in-depth

interview surveys show that the lack of language proficiency, professional and experiential knowledge often holds small and medium-sized businesses back from internationalization. In many cases, their product is either not exportable, or due to the costs calculated after delivery, the manufactured price would no longer be competitive in the potentially targeted markets.

At the end of the study, it is important to point out that proper information about the target market and the collection of relevant data play a significant role in the success of entering an international market. In many cases, SMEs indicated that it is impossible to realistically assess a market they are completely unfamiliar with without personal experience. Even in the case of large companies, it appeared without exception that expansion could only take place with the help of international acquaintances.

Overall, the research highlights that SMEs stepping out to foreign markets tend to perform better and to show greater resilience during recession periods. SMEs are the backbone of the Hungarian economy significantly contributing to the overall GDP and employment. SMEs entering foreign markets could further increase their potential, however, it is clear that small and medium sized businesses are often facing both local and global difficulties. The researched field provides further possibilities to explore and opens up new questions such as how these SMEs could be efficiently assisted, and whether it would be possible to further optimize their supply chains to enable competitiveness on cross-border markets as well. These open questions can be assessed with future exploration in the researched area.

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The relationship between macroeconomic factors and non-performing loans (NPLs) in Lao PDR: An application of the Vector Error Correction Model

Chintana Khouangvichit

The role of the banking sector in driving economic development cannot be understated. Its stability is a critical factor that sets the pace for economic progress. Among the various indicators of financial stability, non-performing loans (NPLs) held by banks hold particular significance as they reflect asset quality, credit risk, and the efficient allocation of resources to productive sectors. NPLs have indeed been a subject of concern for the banking sector, with their prominence intensifying, especially after the 2008 financial crisis. This study investigates the relationship between Macroeconomic factors and non-performing loans in Lao PDR. The secondary data of four variables, namely, Interest Lending rate, CPI-Inflation, Nominal exchange rate, and Money supply from the first quarter of 2012 to the last quarter of 2021 have been collected in order to analyze the long-term relationship among economic factors and estimate the short-term adjustment toward the long-term equilibrium level. The Vector Error Correction Model (VECM) is applied to measure short-term adjustment toward the long-term equilibrium level. Based on the estimation results of the Vector Error Correction Model, two variables have a positive and significant effect on long-term non-performing loans, namely, lending interest rate, and money supply, and a significant inverse relationship with inflation, and exchange rate. Meanwhile, in the short term, only lending interest rates have a significant effect on non-performing loans.

Keywords: Non-performing loans, macroeconomic, Johansen Cointegration, Vector Error Correction Model

1. Introduction

The pivotal role played by the banking sector in driving economic growth and development is paramount. Banks act as intermediaries, bridging the gap between those with surplus funds and those seeking capital for various economic activities. A high-performing banking sector is a catalyst for economic expansion, while a dysfunctional one can impede progress. Consequently, the stability and effectiveness of the banking sector assume critical importance, essentially setting the trajectory for a nation's economic development.

A well-developed financial sector encompasses efficient banks and robust stock markets, which collectively contribute to fostering economic growth. This is achieved by directing savings towards productive investments, mitigating information disparities, and stimulating innovation (Levine, 1997). The significance of financial institutions, legal frameworks, and governmental policies in nurturing financial development cannot be overstated. Among various indicators of financial stability, non-performing loans (NPLs) are catastrophic for banks and can disrupt the entire financial system of an economy, and can even signal the onset of a banking crisis (Louzis et al., 2012). A rise in NPLs indicates an unhealthy economic condition and

poses significant risks to liquidity and profitability for banks, corporations, and individuals. The deterioration of banks' asset quality is not only financially destabilizing for the banking system, but it may also lead to economic inefficiency, impair social welfare, and contribute to declining economic activity (Ghosh, 2015).

In the financial sector of Lao People's Democratic Republic) PDR, banks have long played a central role, with State-owned commercial banks taking the lead. However, things started to change in the mid-2000s when the sector began to open up gradually. This shift gathered pace with the introduction of the new Law on Commercial Banks in 2007, which attracted a significant number of private and foreign banks into the country. This transformation has led to notable progress in the financial sector, including increased access to financial services and improved distribution of resources. The banking sector, in particular, has become a crucial part of Lao PDR's financial system, greatly influencing the country's economic stability.

Despite these positive developments, the banking sector in Lao PDR faces a significant challenge in the form of non-performing loans (NPLs). NPLs are loans that borrowers have difficulty repaying, and they can weaken a bank's financial health, which, in turn, affects the broader economy. Unfortunately, Lao PDR has been dealing with a persistent issue of rising NPLs, deviating from the international standard where an NPLs rate of 2 percent or below is considered ideal. In recent years, the NPLs rate in Lao PDR has surpassed 3 percent, highlighting the need for effective strategies to address this challenge and protect the country's financial stability (BoL, 2022).

Numerous studies have been conducted to determine the factors that contribute to non-performing loans. However, it is challenging to identify a single relationship between them, as different studies have identified varying determinants of NPLs, and these variables have exhibited different relationships with NPLs. The literature suggests two sets of factors that explain the evolution of NPLs over time. The first focuses on external events, such as overall macroeconomic conditions, which are likely to impact borrowers' ability to repay their loans. The second, which examines the variability of NPLs across banks, attributes the level of non-performing loans to bank-level factors. Empirical evidence supports both sets of factors. However, in Lao PDR, there is a lack of studies focusing on the factors that affect NPLs across the entire banking sector, with most studies focusing on specific banks. Therefore, the purpose of this study is to investigate the influence of macroeconomic factors, namely, the consumer price index (CPI), exchange rate, interest rate, and money supply on non-performing loans (NPLs) in the Lao PDR banking system over the period 2012Q1–2021Q4. The results of this study can be expected to contribute to literature relating NPLs in the country, as well as benefit policymakers. For the latter, understanding macroeconomics behavior can contribute to a better policy formulation.

The choice to explore this topic is driven by the critical role of non-performing loans (NPLs) in the world of finance. NPLs have emerged as a significant global threat to financial systems. In numerous financial stability reports published by central banks, the alarming rise in NPLs consistently stands out as one of the most pressing dangers to the stability of the banking sector. This matters because NPLs often require banks to set aside substantial amounts of capital as a safety net to cover potential losses resulting from these troubled loans. As NPLs increase in number and scale,

banks find themselves compelled to allocate more and more capital to cushion against potential losses. This continuous capital allocation can gradually erode the financial foundations of banks, potentially limiting their ability to provide new loans and support economic growth.

In the most severe scenario, a widespread surge in NPLs spanning multiple banks can trigger systemic risks that threaten the entire financial system. If not managed effectively, this situation has the potential to spark a financial crisis, lead to the failure of banks, and cast economies into broader turmoil. It is worth noting that the role of macroeconomic conditions becomes even more significant in this context. Their effects become increasingly pronounced as NPLs mount. As such, this research is driven by the need to gain a comprehensive understanding of whether and how these macroeconomic factors influence NPLs and, if they do, the specific nature of this influence.

The remainder of the study is organized as follows. Section 2 reviews the theoretical and empirical literature related to the macroeconomic factors which are expected to affect the ratio of NPLs. Section 3 discusses the methodology applied in this study. The empirical results are presented in section 4, and the last section is the conclusion of the study.

2. Literature review

2.1. Theoretical background

One definition states that a non-performing loan (NPL) refers to a financial asset that banks have not received interest or installment payments from, as per the agreed-upon schedule. Put simply, when a loan stop generating income for the bank and fails to perform according to the terms of the loan agreement with the borrower, it is classified as an NPL. The European Central Bank (ECB) has defined NPLs as loans that are either more than 90 days past-due and considered material, or loans where the debtor is unlikely to fulfill credit obligations in full without collateral, irrespective of past-due amounts or days overdue (European Central Bank 2017:49). The financial system of a country, including that of Lao PDR, relies on the level of NPLs as a percentage of total loans as an important indicator. This percentage is obtained by dividing the value of non-performing loans by the total value of the loan portfolio. The gross loan value recorded on the balance sheet, rather than only the overdue amount, should be considered as the nonperforming loan amount.

Numerous researchers have conducted studies to examine the connection between macroeconomic factors and loan quality, and have sought to link the financial condition with the stability of banks. They found that interest rates are among the most important economic factors since they have a direct influence on economic conditions, e.g. decisions relating to consumption, saving, and investment. Interest is the cost of borrowing money, usually expressed as a percentage of the amount borrowed. The interest rate is the percentage rate of interest for a specified period (monthly or annually). An increase in interest rates can have a negative effect on loan quality, as higher debt costs make it more difficult for the borrower to repay the loan. Furthermore, high interest rates are a potentially harmful option for borrowers

(Bofondi–Ropele, 2011). The impact of heightened debt costs, which can make it more challenging for borrowers to meet their repayment obligations, should be assessed with careful consideration of the initial interest rate fixation period. In cases where a loan maintains a fixed interest rate throughout its entire maturity, the debt service remains constant over the loan's term. Consequently, fluctuations in prevailing interest rates do not affect the borrower's repayment burden during this period.

However, the situation is different when a loan necessitates refinancing upon maturity. In such instances, borrowers could potentially encounter an interest rate shock, as the terms for the new loan may be substantially influenced by the prevailing interest rate environment. Therefore, the susceptibility of borrowers to changes in the interest rate landscape hinges on various factors, including the structure of the interest rate, the maturity of the loan, and the necessity for refinancing. It is imperative to appreciate these loan-specific characteristics, as they can significantly impact borrowers, particularly in a context like Lao PDR. In the case of Lao PDR, short-term loans with maturities of one to three years are prevalent, particularly for meeting working capital requirements, facilitating trade finance, and providing smaller-scale business loans. Long-term loans, on the other hand, are less common. Consequently, borrowers in Lao PDR may indeed experience the effects of interest rate fluctuations, given the prevalence of short-term loan structures.

The lending interest rate is assigned significant importance in the literature pertaining to non-performing loans (NPLs) as it influences bank deposits and loans, making it a crucial variable in the examination of loan performance within the banking system (Castro, 2013). When the lending rate is higher, this leads to increased costs on loans and advances, thereby potentially reducing borrowers' repayment capacity and increasing the default rate. Empirical evidence from studies such as Nkusu (2011), Adebola et al. (2011), and Berge and Boye (2007) has consistently demonstrated a positive correlation between the lending rate and NPLs. An escalation in interest rates diminishes the payment capacity of borrowers, thereby establishing a positive relationship between non-performing loans and interest rates (Nkusu, 2011). Cucinelli (2015) further contends that banks adopting aggressive lending policies and charging high interest rates from borrowers tend to experience higher levels of non-performing loans.

Furthermore, the literature suggests that NPLs are influenced by the nominal exchange rate. A depreciation in the exchange rate can lead to a decline in the quality of bank assets, resulting in higher levels of non-performing loans (NPLs). This situation arises when the nominal exchange rate increases, signifying a weakening of the domestic currency. As a result, borrowers who have taken out loans denominated in a foreign currency are faced with higher repayment obligations. This is a significant concern for them because they must still settle the loan in the same foreign currency. However, due to the depreciation of their domestic currency, they now require a larger amount of their own currency to obtain the foreign currency needed for repayment.

As a result, the rise in the nominal exchange rate diminishes borrowers' ability to fulfill their obligations, thereby contributing to an increase in NPLs (Nkusu, 2011). In the context of Lao PDR, where the economy experiences a degree of dollarization, commercial banks generally provide loans in the local currency. However, it is worth noting that the use of the US dollar as a lending currency is prevalent and shared

significantly a mount in the Loan portfolio (IMF, 2019). This means that borrowers in the country may opt for loans denominated in US dollars, which exposes them to exchange rate risks when the domestic currency weakens, potentially contributing to higher NPLs. In studying the determinants of asset quality in banks, Alhassan et al. (2014) employed the real exchange rate as a measurement. However, Otani et al. (2009) utilized the nominal effective exchange rate in their work, and Beck et al. (2015) also adopted nominal effective exchange rates in their study on the determinants of NPLs. Consequently, this study follows the approach of employing the nominal effective exchange rate as a measure of the foreign exchange rate, aligning with the perspectives of Otani et al. (2009) and Beck et al. (2015).

Inflation is considered another factor that potentially contributes to non-performing loans (NPLs), although its impact is ambiguous. Inflation occurs when prices of goods and services increase over time (Abel, 2005). Recent research by the International Monetary Fund (IMF, 2016) suggests that the relationship between high inflation and NPLs can have either positive or negative implications. Generally, inflation is believed to be positively associated with non-performing loans. As inflation rises, the cost of conducting business increases, leading to reduced profitability and a diminished capacity to repay debt. In a study of US commercial banks Ghosh et al. (2013) found that inflation has a positive effect on NPLs while negatively affecting borrowers' real income and impairing their ability to meet their debt obligations.

However, a study by Klein (2013) states that inflation may enhance debt servicing capacity by diminishing the value of the debt or outstanding principal sum, affecting non-performing loans. Real debt services decline with higher inflation, driving down non-performing loans. Hence, inflation may potentially diminish the debt principal amount, assisting with the decrease of property NPLs through higher repayments. Nkusu (2011) has examined the NPLs determinants of 26 advanced countries and has concluded a negative impact of inflation on NPLs. In the present study inflation will be represented by the consumer price index. The index includes all goods and services in the economic region, if they are part of the consumer spending of private households.

Money supply influences banks' financial statements through lending, investment, and profitability. An increase in broad money raises bank deposits, so a bank’s lending and investment resources grow proportionally as well. The money supply refers to the overall amount of money circulating within an economy during a specific period. It can be calculated in various forms, typically classified into three categories: Reserve Money (Mo), Narrow Money (M1), and Broad Money (M2). For our study, we selected M2 as the representative measure of money supply due to its comprehensive nature, encompassing both Reserve Money and Narrow Money.

An increase in M2 can have several consequences, some of which are less favorable. First, it can contribute to inflation, diminishing the real value of borrowers' incomes and making it more challenging for them to meet their debt obligations. Additionally, an excess of liquidity within the financial system can lead to riskier lending practices, as banks may extend loans to borrowers with less robust credit histories. This relaxation of credit standards can lead to a higher incidence of loan defaults, ultimately resulting in a rise in NPLs. A growing money supply may also

signify an increase in credit availability throughout the economy. This could prompt both individuals and businesses to seek loans, potentially leading to higher debt levels. However, the impact on NPLs hinges on the quality of credit risk assessment conducted by banks and the ability of borrowers to meet their repayment obligations. If lending standards are not upheld, it can result in a surge in NPLs. Studies by Badar et al. (2013), Akinlo and Emmanuel (2014), and Leka et al. (2019) have found a positive correlation between an increase in money supply and a rise in non-performing loans. These findings suggest that the expansion of the overall money stock may have contributed to the deterioration of banks' portfolios in the country, primarily due to inaccurate credit analysis.

2.2. Empirical review

Numerous empirical studies have explored the relationship between macroeconomic factors and nonperforming loans, revealing consistent findings. The majority of these studies indicate a positive correlation between NPLs and various factors such as interest rate, lending rate, unemployment, inflation, public debt, and exchange rate.

One notable study conducted by Badar et al. (2013) focused on the impact of macroeconomic forces on nonperforming loans in 36 commercial banks in Pakistan during the period of 2002 to 2011. The researchers examined both the long-term and short-term dynamics between NPLs and macroeconomic variables. Their analysis incorporated inflation, exchange rate, interest rate, gross domestic product (GDP), and money supply as key macroeconomic indicators. The results of their study revealed strong negative long-term associations between NPLs and inflation, exchange rates, interest rates, GDP, and money supply. These findings underscore the significance of these macroeconomic factors in influencing the occurrence and magnitude of nonperforming loans.

The study by Hoggarth et al. (2005) for United Kingdom over the period 1988–2004 found inflation and interest rates to be the main determinants of non-performing loans in the UK. Vogiazes and Nikolaidu (2011) looked at the factors that contributed to non-performing loans in the Romanian banking industry between 2001 and 2010. The findings demonstrated that Romania's NPLs were primarily determined by spending on construction and investment, unemployment, inflation, the ratio of external debt to GDP, and money supply generally construed. Accordingly, in another survey, in a comprehensive study by the ECB in 2011 over 80 economies, the asset quality of the banks is significantly influenced by the output growth, nominal exchange rate fluctuations as well as interest rate in case the assets markets have been developed too. In the study of Louzis et al. (2012), a dynamic panel data approach and variables from the macroeconomic and banking sectors to identify the causes of non-performing loans in the Greek banking sector. The empirical research demonstrated that macroeconomic factors, such as GDP, interest rate, public debt, and unemployment, as well as the bank-specific variable of management quality can be a cause of NPLs in the Geek banking sector.

Furthermore, the study by Nkusu (2011) for 26 advanced economies over the period 1998–2009 investigated the determinants of NPL ratio and of the first difference of the NPL ratio. The results showed that adverse macroeconomic

development, in particular, a contraction of real GDP, a high unemployment rate, high interest rates, a fall in house prices and a fall in equity prices negatively affected NPLs. In the same way, study by De Bock and Demyanets (2012) for 25 developing economies over the period 1996–2010 revealed that real GDP contraction, currency depreciation against the US dollar, weaker terms of trade and outflows of debt – creating capital precipitated higher aggregate NPL ratio of the banking sector. Siddiqui et al. (2012) carried out a study on the impact of interest rate volatility on non-performing loans in Pakistan in the periods between 1996 and 2012, the study concluded that interest rate is the cause of rising NPLs in Pakistan significantly. Bogdan (2017) found that the determinants of bad loans in the banks from Central and Eastern Europe are Real GDP growth rate and inflation rate CPI with a negative effect, Unemployment rate with a positive effect.

Using panel data, Beck et al. (2013) looked at the macroeconomic factors that influence non-performing loans across 75 countries. According to the study's findings, real GDP growth, share prices, currency rates, and lending interest rates were the factors that had the most significant impacts on non-performing loans between 2007 and 2012, the study identified that the interest rate has significantly negatively driven NPLs, and the banks' NPLs are generally exacerbated by the impact of the higher real money supply in the long run. Donath et al. (2014) in a study for Romania and for Baltic countries found that for the latter, lending interest was significant with a positive impact for Estonia and Lithuania, and with a negative impact for Romania. The lending interest has a positive relationship for Latvia, but not as significant as with the others. A study by Beck et al. (2013) revealed that NPLs were affected significantly by the GDP growth, stock prices, the exchange rate, and the loan interest rate.

Adebola et al. (2011) conducted a study to assess the determinants of non-performing loans (NPLs) in Islamic banking in Malaysia during the period from January 2007 to December 2009. They utilized the autoregressive distributed lag (ARDL) technique and found evidence of cointegration among the variables. The results indicated that the interest rate had a positive and significant impact on NPLs. In a similar study by Viphindrartin et al. (2020), which focused on the Non-Performing Loans of Rural Banks in Indonesia for the period from January 2015 to December 2018, the researchers employed a Vector Error Correction Model (VECM). Their findings revealed that inflation and interest rate exerted a positive and significant influence on non-performing loans in the long term. Furthermore, in the short term, credit and interest rates were the only variables that had a positive and significant effect on non-performing loans. Inflation and exchange rate variables, on the other hand, demonstrated a negative and insignificant impact on bad credit in the short term.

Okyere and Mensah (2022) analyzed the determinants of NPLs in Ghana's banking industry using monthly data from January 2007 to December 2019. They considered bank-specific and macroeconomic variables and employed the ARDL bounds test of co-integration to examine short-term and long-term relationships. The study found that bank-specific factors such as lending rate, profitability, Cost to Income Ratio, Capital Adequacy Ratio, and Net Interest Margin influenced NPLs. At the macroeconomic level, inflation and economic growth were found to reduce NPLs. Additionally, the previous year's NPLs and net interest margin decreased current NPLs, while the credit adequacy ratio promoted current NPLs in the short run.

Several empirical studies have delved into the intricate relationship between Non-Performing Loans (NPLs) and macroeconomic variables, offering valuable insights into the dynamics of these interconnections. Adebola et al. (2011) investigated this nexus in the context of Malaysia's banking sector and found that NPLs have a significant positive impact on interest rates, underlining the potential feedback effects of NPLs on the broader economy.

3. Data and Methodology

3.1. Data

The objective of this study is to investigate the impact of macroeconomic factors on nonperforming loans in Lao PDR. The data used in this study are obtained from the quarterly reports of the Central Bank of Lao PDR (Bank of Lao PDR: BoL). The study adopts the widely accepted definition of nonperforming loans, which considers loans and other assets as nonperforming when the principal and interest payments are overdue by 90 days or more. In this study, the dependent variable is defined as the ratio of nonperforming loans to total bank loans. As for the independent variables, the study examines the statistical significance of the consumer price index, Money Supply Aggregate M2, nominal exchange rate, and lending interest rates for loans. These variables are commonly studied and expected to have an impact on nonperforming loans.

In the context of analyzing the variables that influence Non-Performing Loans (NPLs), the inclusion of Gross Domestic Product (GDP) growth rate as an independent variable represents a critical aspect of macroeconomic analysis. It is well-recognized that GDP growth rate can exert a substantial influence on credit risk and the performance of loan portfolios. However, it is with regret that this study must acknowledge the omission of GDP growth rate from the analysis, owing to the unavailability of quarterly data required for its inclusion. The omission of GDP growth rate due to quarterly GDP data is not consistently reported in many datasets, rendering it challenging to procure the requisite information for this study period.

This limitation may render this analysis less comprehensive, potentially overlooking the nuanced dynamics between economic expansion or contraction and NPL dynamics during the specified timeframe. Nevertheless, the insights derived from this analysis, grounded in the data available to this study, remain pertinent in advancing our understanding of NPL determinants within the limitations of the present research context.

3.1.1. Econometric model

The model which is statistically examined to describe the relationship between NPLs and explanatory variables is constructed as follows:

$$NPLs = \beta_0 + \beta_1 LnCPI_t + \beta_2 LnMLR_t + \beta_3 LnEXR_t + \beta_4 LnM2_t + \varepsilon \qquad (1)$$

According to the model, the NPLs outline non-performing loans ratio. The data on NPLs ratio rates are reported as the average of the whole banking industry rather than as the rates of individual banks. M2 real money supply is aggregate term,

MLR is lending interest rate, and the ratio, CPI as consumer price index and EXR is nominal exchange rate. The designation "ln" is used to denote the logarithmic form of the variables under investigation, $\beta 0$ is the coefficient of the constant term, while β_1, β_2, β_3 and β_4, represent the partial coefficients of the independent variables for each specified model. All the variables in the function are predicted to have long-term relationships.

Table 1. Report of the source and expected sign of the coefficient

Variable	measurement	expected effect (coefficient)	Source
Non-performing loan ratio (NPLs)	percentage		Bank of Lao PDR, quarterly report
Money supply-M2	index	+	Bank of Lao PDR, quarterly report
Minimum loan rate (MLR)	percentage	+	Bank of Lao PDR, quarterly report
CPI- Inflation (CPI)	percentage	+/-	Bank of Lao PDR, quarterly report
Nominal exchange rate (EXR)	USD/Kip	+	Bank of Lao PDR, quarterly report

Source: own construction

An increase in the lending rate has been found to diminish the borrower's capacity to repay loans, leading to an increase in nonperforming loans (NPLs). The impact of Consumer Price Index (CPI) inflation on loan repayment capacity can vary, resulting in either positive or negative effects. Higher inflation can improve borrowers' ability to repay loans by reducing the real value of outstanding debts, thereby reducing NPLs. Conversely, inflation can weaken borrowers' repayment capacity by reducing their real income, resulting in an increase in NPLs. In the context of exchange rates, the depreciation of a country's currency can have significant implications for borrowers, especially those who have taken loans denominated in foreign currencies. When the local currency depreciates, it essentially means that it loses value relative to the foreign currency in which the loan is denominated. This can lead to an increase in the debt burden for borrowers. Therefore, an increase in the nominal exchange rate is associated with higher NPLs. Regarding Money Supply Aggregate M2, this study assumes a positive relationship with NPLs. An increase in liquidity prompts banks to extend more credit, which in turn increases NPLs within the banking sector.

The investigation is based on the following hypotheses:

H1: The inflation rate has a positive and inverse relationship with the level of Non-Performing Loan.
H2: The exchange rate has a positive relationship with the level of Non-Performing Loan.
H3: The interest rate has a positive relationship with the level of Non-Performing Loan.

H4: Money supply has a positive relationship with the level of Non-Performing Loan.

3.2. Method

The analysis is carried out in the following order. The first step is to test for the presence of unit root. This is due to the fact that most time series in economics show a trend over time and are typically not stationary (containing unit root). It follows that if series is non-stationary, the mean, variance, and covariance are not constant over time. When data contains unit root, it means any result accrued to such data will be spurious or nonsensical. Spurious regression implies that the relationship between variables may appear statistically significant, though there is no meaningful relationship among the variables.

This paper employs PP (Philip and Perron 1988) unit root tests to verify the level of integration of the variables. The null hypothesis PP test states that the series have unit root, while the alternative hypothesis rejects this claim by suggesting stationarity.

$$\Delta Y_t = \beta_0 + \gamma Y_{t-1} + \beta_1 (t - \frac{T}{2}) + u_t \quad (2)$$

$H_0: \gamma = 0$, Series has a unit root (non-stationary).
$H_1: \gamma < 0$, Series has no unit root (stationary).

Once the orders of integration of the variables are determined via unit root tests and we ensure that all the variables are integrated of order one, i.e. I (1), then the Johansen (1991) technique is employed to test for cointegration among variables within a model. The optimal lag length selections in the VAR must be satisfied to apply Johansen's approach, which is relatively sensitive to lag lengths. In this study, the optimal lag selections are based on AIC and Final Prediction Error (FPE). Once the cointegration is confirmed to exist between variables, then the third step entails the construction of error correction mechanism to model dynamic relationship. The purpose of the error correction model is to indicate the speed of adjustment from the short-term equilibrium to the long-term equilibrium state. Since the variables are supposed to be cointegrated, then in the short run, deviations from this long-term equilibrium will provide feedback on the changes in the dependent variables in order to force their movements towards the long-term equilibrium state. Hence, the cointegrated vectors from which the error correction terms are derived are each indicating an independent direction where a stable meaningful long-term equilibrium state exists.

Also, the causality relationship should be examined with the Vector Error Correction Model (VECM) method. Because if there is a cointegration relationship, there must be at least one directional causality relationship between the variables (Granger, 1988). Equation of this method is as follows:

$$\Delta Y_t = \alpha_1 + \sum_{i=1}^{p} \beta_i \Delta Y_{t-i} + \sum_{i=1}^{p} \gamma_i \Delta X_{t-i} + \varphi_1 ECT_{t-1} + u_t \quad (3)$$

In Equation (1), γ_i coefficients test short-term causality and φ_1 coefficient tests long-term causality. If $\gamma_i \neq 0$ (significant), it shows short-term causality, and if $\varphi_1 \neq 0$ (significant), it shows long-term causality relationship X to Y. Δ shows the change in the independent variables and ECT_{t-1} is the lagged error correction term. Where β_i shows the speed by which the disequilibrium in short- and long-term values is adjusted by a contribution of the independent variables.

4. Empirical Result

4.1. Unit root test

Many studies point out that using non-stationary macroeconomic variables in time series analysis causes superiority problems in regression. Thus, a unit root test should precede any empirical study employing such variables. All the variables under study must be stationary, otherwise spurious regression may be found. Henceforth, the Phillip Perron (PP) Unit Root Test has been implemented to ensure that all the variables in the regression equation are stationary. The result is shown below:

Table 2. PP unit root test results

Variable	Level	t-statistics	P-Value	Result	Level	t-statistics	P-Value	Result
LnBPLs	Level	-1.4213	0.5617	Accept Null	1st difference	-4.3296	0.0015*	Reject Null
LnMLR	Level	-1.6327	0.4565	Accept Null	1st difference	-2.9435	0.0497**	Reject Null
LnCPI	Level	-1.5142	0.516	Accept Null	1st difference	-5.9463	0.0000*	Reject Null
LnEXR	Level	3.0468	1.0000	Accept Null	1st difference	-5.0218	0.0002*	Reject Null
LnM2	Level	-0.4967	0.8811	Accept Null	1st difference	-5.1610	0.0001*	Reject Null

Source: own computation
Note: the * indicate significant at 1%, and ** at 5%

The interpretation is that in level data, the p-values are higher than specified significance levels 0.05 (5%) and 0.01 (1%). So, we failed to reject the null hypothesis in both cases, at a 5% level critical value and at a 1% level critical value. Even at a 10% (0.1) level critical value, the study failed to reject the null hypothesis. Therefore, all the series are not stationary at level, the first differences of the non-stationary variables are taken. In Table 2, all the variables, in PP unit root test become stationary when their first differences are taken I (1).

Table 3. Optimal lag length

Lag	LogL	LR	FPE	AIC	SC	HQ
0	220.1303	NA	4.44E-12	-11.95168	-11.73175	-11.87492
1	436.3274	360.3284	1.10E-16	-22.57374	-21.25414*	-22.11317
2	468.5526	44.75724*	8.01E-17*	-22.97514	-20.55588	-22.13076*
3	497.8376	32.53891	7.96e-17	-23.2132	-19.69427	-21.985
4	526.442	23.83697	1.08E-16	-23.41344*	-18.79485	-21.80143

Source: own computation

In order to determine optimal lag length of residuals, usual criteria were used. These are the following: Schwarz's Bayesian Criterion, Akaike's Information

Criterion, Hannan-Quinn Information Criterion, likelihood ratio, and Final Prediction Error. The criteria state that two is the optimal lag length (Table 3.)

4.2. Cointegration test

To analyze the Cointegrating relationships between the variables, the Johansen co-integration test is applied. Cointegration relationships indicate whether the variables are connected in the long term and consequently they converge to a common long-term equilibrium. The results for the Johansen cointegration test based on trace and maximum-eigen statistic are presented in Tables 4 and 5.

Table 4. Cointegration Analysis Trace statistic

Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.740927	103.8490	79.34145	0.0002
At most 1	0.477534	55.22575	55.24578	0.0502
At most 2	0.381082	31.85473	35.01090	0.1048
At most 3	0.262691	14.58255	18.39771	0.1577
At most 4	0.095455	3.611618	3.841465	0.0574
Trace test indicates 1 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				

Source: own computation

Table 5. Cointegration Analysis Maximum Eigenvalue statistic

Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.740927	48.62323	37.16359	0.0016
At most 1	0.477534	23.37103	30.81507	0.3068
At most 2	0.381082	17.27218	24.25202	0.3177
At most 3	0.262691	10.97093	17.14769	0.3140
At most 4	0.095455	3.611618	3.841465	0.0574
Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				

Source: own computation

The study's outcomes demonstrate the rejection of the null hypothesis of no cointegration for both trace and maximum eigenvalues in Tables 4 and 5. Furthermore, it indicates the presence of a single cointegration vector, exceeding the critical value at a 5% level of significance. This confirmation of cointegration between Non-Performing Loans (NPLs) and the selected macroeconomic variables, as indicated by the null hypothesis rejection in both trace and maximum eigenvalue examinations, validates the utilization of VECM (Vector Error Correction Model).

These findings underscore the existence of a stable long-term equilibrium relationship, signifying shared information among these variables over time. Consequently, the application of VECM is justified, given its appropriateness for systems characterized by cointegration, facilitating the exploration of both short-

term dynamics and long-term associations. Moreover, the identification of a single cointegration vector surpassing critical values at the 5% significance level reaffirms the aptness of VECM in capturing the essential interactions between NPLs and macroeconomic variables. Therefore, the results not only substantiate the necessity of error correction modeling but also emphasize the robustness and dependability of VECM in elucidating the intricate interplay between NPLs and the broader economic context.

4.3. Vector error correction model

Since the Johansen cointegration test has shown existence of one cointegration vector, the Vector Error Correction Model was applied in order to adequately measure and model dynamics of changes and causality between variables. The long run relationship among variable is as follow:

$$ETC_{t-1} = y_{t-1} - \beta_0 - \beta_1 X_{t-1}$$

$$ETC_{t-1} = 1.000lnnpl_{t-1} - 47.567 - 9.227lnmlr_{t-1} - 4.545lnm2_{t-1} + 7.478lnexc_{t-1} + 10.828lncpi_{t-1} \quad (4)$$

Table 6 presents the results of the long-term relationship among the variables. It reveals that there is a positive relationship between lending interest rate and money supply with non-performing loans (NPLs), while the nominal exchange rate and CPI inflation exhibit a negative relationship with NPLs in the long term. All the coefficients are statistically significant at the 1% level, as indicated by their t-statistic values.

Table 6. Estimates of Vector Error Correction Estimation

Variable	Coefficient	T-statistic
Long run		
LNNPL(-1)	1.000000	
LNMLR(-1)	-9.227786	-13.4967
LNM2(-1)	-4.545655	-14.9972
LNEXC(-1)	7.477814	14.3106
LNCPI(-1)	10.82847	13.3588
C	-47.5673	

Source: own computation
Note: significant a own computation t 1% level

Specifically, the lending interest rate has a significant positive impact on NPLs, implying that an increase in the lending interest rate is associated with a rise in NPLs. This finding can be explained by the fact that higher interest rates reduce the capacity of borrowers to meet their loan obligations. This result is consistent with previous studies conducted by Nkusu (2011), Adebola et al. (2011), and Berge–Boye (2007).

In the case of money supply, this result may be explained by the fact that the expanded money supply has the capacity to extend credit more readily. This boost in

lending activity can stimulate various economic sectors, leading to increased investment, consumption, and overall economic activity. While an increase in lending activity can contribute to economic growth, it also carries certain risks. One potential risk is that banks, in their eagerness to lend, may become less stringent in their evaluation of borrowers' creditworthiness. In other words, they may relax their credit standards or criteria for granting loans. This relaxation can be driven by the desire to capture a larger share of the lending market and to meet the increased demand for credit. However, when credit standards are lowered, there is a greater likelihood of loans being extended to borrowers who may not have been considered creditworthy under stricter lending criteria. These borrowers might have a higher risk of defaulting on their loans due to their financial circumstances or inability to meet their repayment obligations. Over time, as loans are extended to riskier borrowers and economic conditions fluctuate, some of these borrowers may struggle to repay their debts. This situation can result in a higher incidence of non-performing loans within banks' portfolios. The result of the study in line with the study by Badar et al. (2013), Akinlo–Emmanuel (2014).

In case of exchange rates, the results are contrary to the initial hypothesis, which indicate that the exchange rate has a positive relationship with NPLs. However, the empirical findings from Roy (2014) on the impact of macroeconomic factors on non-performing loans in the Indian banking industry reveal an unexpected result: an increase in exchange rates, or a depreciation of currency rates, leads to a reduction in NPLs. This finding challenges the anticipated relationship between NPLs and the exchange rate, suggesting the possibility of an inverted linkage, which merits further exploration.

Regarding inflation, the study has revealed a negative association between inflation and NPLs. This finding suggests that inflation may have a beneficial effect on debt servicing capacity by reducing the value of outstanding debt or the principal sum, thereby influencing NPLs. This aligns with the findings of a study conducted by Klein (2013), which highlighted that higher inflation leads to a decline in real debt services and consequently contributes to a decrease in non-performing loans.

4.4. Short run dynamic

In the context of short-term dynamics, the Error Correlation Coefficient plays a pivotal role in quantifying the speed at which a statistical model responds to and corrects deviations or disruptions from the equilibrium. This coefficient reflects the level of correlation among errors or discrepancies observed within a short time frame, providing insights into how rapidly a model adjusts to restore equilibrium conditions following perturbations. In essence, it quantifies the model's agility in adapting to short-term variations and its ability to minimize the persistence of discrepancies during these transient periods.

Table 7. Error Correction coefficient

	D(LNNPL)	D(LNMLR)	D(LNM2)	D(LNEXC)
ECT	-0.14429	0.013394	0.034776	-0.00349
T-statistic	[-3.11511]	[0.60139]	[1.46239]	[-0.23127]

Source: own computation

The coefficient of the error-correction term estimated in the NPLs equation (as presented in Table 7) exhibits statistical significance and a negative value. This finding provides empirical evidence of a convergent process from short-term dynamics towards a long-term equilibrium among the independent and dependent variables, significant at the 5% level of significance. The magnitude of this coefficient, quantified at -0.144, signifies the rate at which adjustments occur when the system experiences disequilibrium.

To elucidate, the speed of correction when transitioning from a state of disequilibrium to long-term equilibrium amounts to approximately 14.4% of the initial disequilibrium observed within NPLs. Specifically, this implies that, in practice, 14.4% of the initial deviation from equilibrium in NPLs is rectified over each adjustment period.

For the exchange rate variable, the adjustment coefficient also carries a negative sign, although it lacks statistical significance. In contrast, for the interest rate and money supply variables, the adjustment coefficients exhibit positive values. This positive sign indicates a relative absence of significant adjustments toward long-term equilibrium in situations characterized by disequilibrium, suggesting a less pronounced correction process for these variables.

Table 8. Vector error correction model: short run dynamic

Variable	Coefficient	t-Statistic	Prob.
ECT	-0.144289	-3.115107	0.0039
LNNPL(-1)	0.121906	0.653181	0.5185
LNMLR(-1)	-1.941435	-3.159486	0.0035
LNM2(-1)	-0.419074	-1.200234	0.2391
LNEXC(-1)	0.36963	0.637907	0.5282
LNCPI(-1)	0.409303	1.515903	0.1397
C	-0.005492	-0.326463	0.7463

Source: own computation

Table 8 indicates that among the independent variables this is only lending interest rate that is statistically significant at the 5% level. Specifically, the most influential determinant of the NPLs' short term dynamics is the change of lending interest rate which indicates that lending interest rate has a causal relationship with NPLs in the short run. An increase of interest rates leads to higher debt service costs and due to the higher debt burden of economic agents the amount of non-performing loans increase and cause a rise in NPLs. The analyses also suggest that in the short

term exchange rate is associated with an increase in NPLs but not significantly. This indeed suggests that an appreciation of the exchange rate may weaken the performance of the export-oriented sectors, thereby exacerbating a banking crisis.

4.5. Causality test

In order to determine the causal relationship between the variables, Granger causality tests were applied using the same lag length as in the VECM. The null hypothesis of this test indicates non-causality and the alternative hypothesis in the case of a rejection indicating causality between the dependent and independent variables.

Table 9. Pairwise Granger causality test

Null Hypothesis:	**Observations**	**F-Statistic**	**Probability**	**Result**
LNMLR does not Granger Cause LNNPL		0.18521	0.6695	Accepted null
LNNPL does not Granger Cause LNMLR	39	7.14488	0.0112	Rejected null
LNM2 does not Granger Cause LNNPL	39	6.10646	0.0183	Rejected null
LNNPL does not Granger Cause LNM2		3.97801	0.0537	Accepted null
LNEXC does not Granger Cause LNNPL	39	11.1231	0.002	Rejected null
LNNPL does not Granger Cause LNEXC		0.78488	0.3815	Accepted null
LNCPI does not Granger Cause LNNPL	39	0.5587	0.4596	Accepted null
LNNPL does not Granger Cause LNCPI		3.45174	0.0714	Accepted null

Source: own computation

Table 9 presents the results of Granger causality tests examining the causal relationships between Non-Performing Loans and independent variables. The outcomes of these tests indicate that the null hypothesis of no causality from NPLs to the Lending Interest Rate (MLR) has been rejected, suggesting a causal relationship from NPLs to MLR. However, the hypothesis that MLR causes NPLs was accepted, implying no causal link from MLR to NPLs. This indicates a unidirectional causality running from NPLs to MLR, where changes in NPLs affect MLR, but the reverse is not supported.

Regarding the relationship between M2 (Money Supply) and NPLs, the study found evidence of causality running from M2 to NPLs, indicating that changes in money supply affect NPLs. However, there was no significant evidence of causality from NPLs to M2, suggesting that NPLs do not significantly impact money supply changes. Additionally, the analysis revealed that the Exchange Rate (EXC) Granger causes NPLs, implying that changes in exchange rates influence NPLs. Conversely, there was no evidence of causality from NPLs to EXC, indicating that NPLs do not significantly affect exchange rate fluctuations.

The apparent contradiction arises because the initial interpretation suggested that higher MLR leads to higher NPLs, while the causality results imply that changes in NPLs affect MLR but not the other way around. It is important to clarify that the Granger causality tests examine temporal relationships and directional causality. The positive impact of lending interest rates on NPLs, as discussed previously, pertains to the contemporaneous relationship between these variables and may reflect their long-term equilibrium dynamics. The Granger causality tests, on the other hand, focus on whether changes in one variable can predict changes in another variable over time. In this context, they reveal that NPLs can predict changes in lending interest rates

(MLR), suggesting that NPLs influence MLR in the short term. However, they do not necessarily contradict the long-term relationship between lending interest rates and NPLs, which may still hold but is not captured by the Granger causality tests.

4.6. Diagnostic test

VECM model is applied to investigate the existence of long-term and short-term effects among the variables. Diagnostic tests were also carried out to check whether the study results are reliable and valid. Heteroskedasticity has been conducted to examine the model's quality of this study since heteroskedasticity is considered a major problem in any regression model. For autocorrelation, the Breusch–Godfrey LM test is applied due to the method examining a higher order of correction.

Table 10. Diagnostic test

Test	**Null Hypothesis**	**p-value**	**result**
Heteroskedasticity	No Heteroscedasticity	0.1198	Accept null hypothesis
Breusch–Godfrey	No serial correlation	0.2093	Accept null hypothesis

Source: own computation

Table 10 reports the results of diagnostic tests, Breusch–Godfrey serial correlation LM tests show that no serial correlation problem exists with the model. Breusch Pagan Godfrey test for checking Heteroskedasticity shows that P value is higher than 0.05, which means that Heteroskedasticity has been removed. Therefore, the diagnostic tests that were carried out suggest that all results are reliable and valid.

5. Conclusion

The banking industry plays a pivotal role in a country's economy and is considered the cornerstone of its financial transactions. This study has aimed to contribute to the existing literature on non-performing loans by empirically investigating the factors that account for changes in NPLs within the banking sector of Lao PDR. Given that Lao PDR is a developing country, the activities of the banking sector assume a crucial role in the overall health of the economy, as commercial banks dominate the financial intermediation market in such countries.

This study covers the period from 2012 to 2021 and utilizes quarterly data to analyze the effects of macroeconomic variables, namely, lending interest rate, money supply, exchange rate, and consumer price index, on NPLs. The results of the study reveal a long-term relationship between NPLs and these macroeconomic variables, specifically taht an increase in lending interest rate and money supply tend to raise NPLs in the long run, while only the lending rate has a short-term impact on NPLs.

These findings suggest that controlling lending rates within the banking sector can prove advantageous in the management of NPLs over time. Consequently, policymakers should exercise vigilance when implementing policies that lead to substantial increases in lending interest rates and money supply. Such policies may

contribute to a prolonged escalation in NPLs. Policymakers must strike a delicate balance between stimulating economic growth through monetary measures and managing the associated financial stability risks. A comprehensive assessment of monetary policies, including interest rate controls, is imperative. While the study underscores the potential long-term impact of increasing lending interest rates on NPLs, policymakers should also consider broader ramifications on the banking sector and the overall economy, including negative effects via other channels.

Financial institutions should continuously refine their risk assessment models to incorporate the effects of money supply fluctuations on their portfolios. This involves evaluating how changes in the money supply may influence borrower behavior, credit risk, and liquidity risk. Regulatory authorities can play a pivotal role in encouraging banks to adopt more advanced risk modeling techniques. Additionally, banks should maintain stringent credit underwriting standards, refraining from extending loans to less creditworthy borrowers, especially during periods characterized by significant M2 growth.

The present study has certain limitations. It focuses solely on the influence of macroeconomic factors on the NPL rate, omitting the consideration of bank-specific factors that could potentially have a significant impact on the increasing NPLs within the banking sector of Lao PDR. To address these limitations, future research should explore additional avenues. One potential direction is to conduct studies at a disaggregated level by analyzing loans based on specific purposes, such as commercial, residential, and real estate mortgages. Another avenue is to examine the interactions and relationships between non-performing loans and different types of borrowers, including individuals/households, small and medium-sized enterprises, and corporate borrowers. This analysis would help identify the sectors that contribute the most to NPLs within the economy, potentially leading to financial sector instability.

Furthermore, a notable limitation that could potentially impact the outcomes of this study is the unavailability of data on certain critical factors. This data gap can hinder the depth and accuracy of this analysis, as it restricts this study's ability to comprehensively assess the intricate relationships between various variables. In particular, the absence of data related to key influencing factors might result in an incomplete understanding of the dynamics at play. This limitation underscores the importance of considering the available data's scope and reliability when drawing conclusions from the study's findings. Future research should prioritize efforts to obtain more comprehensive datasets to enhance the robustness of analyses in this domain.

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Chapter III
Societal and Cultural Aspects in the Era of Green and Digital Transitions

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The meaning of social resilience: Interdisciplinary status or a new viewpoint?

Balázs Mahler

In recent decades, resilience has risen in economic and social sciences, especially after the worldwide financial and pandemic crises. According to the interdisciplinary status, several points of view about resilience are not precisely defined in the studies. Furthermore, resilience indicators are very diverse, and no standard agreeable indicator is set in economic or sociological studies. At the same time, it is arguable whether it needs any proper indicator set. This paper considers the social and economic indicator set of the studies of the last couple of years to cluster them and analyse the meaning of social resilience from a sociological and economic point of view. Based on the analysis, the study's results aim to enlighten the role of social resilience in the current economic and sociological studies and search for the answer to the following question: Is resilience a new interdisciplinary way or 'just' a unique viewpoint in current social sciences and economics?

Keywords: resilience, social resilience, indicators, interdisciplinary, social sciences, definition

1. Introduction

In the last decade, especially in the wake of various natural and economic crises, scientific discourse has increasingly focused on attempts to define and measure resilience. However, the literature gives a rather differentiated picture of the phenomenon of resilience, depending on the perspective of the discipline (e.g. economic, social, natural sciences, etc.) and on what is meant by it. Although attempts have been made to define different frameworks and to classify the phenomenon in different ways, these are not necessarily reflected at the level of measurement. At present, we can say that everyone understands resilience in terms of what they really want. This is of course not a problem in the ever-changing scientific environment, but it is worthwhile to examine from time to time what exactly the measurements are actually aimed at, and from this we can draw conclusions about what is actually at the root of resilience.

The aim of this study is therefore to examine the measurement of resilience, and specifically social resilience. The focus of this study is on social resilience primarily because both economic and environmental responses to disasters can be interpreted in economic or social terms, but social resilience is the less tangible of the two. It can be interpreted from different perspectives, and thus can be measured with a wide range of indicators, and its representation in the literature is accordingly quite differentiated. It must be emphasized, however, that because of the different theoretical bases it is difficult to compare the indicators of studies.

In this study, therefore, after presenting the literature, I will attempt to group the sets of indicators used to study social resilience, both to provide a framework for

interpreting the concept and to highlight the aspects from which science currently interprets this phenomenon.

The main aim of this study is to contribute to the ongoing discourse on the role and interpretation of resilience in social sciences and economics, and to provide a new contribution to the framing and interpretation of the concept through the results of this research.

In the first part of the paper, I will review the scientific understanding of resilience, then I will present a theoretical framework for peer resilience, followed by some examples of its measurement in practice. The present paper is based on a literature review of studies published between 2021 and 2023 and attempts to categorize the indicators used in them. A total of 21 studies were examined and the results are presented in Section 4. The methodological description of the research is presented in Section 3.

2. Theoretical background

2.1. Resilience theories

In the last two decades, the concept of resilience has achieved significant "success" in both scientific and everyday discourse. A term originally originating in engineering, it has gained ground in the humanities (Szabó, 2017), then in ecology (Békési, 2002), social sciences, regional and economic sciences, and has become an interdisciplinary notion (Békési, 2002).

Resilience, in its original meaning, refers to the resilience of an object, organism, ecosystem, or even a regional economic system or a well-defined functional part of it, the labor market, to the extent to which it can respond to, adapt to, and recover from challenges, either by returning to its original state or by partially adapting and changing its characteristics to a new state of stability (Martin, 2012).

It is important to highlight the protection factor ability of resilience (Maclean et al. 2014), i.e. the interpretative framework that resilience can always be defined in terms of a disaster that is occurring or has already occurred. However, it should also be noted that the majority of studies have generally understood it in terms of a specific, sudden-onset and fast-evolving disaster, but following the COVID-19 pandemic, this interpretation has been reassessed (Champlin et al., 2023) and can be considered valid for explaining the effects of protracted crises.

The evolution of the concept initially sought to describe society's relationship with nature, as continuous development implied a degree of adaptability on the part of social relations, but today resilience is used to describe the transformation associated with global and environmental changes and challenges (Keck–Sakdapolrak, 2013).

A relevant and regularly cited economic approach to defining resilience has also been developed by Martin and Sunley (2015). According to their theoretical framework, three main definitions of resilience can be distinguished, these being (1) 'bouncing back' from shocks, i.e. technical or engineering resilience, which has been mentioned earlier; (2) 'extended ecological resilience', which assumes the absorptive capacity of a given system, such that the fundamental properties of the system remain

unchanged; and (3) "positive adaptivity", i.e. the system responds to shocks by incorporating them into itself, and thus its fundamental properties change.

The typological approach is taken a step further by Davidson et al. (2016) who reviewed a large spectrum of literature to establish a systematic principle and investigated whether resilience can ultimately be considered a kind of pre-paradigmatic theoretical framework. Their results distinguish three types of resilience, based on different conceptual elements: (1) basic, (2) adaptive and (3) transformative. In their view, resilience can be considered as a phenomenon in its present state as preparadigmatic, mainly because it is a rather differentiated field both in terms of conceptual frameworks and methodological approaches, and the lack of consensus and unclear positions make it difficult to represent it as a discipline.

The next step, based on the experience of the literature in recent years, was differentiation. In the academic discourse, resilience has emerged in relation to different socio-economic subsystems. Today, we can talk about economic, social, socio-ecological, community, community disaster, urban, and regional resilience (Bueno et al., 2021; Davidson et al., 2016; Kwok et al., 2016; Lester–Nguyen, 2016; Maclean et al., 2014; Martin, 2012; Saja et al., 2019; Stone-Jovicich, 2015; Suleimany et al., 2022). This has been accompanied by a different dimensional division of the concept, namely, personal and social resilience (Keijzer et al., 2021), which aims to approach the notion from an individual and collective perspective.

Some theories suggest a hierarchy and grouping of different types of resilience, such as social, demographic, economic, community, institutional, infrastructural, and environmental resilience as sub-systems of urban resilience (Yang et al., 2022).

A further aspect of the interpretation of resilience is its dynamics, i.e. whether it is seen as a process or an output (Keck–Sakdapolrak, 2013; Saja et al., 2021). The vast majority of analyses tend to focus on a particular state, i.e. they disregard its dynamic aspect, while several theorists have argued that the process capability cannot be separated from the resilience (Keck–Sakdapolrak, 2013). However, the study of both aspects provides important contributions to the understanding of resilience.

It can be argued that there is no single theoretical framework, if only because resilience balances on the intersection of several disciplines (e.g. economic and social sciences, natural sciences, disaster management, geography, and behavioral science, etc.) (Champlin et al., 2023), so that contributions from several places add color but also complicate a single interpretation.

2.2. Types of Resilience

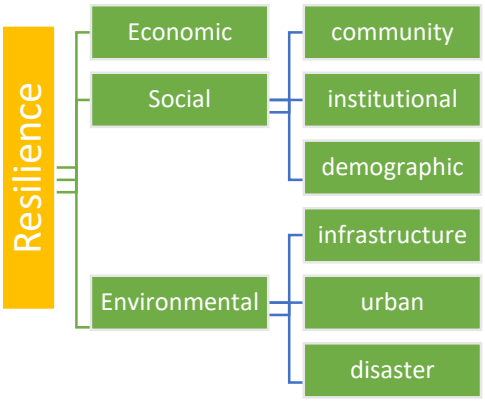
For a better overview of the different types of resilience, it is useful to frame the theoretical approaches from a social science perspective.

In my interpretation, contrary to Yang et al.'s (2022) view that urban resilience has a kind of integrating function, assuming a hierarchical system, I distinguish three broad categories of resilience: economic, social, and environmental.

In the present breakdown, economic resilience has not been further subdivided, but it can be extended in the future. Social resilience builds on the resilience built up by social relationships, and, as mentioned above, it includes

community resilience, demographic resilience, and institutional resilience. Environmental resilience refers primarily to existing physical assets, which is why infrastructure, urban and disaster resilience are included.

Figure 1. Species of resilience



Source: own construction

2.3. Social resilience

As mentioned in the introduction, I will now narrow the theoretical overview to social resilience. The interpretative framework of social resilience, like that of resilience in general, is not well developed in the literature. Moreover, according to Keck and Sakdapolrak (2013), there is some doubt as to whether social resilience is a suitable description of social concepts at all. Some authors see the interdisciplinary nature of the subject as a positive element, while others criticize it for obscuring the social, power, or essentially sociological nature of the processes.

Keck and Sakdapolrak's (2013) literature review concluded that three aspects of social resilience can be described: (1) coping capacity, (2) adaptive capacity, and (3) transformative capacity. In addition to these, they took into account the main determinants of social resilience, which are:

A) Social relations and network structures (social capital, trust, reciprocity, mutual support, and informal social interactions).
B) Institutions and power relations (means of access of individuals to resources, the role of institutional determination in relation to socio-economic system and structure, cultural capital, losers and winners in the construction of resilience).
C) Knowledge and discourses (the role of culture, perception of danger, preferences, knowledge and experience at individual and social level).

Besides the various typological experiments, an important finding is that social or societal resilience can be described as a dynamic process rather than as a statement of fact or a characteristic of a social group and is, therefore, more difficult to capture. In the same way, resilience can be understood in relation to the economic,

social, institutional, and ecological context rather than in isolation, which illustrates the complexity of the concept. Furthermore, social learning, participatory decision-making, and the capacity for collective transformation are seen as central to social resilience, while technological innovation and power relations naturally have a significant impact on such transformation. It also follows that resilience can also be understood in terms of political or power relations.

From the above, it is clear that a kind of definition of the conceptual framework has begun in the literature, a theoretical mapping of the concept and its integration into different theoretical frameworks. It also appears that, from the perspective of several disciplines, resilience, and within this, of social resilience, can be conceptualized mainly as a new methodological approach, or even more as a way of looking at things, a perspective of investigation, rather than as a complex structure. The question is, however, whether a uniform interpretation is needed at all? Is there a set of criteria on the basis of which this can be done, and is there a rational reason why?

2.4. Resilience in practice

A substantial body of social and economic literature on the practical measurement of resilience, and, within it, social resilience, has developed over the last two decades. Due to the conceptual dissonances discussed above, this research is rather scattered in terms of its nature, methodology, and, where relevant, subject matter. In what follows, I will illustrate, mainly with examples from the economic and labor market field, that the extent of resilience is usually measured using a methodology of statistical modelling based on economic theories.

Some of the analyses were based on a single country or on a comparison between two countries. The labor markets of Belgium and the Netherlands coped well with the economic crisis of 2008-2010 compared to the EU average, as examined by Fenger et al. (2014).

Only one country was studied by Håkansson and Bejaković (2020), who analyzed the Croatian labor market and explained its inertia by low mobility. A country-wide study was also conducted for Romania, measuring the resilience of the economy in terms of the ratio of employed to unemployed (Șerban–Tălângă, 2020), as was a provincial-level study for Spain, measuring the economic downturn (Villaverde–Maza, 2020).

Comparative studies have also been carried out at the European level (Czeczeli et al., 2020; Giannakis–Mamuneas, 2022), comparing the labor markets and economies of different countries using different methodologies. There have also been quantitative, questionnaire-based comparative studies of European business executives (Lengyel et al., 2017).

The ambiguity of measuring resilience is well illustrated by the results of Palaskas and colleagues (2015) comparing urban and rural areas in Greece, and the study on the economic resilience of Hungarian settlements (Szép et al., 2021). While the former measured the greater resilience of lagging regions to urban areas, the latter identified the North Transdanubian region and Budapest – i.e. the most economically developed regions – as the most resilient regions of Hungary.

The above examples also confirm that resilience is not a well-defined, conceptualized thesis, neither in a theoretical nor in a practical sense, but that a resilience approach can help in the understanding of different social problems and finding answers to challenges. It is also important to note that the impact of crises is complex, and the responses to them are differentiated, territorially, socially, and economically alike.

The above also confirms the idea that the indicator sets used to measure resilience are heterogeneous in nature, and that a conceptual analysis of these indicator sets could contribute to further clarifying the conceptual framework and standardizing measurements.

3. Methodology

3.1. Literature review of methodology

In order to define the interpretative framework of social resilience within the current scientific discourse, a systematic review of the current literature is necessary (Petticrew–Roberts, 2006). To this end, in this study I conducted a systematic search focusing on indicators found in scientific articles from a specific period. Such research has been done recently (Saja et al., 2019; Tariq et al., 2021), which, similar to the present work, aimed at defining an interpretative framework for peer resilience, but interpreting it from a broader perspective.

I used the ScienceDirect database for data collection. Three filters were set for the search criteria: first, the search term was "social resilience", second, the period under study was 2021-2023, and third, three "subject areas" were selected, namely (1) social sciences, (2) business, management and accounting, and (3) economics, econometrics and finance. The ScienceDirect database returned a total of 231 relevant hits based on the above search criteria within the time frame of the data collection, which were screened and filtered one by one according to the methodological criteria presented below. The screening criteria were as follows:

- Only articles that investigated (also) social resilience based on some existing data, databases or statistics were included in the final analysis
- No scientific papers were included in the analysis that had the above objectives but where the full range of indicators used was not clearly indicated in the article and its annexes (partial excluded).
- Only English language articles were selected.
- Only papers published in the period under review were included.

After the first round of screening, only 26 scientific articles were selected that fully met the above criteria. The next step was to analyze the selected articles in detail, one by one, by extracting the research topic, the definition of social resilience and the indicators used, and then collating, grouping and summarizing the information gathered.

A detailed analysis of the articles revealed that a further five studies were not suitable for the final analysis (e.g. the full set of indicators could not be identified, the research topic did not meet the preliminary criteria).

As mentioned in discussing the theoretical underpinnings above, since the interpretative framework of resilience was not sufficiently institutionalized, it was necessary to separately assess and classify certain reporting similarities according to analytical criteria during data processing. The words 'socio' and 'socioeconomic' were considered as such a semantic match, given that the latter, although having a broader semantic content, has a data content that is appropriate for the purposes of this study. In these cases, the obvious economic indicators were not analyzed, but the social measures were.

The analyzed papers cover a rather broad spectrum of different disciplines, from social resilience measurement in water supply systems in Tanzania (Sweya et al., 2021) to socio-economic resilience in US cities (Kumar–Mehany, 2022) to social resilience measurement in smart cities in China (Zhou et al., 2021), to name the most prominent examples, covering a wide range of fields. Nevertheless, no methodological limitation has been placed on the scope of the studies, as each valid study that understands social resilience has produced data relevant to this paper.

It is important to note that the aim of this paper is not to discuss the methodological approach or application of specific research, and therefore the scientific publications analyzed have not been narrowed down on this basis.

4. Results

4.1. Characteristics of studies[1]

The characteristics of the studies are that most of them aim at a natural science theme, including disaster prevention, and they also subordinate the issue of social resilience as a sub-area of urban or community resilience. The measurement of social resilience was mostly based on mathematical statistical methods using existing databases.

Among the studies analyzed, despite the fact that the database filtering mechanism selected only social, economic and business topics, a surprisingly high number of papers, more than half of them, are in the natural sciences (disaster risk, geography, and environmental engineering) and much fewer in the social sciences or economics.

The dominant type of resilience targeted for analysis was community and urban resilience for a total of 13 studies, in most of which the researchers categorized social resilience as part of these and measured it accordingly. In terms of methodology, I distinguish between the following:

[1] The data presented in this section are presented in tabular form in the annex.

- dominated by model building statistical analysis, e.g. the resilience of smart cities or the use of a pre-developed set of indicators (e.g. BRIC) (Javadpoor et al., 2021; Zhou et al., 2021);
- questionnaire-based survey, e.g. measuring resilience in rural settlements among the local population, or in a metropolitan environment (Alizadeh–Sharifi, 2021; Farahani–Jahansoozi, 2022; Rana et al., 2021);
- two studies used mixed (qualitative and quantitative) methodologies;
- two case studies, while
- one used a literature review only.

Of the 21 studies, 15 did not provide a clear definition of what they meant by social resilience, while the remaining six either presented their own definition or referred to definitions by other authors.

Measuring social resilience can be interpreted primarily as a response to various natural or economic impacts, but this response can always be articulated as some kind of social or economic response, and thus, for example, natural problems are also measured as economic or social resilience, as the grouping of indicators in the next subsection shows.

4.2. Analysis of social resilience indicators

From 21 studies, a total of 177 indicators were collected, with one study having the fewest, three, and one the most, 29, the latter being a questionnaire survey measuring indicators with a single attitudinal question. On average, researchers measured social resilience with 8.5 indicators per study.

The indicators have been given their final names after a series of rounds of reduction in order to make them comparable and analyzable. During the reduction process, I tried to keep most of the information content, reducing it only to the extent that the meaning of the indicator was not affected by the process (i.e. from community awareness to awareness, or from population composition to composition). During the reduction process, I ignored the sign of the indicators (i.e. 'disability' or 'without disability'), aiming only to keep the meaning.

The 177 indicators are classified in a total of 15 categories, with the most prominent being those related to demographic (18.1%), economic (11.3%) and social disadvantage (11.3%).

Table 2. Indicator groups

Indicator groups	Frequency	Percent
demographic	32	18.1
economic	20	11.3
social deprivation	20	11.3
social capital	16	9.0
personal	16	9.0
disaster specific exp	14	7.9
cooperation	12	6.8
health	12	6.8
education	10	5.6
physical	6	3.4
communication infr.	5	2.8
social network	5	2.8
organizations	4	2.3
public	2	1.1
wealth	3	1.7
Total	177	100.0

Source: own construction

The indicators in each group and the description of the groups are presented in the following table.

Table 3. Indicator set of indicator groups and descriptions

Indicator group	Related indicators	Description
communication infrastructure	internet access households with a telephone	A collection of indicators related to communication infrastructure.
cooperation	participation social capacity and adaptability social transformation and strength social cohesion social education social collective efficacy relationship social embeddedness social preparation social exchange of experiences and information	Social cooperation, including cooperation based on different social relationships and their outcomes, e.g. cohesion, embeddedness, knowledge transfer.

Indicator group	Related indicators	Description
demographic	population composition total population population over 65 years old population below age 65 age 15-64 demography (Youth - Aging) population density male-female ratio population growth college students population changes family type racial diversity teen pregnancy rate age dependency ratio urbanization rate households household size housing first responders female employment migrant crime	In addition to the basic demographic indicators (population data, age groups), the set of demographic indicators also includes various household data, urbanization rates and crime. The indicators refer to a wide range of demographic observations.
disaster specific experience	mitigation plan preventive health measures amount of risk-sharing disaster related experiences cooperation in disaster response households with swimming skill households with first aid skills preparedness risk awareness and training risk perceptions	Knowledge and experience related to disasters include different disaster prevention plans, risk-sharing ratios, and the existence of skills related to prevention and survival. All community knowledge and experience that can play a role in preventing risks and minimizing impacts.
economic	per capita GDP per capita taxes per capita income total Exports unemployment rate energy employment in tertiary industry total retail sales of social consumer goods savings purchasing power income public expenditure	In addition to economic data in the traditional sense, this includes individual economic expenditure and savings.

Indicator group	**Related indicators**	**Description**
education	Level of education and skills diversity higher education entities people in higher education high school dropout rate Education of the household head education level education expenditure education level	This group focuses on the overall level of education at the societal level, with a focus on the share of highly educated people, based on the indicators classified, both at the individual and household level. It also includes educational infrastructure and education-related expenditure as measures of educational attainment.
health	doctors hospitals health psychological diseases health infrastructure health workers health services health infrastructure	The set of health indicators covers the existence of health human capital, health infrastructure and various health services.
organizations	faith organizations public management and social organization organization	One measure of social cohesion is the existence of social (mainly religious) organizations and public support service organizations.
personal	adoption of new technologies awareness attitudes creativity experience education and awareness insurance leadership use of knowledge sense of identity	The personal group includes measures of the individual's level of skills and knowledge and certain capacities. It also includes an assessment of the existence of individual care.
physical	location of house water facilities affordable housing transport infrastructure community spaces and amenities	This group includes indicators measuring the physical infrastructure of the human environment.
public	public related employee	Although it only appeared in a small number of cases, I considered the existence of public sector resources as a separate group.
social capital	social capital social tension social trust social innovation social coping style social responsibility and commitment social support social motivation and hope social positiveness cultural/religious norms and practices trust in authorities collections of public libraries social knowledge and skills	The social capital group consists primarily of indicators measuring the experience, strength and cohesion of the local community, but also includes cultural indicators.

Indicator group	Related indicators	Description
social deprivation	inequality level poverty percentage homeless population not dependent on social assistance female headed household social - related resource dependency persons with special needs food assistance language related problems literacy status of HH persons with special needs child labor disability poverty youth dependency elderly dependency percentage of disadvantaged groups	Social deprivation is primarily a group of indicators measuring social deprivation, poverty, single-parent families and people with special needs, but also includes indicators measuring addictions, social services and language difficulties.
social network	communication social networks	Social networks are partly different from both communication- and social capital groups, this measures primarily the existence of communication between actors and the relationships between individuals.
wealth	cars per 1,000 persons own vehicle households with at least one vehicle	There are three different indicators in this group, some of which can be considered as part of the personal group, or economic indicators, based on the research, but these indicators give a better sense of the economic potential of the group under study.

Source: own construction

Each group refers to a different aspect of resilience, and the typology reveals the diversity of the notion. The analysis resulted in several sets of indicators with relatively few indicators (e.g. wealth, social network, public, organization, community infrastructure), but the studies seem to indicate that these are important segments of the measurement of social resilience, as are the groups with a much wider range of indicators (e.g. demographic, social deprivation, etc.). The grouping highlights that the measurement of social resilience has been implemented across a rather broad spectrum in the studies analyzed.

5. Conclusions and discussion

In this paper, I have reviewed the main theoretical approaches to resilience, including social resilience, and then systematically reviewed the literature to examine and group the social resilience indicators used in studies published in the years 2021-2023.

1. The results detailed in Section 4 show a broad spectrum approach, despite the fact that the concept of social resilience has not yet spread in the literature. In the analysis, I have tried to avoid over-reduction, but the result is that the types of indicator sets used to measure social resilience are quite broad, ranging from personal knowledge and values to social knowledge and the existence of a physical human infrastructure. This confirms both the diversity of theoretical approaches and the lack of a centripetal force field to bring together and articulate the phenomenon.
2. The results partly reflect the characteristics of resilience identified by Keck and Sakdapolrak (social relations and network structures, institutions and power relations, knowledge and discourse), but the indicators also shed light on new aspects such as human capital and related built infrastructure, or economic aspects. These are all elements of social resilience that are measured, but not or only peripherally addressed by theoretical approaches.
3. The methodology used was appropriate in the sense that it provided a better overview of what exactly is measured in the different studies under the heading of social resilience. Accordingly, it should be considered as a way forward and a larger sample should be further tested in the future.

One of the limitations of this study is the scope of the data extracted, as it focused only on the indicators and the definition of social resilience, so neither the results nor the conclusions drawn from them were processed. This also represents an opportunity for further work in the future. The study did not cover it, but the definitions of resilience extracted from the studies will be processed, which will allow another aspect of the phenomenon to be investigated.

In conclusion, the results of the present study add to the academic discourse on resilience, and although the attempt contained herein cannot be considered complete, it is nevertheless a way forward and an opportunity to partially systematize the interpretative problems raised by the topic of resilience.

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Annex

*Table A-1.*Field of discipline of analyzed studies

Discipline type	**Frequency**	**Percent**
disaster risk	10	47.6
economic	2	9.5
geography	2	9.5
regional	2	9.5
social	2	9.5
environmental engineering	1	4.8
socio-economic planning	1	4.8
tourism	1	4.8
Total	21	100.0

Source: own construction

Table A-2. Dominant type of resilience targeted by studies

Resilience type	**Frequency**	**Percent**
community	8	38.1
urban	5	23.8
social	4	19.0
regional	2	9.5
socioeconomic	1	4.8
disaster	1	4.8
Total	21	100.0

Source: own construction

Table A-3. Applied methods in studies

Applied methodology	**Frequency**	**Percent**
model building statistical analyses	11	52.4
questionnaire survey	5	23.8
Literature review, questionnaire	2	9.5
case study	2	9.5
literature review	1	4.8
Total	21	100.0

Source: own construction

Marianna Sávai (ed) 2024: Green and Digital Transitions: Global Insights into Sustainable Solutions, Szeged, 10.14232/gtk.gdtgiss.2024.12

Systematics literature review of non-consumption: Forms and dimensions of consumer behavior

Ágnes Maksimovic

The study uses a systematic literature review methodology to analyze the research on non-consumption, systematize it, and define the consumption behaviors associated with this phenomenon. The advantage of this method over the traditional narrative literature review is that it is designed to follow a predefined set of criteria in such a way that it can be reproduced at any time. As it precisely includes the protocol to identify the literature used, it avoids possible researcher errors. The study finds that the drivers of non-consumption include sustainability, food consumption, and voluntary simplicity but are not reduced to these groups. The findings of the review allows to situate non-consumption within the dimensions of sustainable consumption and voluntary simplification.

Keywords: non-consumption, consumer behavior, systematic literature review (SLR), voluntary simplifiers, sustainable consumption

1. Introduction

In the early 2000s, the subject of non-consumption was not frequently examined in the international marketing and consumer behavior literature. Recently, however, there has been an increasing research interest in non-consumption. I use the term non-consumers to refer to people who could buy and consume specific products but, for some reason, choose not to. While there has been an increase in interest in research on non-consumption, there are many challenges to fully understanding the phenomenon, as confirmed by the literature review conducted by Makri et al. (2020). The phenomenon of non-consumption remains to be explored in the international literature, as it is also interpreted as a habit, attitude, lifestyle, motivation, or set of practices. International researchers, however, tend to focus on the causes of non-consumption (Kozinets et al., 2010).

At this stage, the current study does not define non-consumption but identifies the consumption groups associated with non-consumption.

When a consumer does not consume, it is not only the result of a lack of motivation to consume but also of more complex motivations that lead to non-consumption. Non-consumption motives are present at both individual and collective levels. Several studies mention pro-social concerns at the collective level (Chatzidakis–Lee, 2013; Galvagno, 2011; Lee et al., 2009) and environmental concerns as triggers for non-consumption. The systematic literature review (SLR) method analyses studies according to criteria predefined by the researcher. This method ensures that empirical studies in a given area are organized according to a transparent framework. Once the literature review is completed, the research findings on the topic analyzed are reviewed. A systematic literature review has the advantage of being a reliable source, methodologically transparent, and reproducible (Tranfield

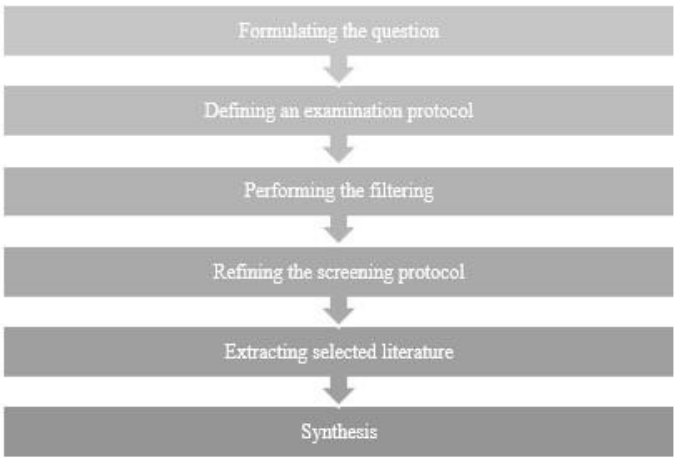
et al. 2003). In addition to the literature review, this paper includes a network diagram that is based on the co-occurrence of keywords in research related to non-consumption. This diagram serves as a helpful guide to better comprehend the phenomenon.

The current study aims to identify the forms and dimensions of consumer behavior related to non-consumption using a systematic literature review and a software tool for constructing and visualizing bibliometric networks. The study was carried out through computer and manual screening, which included a download and review of the relevant scientific literature. After the review and network diagram, studies about voluntary simplifiers and sustainable consumption were further explored. It was found out that non-consumption is a passive phenomenon compared to voluntary simplifiers, as there is no emotional response. In voluntary simplification, an individual's sense of happiness and fulfilment is also dependent on his or her consumption habits, whereas, in non-consumption, self-expression is not involved. Both phenomena aim to reduce overconsumption and they link with each other with the willingness through sustainable consumption.

2. Methodology

The Systematic Literature Review (SLR) is a scientific method in which studies relevant to the research can be identified and screened. The methodology involves gathering answers to a research question through a literature review and then assessing the answers by the researcher against the given criteria. The methodology is used to identify empirical studies related to research (Figure 1) in a transparent system. Once the literature review is completed, relevant research results are analyzed (Booth et al., 2011; Bettany-Saltikov, 2012; Booth 2016). The advantage of a systematic literature review is that it includes reliable sources, provides methodological transparency, and allows replication of such research (Tranfield et al., 2003).

Figure 1. Process of the systematic literature review method



Source: Bettany-Saltikov (2012)

This study aims to identify the forms of consumer behavior associated with non-consumption and to situate non-consumption within the consumption dimensions identified. In order to ensure reliability and high quality, two electronic databases, Web of Science (Clarivate Analytics) and Scopus (Elsevier), were explored for literature. Google Scholar was used to determine the number of citations of the selected literature independently of the previously chosen databases.

With the literature review my aim is to position non-consumption in the field of consumption and to identify the various contexts or situations in which international authors have explored the topic. I want to categorize or classify different contexts in which non-consumption has been studied in the literature. The primary objective of the study is to explore the concept of "non-consumption" within the context of consumer behavior. I am interested in understanding situations and contexts of non-consumption related activities. By examining the literature, I aim to identify trends or patterns in how non-consumption is discussed in the international literature. This could include identifying common themes, methodologies, or theoretical frameworks, potential areas for further research, policy implications, or practical applications.

On January 3, 2023, the Google Scholar search engine yielded more than 16,300 results for the search term "non-consumption" OR "non-consumption" OR "non consumption." A literature search was also performed using the Google Scholar dataset Publish and Perish (www.harzing.com). However, given that the software has a limited filtering capacity, displaying a maximum of 1,000 studies, no thematic filtering or journal filtering is possible; therefore, this database search method was discarded. A Systematic Literature Review (SLR) based on a specific methodology leads to much more accurate and transparent results using Scopus (Elsevier) or the Web of Science (Clarivate Analytics). Their advantage is that it is easy to filter relevant publications on a topic, there is no limit to the number of studies displayed, but one can export up to 999 studies from the databases.

The systematic literature review was done between March 1, 2022, and December, 31, 2022. After defining the main research question, the primary keywords closely related to non-consumption ("non-consumption" OR "non-consumption" OR "non consumption") were selected. The study was carried out in the databases ScienceDirect (Elsevier) and Web of Science (Clarivate Analytics), which are accessible in an electronic web browser. The filtering of the datasets was performed in journals in English. It is important to note that during the filtering process, some journal articles that are in fact book chapters may be listed as journals in the databases, and a researcher may come across studies that would meet the research criteria have been withdrawn by the original author. In order to avoid this type of anomaly, empirical research that was identified in the first round has been uploaded to the Zotero (https://www.zotero.org) database. The Zotero database not only supports the researcher in ensuring the credibility of the literature but also allows the preparation of annotations, the creation of bibliographies, and the export and storage of the research identified in different file formats (RIS, CSV, BibTeX).

A systematic literature search reveals little research on non-consumption in the Hungarian marketing literature. In Hungary, a particular marketing-oriented approach to this topic can be found in Törőcsik and Jakopánecz (2010) and Törőcsik et al. (2018).

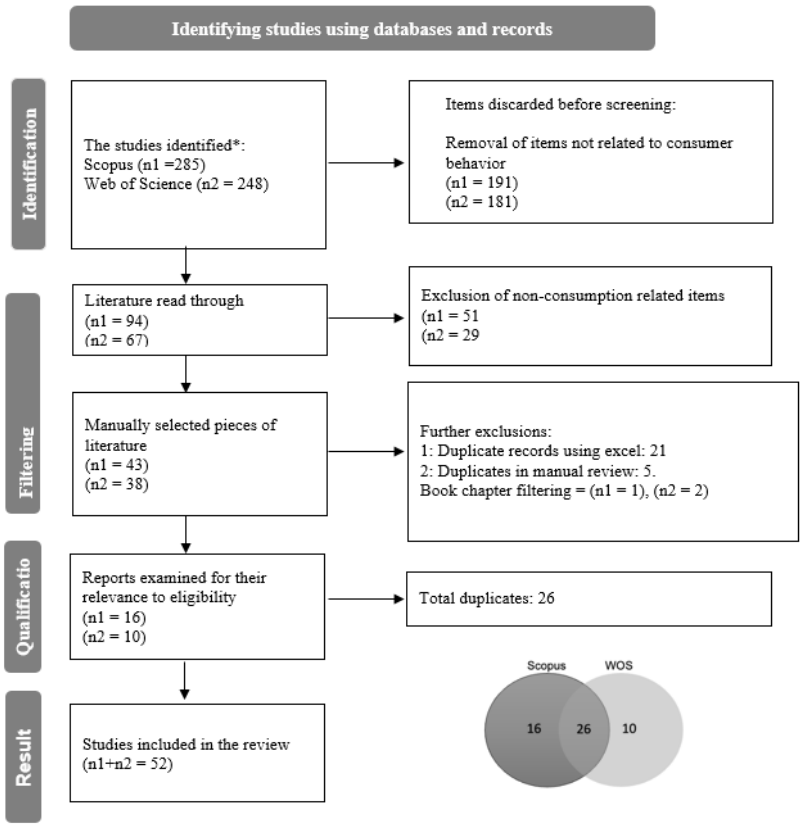
The steps of the literature search are depicted in detail in the PRISMA Flow Diagram (SLR) (Figure 2). It is important to note that several disciplines investigate the topic. In the present study, the Scopus database identifies two hundred and eighty-five journal articles in English that contain a variant of the term non-consumption in their title, abstract, or keywords. The majority of the articles in the fields of medicine (126), nursing (61), agriculture, and biological sciences (55) are related to non-consumption (Figure 2). The Web of Science database contains 248 English-language journal articles that contain the keywords under investigation.

Törőcsik and Szűcs (2021) point out that co-disciplines also study non-consumption, so it is essential to take these sciences into account. The spectrum of research, therefore (filtered from the digital database used in the first step) does not exclude sociology, psychology, management, consumer and cultural studies, cultural anthropology, or the fields of consumer behavior and non-consumption. In this way, it provides scope for a manual review, as a second step, of the analysis of the literature in which subcategories relevant to non-consumption can be identified. Research on socially harmful consumption problems was excluded (Figure 2.). In both databases, 533 pieces of literature were identified.

The computer screening was followed by a manual screening, which concluded with a download and audit of the papers. In the second step of the search, a total of one hundred and sixty-one articles, of which ninety-four Scopus (n1=94) and sixty-seven Web of Science (n2=64) articles were cataloged and scanned using the Zotero software. In reviewing the articles, it was found that eighty (n1=51, n2=29) studies were unrelated to non-consumption, so I have excluded these studies. Eighty-one studies were identified related to non-consumption in the two databases. Finally, the selected pieces of literature were imported into an excel spreadsheet, where twenty-six duplicate records were found. Even though publications that were not in scientific papers during the initial screening were discarded, three articles still slipped through the process, so these were manually deleted from the spreadsheet.

Finally, sixteen Scopus, ten Web of Science, and twenty-six pieces of literature were identified from both databases relevant to the definition of non-consumption and its definable categories relevant to marketing-oriented research (Figure 2), of which five dissect the relationship between voluntary simplifiers and non-consumption and three the relations of sustainable consumption and non-consumption.

Figure 2. PRISMA 2020 flowchart for new systematic reviews involving only searches in databases and registers



Source: Based on flowchart of the systematic literature review based on the PRISMA recommendation (Subirana et al., 2005)
Note: *From all literatures that include the terms nonconsumption, non-consumption, and non consumption in the title, abstract or keywords indicated

The results are arranged in ascending order of citations, following the systematic literature search method. Then, reading through the titles, keywords and abstracts, the three most relevant pieces of literature on non-consumption (and its various types or related consumption patterns) the most cited in Google Scholar were selected (Table 1.).

In summary, the literature review concluded that the concepts of consumer resistance, anti-consumption, sustainable consumption and the group of voluntary simplifiers should be examined and then defined in what ways they differ from non-consumption.

Table 1. Top 3 most cited and most relevant literature on the topic

	Authors and year	**Type of non-consumption**	**Place of research**	**Research method/ Data set sample, time horizon**	**Scopus**	**Web of Science**	**Google Scholar citations 12/16/2022**
1	Cherrier et al., (2011)	examining non-consumption in relation to consumer resistance and anti-consumption	Australia	16 in-depth interviews with women who are deliberately not consuming in the interests of sustainability.	144	128	305
2	Portwood-Stacer (2013)	This study examines consumer resistance to Facebook among non-users. It identifies a group of media rejecting , non-users and conspicuous non-consumers	North America, Europe, Africa, Asia and Oceania.	It draws on around 100 online and print publications and 20 personal interviews with Facebook alumni between 2006 and 2012.	140	112	287
3	Shaw–Moraes (2009)	The aim of the study is to better understand the interaction between voluntary simplicity, (non-)consumption practices and the market. Voluntary simplifiers, sustainable consumption	Scotland	In-depth interview with 28 rural volunteer simplifiers.	do not exist	77	191

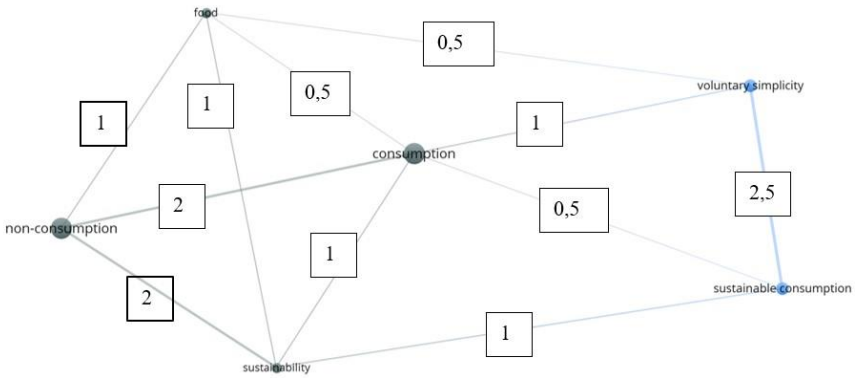
Source: own construction

For the research, it may also be important to connect, represent and cluster the data. When researching a new topic of narrow interest, a limited number of researchers may have published academic papers and findings on the topic. Thus, linkages between publications and findings may be observed. In order to avoid these connections and to maintain the heterogeneity of systematic literature research, the links between researchers have been investigated. VOSviewert software visualizes the links between the subject and the authors. As there is non-consumption related research in two databases, simple export is insufficient to represent the relationships. Data will be exported from Scopus and Web of Science databases and imported into Zotero. Then the results of the two databases will be merged and exported from Zotero in the appropriate format (RIS) to build and

visualize bibliometric networks in VOSviewer. Finally, 59 identified studies were imported into the visualization software.

The combined use of keywords in the selected literature is illustrated in Figure 3. The software identifies two clusters, one for non-consumption, one for sustainability, and one for consumption. Another cluster includes the keywords sustainable consumption and voluntary simplifiers. The link between voluntary simplifiers and sustainable consumption is the strongest (2.5), followed by the link between non-consumption and consumption (2) and the link between non-consumption and sustainability (2). The two clusters are linked by consumption.

Figure 3. Co-occurrence of keywords in the systematics literature review



Source: own construction

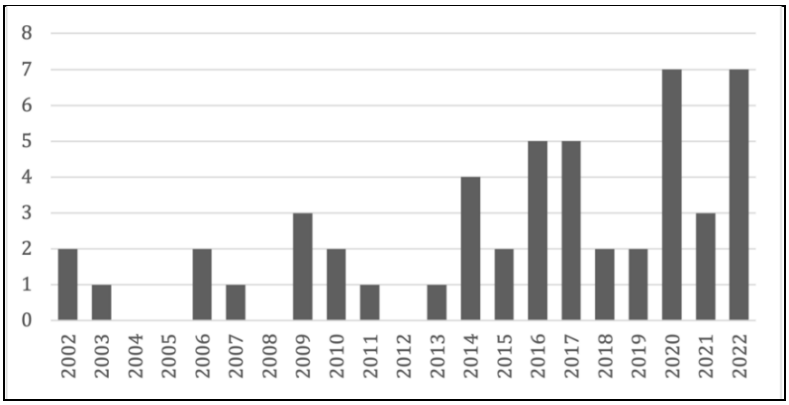
The link between consumption patterns and non-consumption can be supported by co-occurrence analysis using the bibliometric analysis software VOSviewer. It uses bibliometric data (e.g. author, abstract, references, and keywords) from Scopus and Web Of Science databases to explore interrelated topics, concepts, and phenomena. The VOSviewer software displays these relationships in the form of a network diagram, which can be useful in defining the dimension of non-consumption. In the diagram, the elements are displayed in the form of circles, where the size of the circles represents their weight. The elements are grouped into clusters according to the most interrelated thematic areas, which the software indicates by coloring. The thickness of the lines represents the relationship between keywords and is derived from the frequency of co-occurrence of each keyword in different documents (van Eck–Waltman, 2010).

3. Results

It can be concluded that non-consumption concerns researchers in Australia, Scotland, and the US. The research method used by the three most frequently cited articles was the in-depth interview. A research time horizon was identified for one published paper.

It is equally relevant to examine how the number of published research papers on the topic is evolving. Thirteen studies were published between 2002 and 2012 and thirty-nine between 2013 and 2022. The *European Journal of Marketing, International Journal of Consumer Studies*, *Journal of Consumer Culture*, and *Sustainability* are the journals in which the most frequently published research on non-consumption is published. These journals also show that the marketing orientation of the topic has been adopted and that it is not negligible to look at sustainability alongside consumer behavior. A systematic literature search confirms that the number of studies about non-consumption in marketing has increased since 2002 (Figure 4). Between 2002 and 2012, 2 or 3 studies were published per year, with increases from 2014, when between 4 and 7 studies were published annually on the subject.

Figure 4. Yearly publication of 59 non-consumption-related research studies identified through a systematic literature search



Source: own construction

3.1. Forms of consumer behavior related to non-consumption identified through a systematic literature review

Nowadays, refraining from purchasing due to ethical considerations is common, and companies must acknowledge and address this trend. Non-consumption has been a subject of scholarly research since the 1990s, focusing on ethical consumption (Cooper-Martin–Holbrook, 1993). There is an increasing emphasis on the adverse effects of overconsumption, as demonstrated by recent studies (Han, 2019; Hankiss, 2000; Zavetoski, 2002). Experts view non-consumption as an objective fact devoid of any emotional connotations. However, the term "anti-consumption", for example, is often used to describe the emotional resistance, dissociation, and avoidance of consumption, encompassed within the broader category of non-consumption (Lee–Seo, 2016).

The impact of non-consumption extends beyond individual consumers and affects the economy and society at various levels, including the firm, industry, and societal levels. Therefore, it is essential to recognize that the consequences of consumer behavior are intertwined with broader contextual factors.

According to García-De-Frutos and Ortega-Egea (2015), non-consumption is defined in the international literature as a habit, by Galvagno (2011) as an attitude, by Cherrier and Murray (2007) as a lifestyle, and Cherrier (2009) as a set of practices. For this reason, it is not clear how to classify the phenomenon and what methods to use to investigate it. A systematic literature review conducted by Makri et al. (2020) finds that international researchers mainly focus on the reasons for non-consumption (Kozinets et al., 2010). If a consumer does not consume, he or she does not refrain from consumption, not only because of a lack of motivation. The phenomenon is also present at individual and collective levels. At the collective level, pro-social concerns (Chatzidakis–Lee, 2013; Galvagno, 2011; Lee et al., 2009) and ecological concerns (Cherrier, 2009; Hutter–Hoffmann, 2013; Iyer–Muncy, 2009) may motivate non-consumption. The case of non-consumption or non-purchase cannot be clearly classified as a positive or negative phenomenon. For example, the social perception may be positive if someone does not buy material goods because of sustainability concerns, but it may also be negative if someone does not eat healthy. Non-consumption or non-purchase can be a problem for businesses, but it can also be an opportunity (Kim–Mauborgne, 2017). Emotional reactions are barely related to non-consumption behavior.

3.2. The relationship between voluntary simplifiers and non-consumption

A systematic literature review was conducted to identify three articles examining the relationship between non-consumption and voluntary simplifiers (Figure 3.). Before defining the relationship, the simplifiers must be defined.

The voluntary simplifier movement, which emerged in the early 1980s (Elgin 1993), was motivated by the need for a simpler, more sustainable lifestyle. It has been explored in the USA (Zavestoski, 2002) and Western Europe (Etzioni, 1999). In Hungary Dudás and Szakó (2014) explore the topic.

The benefits of simplicity can be found in ancient philosophies and religions. Although the lifestyle of voluntary simplifiers is not necessarily religiously affiliated, for many of these people, spirituality is an essential element of their lifestyle. For the most part, voluntary simplifiers reject objects that do not enhance their sense of happiness (Elgin, 1981). This group chooses this lifestyle not for personal reasons such as stress, time pressure, or work pressures (Hamilton–Mail, 2003) but for social reasons such as environmental protection, ethical concerns, green consumption, or community development (McDonald et al., 2006). The lifestyle of voluntary simplifiers is not limited to consumption activities (Oates, 2008); private education, for example, does not correspond to their self-image (Craig-Lees–Hill, 2002). The group relies less on brand reputation, preferring independent sources such as green publications and community groups. Climate and ethical considerations are favored over cost, although these are not negligible. Such consumers need help accessing the consumption information that is relevant to them. They are more complex and critical in their consumption decisions than the simple consumer, and this group will spend a long time investigating the origin of the product they choose to buy. They are informed, unlike novice voluntary simplifiers who seek information from leaflets provided by retail outlets (Oates,

2008). They do not choose this form of consumption as a 'weapon' against a particular enemy (as in the case of consumer resistance) but rather as a personal reflection, adopting anti-consumption practices in terms of individual fulfillment and the 'desired self' (Cherrier et al., 2011:1758).

Additionally, voluntary simplifiers are characterized by 'anti-promotional' attitudes and resistance to certain forms of consumption (Zavestoski, 2002). They do not seek to avoid market interactions altogether but are simply curious about how to live in an environmentally friendly way. They engage in various practices, including some forms of consumption and non-consumption, which, taken together, result in environmentally friendly consumption patterns. Voluntary Simplifiers represent a kind of alternative lifestyle that allows them to use less energy and resources and to, thus, reduce negative impacts on the environment and their health (Shaw–Moraes, 2009). They also seek to avoid over-consumption in their lifestyles, resulting from materialism and instead focus on the importance of community values (Ballantine–Creery, 2010). Members of this segment deliberately limit their consumption and only purchase material goods necessary for their well-being. However, it is crucial to understand that this consumption restriction is voluntary and does not necessarily lead to deprivation or poverty. The main difference between voluntary consumption reduction and poverty is that while in voluntary consumption reduction, individuals are free to choose how much they buy or consume, in poverty, people are forced to limit their consumption (Kocsis, 2001).

Balsa-Budai and Szakály (2008) identify 5 core values of this lifestyle (material simplicity, environmental awareness, self-sufficiency, personal enrichment, and ethicality).

According to Dudás and Szakó (2014) voluntary simplifiers seek happiness from non-material goods and choose environmentally friendly alternatives in shopping, transport, and energy consumption. They also try to minimize the amount of they buy. This type of consumer behavior offers a more sustainable alternative from an ecological, social, and economic point of view. Dudás and Szakó's study has shown that voluntary simplifiers feel better, are more satisfied with their lives, and subjectively report higher levels of 'well-being' than people who follow the current dominant consumer paradigm.

Regarding non-consumption, people choose voluntary simple living for different motivations, not only because of non-materialistic and non-consumption values (Kala et al., 2017). Non-consumption for them is a choice, like reducing consumption or changing consumption. Such choices usually stem from doubts about whether certain products or services are essential for them and whether they find them ethically acceptable (Barnett et al., 2005).

Table 2. Publications about non-consumption and voluntary simplifiers

Year	Author	Category	Number of Google Scholar citations
2009	Shaw–Moraes	voluntary simplifiers and sustainability, sustainable consumption, non-consumption	191
2016	McGouran–Prothero	voluntary simplifiers and non-consumption	78
2017	Kala et al.	voluntary simplifiers and non-consumption	23

Source: own construction

Shaw–Moraes (2009) explores voluntary simplicity and non-consumption as an approach that does not necessarily indicate that individuals avoid the market altogether. Instead, they find that consumers shape their consumption practices by examining their relationship to the market (Table 2.).

Although anti-consumption movements often appear as protests against the market, people seeking voluntary simplicity often depend on the products in the market while also seeking to be independent of them. Participants tend to balance self-sufficiency, reduced and modified consumption practices, and find solutions such as fair trade, choosing organic products, reducing and modifying consumption, reusing, and growing their own produce.

Some are involved in boycotts (e.g. avoiding supermarkets) and are critical of over-consumption and promotions. Although participants react differently to promotions, many express concern about over-commercialization and aggressive profit motives. Thus, the practice of voluntary simplicity can be interpreted in the context of the market, which often comes with constraints (Shaw–Moraes, 2009). Research by McGouran and Prothero (2016) found that voluntary simplifiers experienced less satisfaction with consumption. Their results point to areas that differ from the non-consumption literature, where deliberate non-consumption created dissatisfaction, lack, and unhappiness in participants. The authors' research found that participants' consumption patterns had predominantly returned to pre-study levels at the end of the study. The research confirms that reducing consumption is a serious challenge and that creating incentives that help consumers reduce consumption is important (McGouran–Prothero, 2016).

3.3. The link between sustainability and non-consumption

The present systematic literature review on non-consumption has been used to identify three articles that explore the relationship between non-consumption and sustainable consumption (Figure 4.). Before analyzing the relationship, let us first define sustainable consumption.

Some consumers choose to reduce their consumption because they want to improve the quality of their lives and 'buy time' (Grigsby, 2012). Others choose

sustainable lifestyles because of concerns and values about environmental and social consequences, which they hope will improve their quality of life (Shaw–Newholm, 2002). However, in extreme cases, some consumers reject consumption altogether, a phenomenon called 'anti-consumption' (Zavestoski, 2002). Sustainable consumption is based on a decision-making process that considers the consumer society's responsibilities and individual consumption, needs, and wants (Vermeir–Verbeke, 2006).

Reheul et al. (2001) define sustainable consumption as consumers' positive attitudes toward sustainable consumption. This means that they pay attention to organic packaging and food origin and avoid genetically modified foods. They regularly buy sustainable organic food because they believe it is better in taste, quality, safety, and freshness and more beneficial to human health, the environment, and the regional economy. Although they have a positive attitude towards sustainable consumption, they play a passive role in environmental promotion. They rarely take concrete steps to improve environmental protection or animal welfare unless they can do so within their budget (e.g. Grunert–Juhl, 1995).

Sustainable consumption goes beyond mere environmental concerns. After all, consumers themselves choose to reduce their ecological footprint as 'ecological' and 'socially responsible' citizens (Lee, 2014). Several studies highlight that, despite consumers' positive attitudes toward the environment, this is not reflected in their purchases, and they are not willing to pay higher prices for green products (Mainieri et al., 1997; Ottman, 1992; Schlossberg, 1991).

However, consumers have more negative attitudes toward price, convenience, and product safety. Sustainable products are generally more expensive and sometimes present an attractive appearance or ease of use. In addition, product preservation and long-term storage can be challenging (Vermeir–Verbeke, 2006).

According to Lee (2014), individuals' attitudes toward sustainable development are closely related to sustainable consumption. This is determined by three essential elements: attitudes supporting environmental organizations, attitudes toward sustainable development efforts, and parental influence. Sustainable consumption is based on a decision-making process that considers the consumer's social responsibility alongside individual consumption, needs, and wants (Vermeir–Verbeke, 2006).

In general, sustainable consumption is associated with values of universalism, benevolence, self-direction, honesty, idealism, equality, freedom, and responsibility. In contrast, power, hedonism, tradition, security, conformity, and ambition are associated with less ethical or sustainable consumption patterns. The value system developed by Schwartz (1992) explains the value difference.

The joint promotion of sustainable consumption and environmental protection is critical to our future. Individuals have an essential role in this, as their behavior influences the work of environmental organizations and the uptake of sustainable consumption (Vermeir–Verbeke, 2006).

Sustainable consumption and non-consumption are related in various ways. According to Martin-Woodhead (2022), an anti-consumerist ethic must cater to altruistic and environmental concerns and the personal gratifications of consuming

differently to gain wider acceptance. Ultimately, a non-consumer or anti-consumer lifestyle must provide personal appeal and pleasure to become popularized. The overlap between individual advantages and sustainability motivations associated with minimalism suggests that it has the possibility to start a cultural shift that criticizes hyper-consumerism and its damaging effects on the environment. Simultaneously, minimalist lifestyles enable individuals to derive personal benefits and contentment. This implies that individuals can live better by consuming less while also reducing their impact on the environment (Martin-Woodhead, 2022).

Cherrier et al. (2011) show that non-consumption can take on two distinct forms: one being a protest against careless consumers (commonly referred to as consumer resistance), the other being driven by self-interest (known as anti-consumption). The authors observed that even small, subjective acts of anti-consumption by individuals can contribute to broader purposes such as environmental preservation and fighting the influence of irresponsible consumers. Sustainability practices are primarily rooted in individuals' everyday, day-to-day activities, where small contributions are made rather than large-scale actions, like walking or cycling to work. Sustainability can be integrated into lives without significantly altering consumption patterns or sense of self (Cherrier et al., 2011).

Table 3. Publications about non-consumption and sustainable consumption

Year	Author	Category	Number of Google Scholar citations
2011	Cherrier et al.	sustainability, sustainable consumption, and non-consumption	305
2009	Shaw–Moraes	sustainability, sustainable consumption, and non-consumption	191
2022	Martin-Woodhead	sustainability, sustainable consumption, and non-consumption	16

Source: own construction

4. Conclusion

We are witnessing constant change, which is why it is necessary to examine the new consumer groups alongside the old ones and to formulate their basic characteristics (Törőcsik–Szűcs, 2021).

The systematic literature review method has been used to identify the forms and dimensions of consumer behavior related to non-consumption. The review has concluded that the concepts of consumer resistance, anti-consumption, sustainable consumption, and the group of voluntary simplifiers should be examined and defined in what ways they differ from non-consumption. The number of studies on non-consumption in marketing has increased since 2002. The journals *European Journal of Marketing*, *International Journal of Consumer Studies*, *Journal of Consumer*

Culture, and Sustainability contained the most frequently published findings on the topic. Overall, the review highlights the importance of examining non-consumption in the context of sustainability, voluntary simplicity, and consumer behavior.

In this study, Scopus and Web of Science searches have been used to examine the time horizon for the term *non-consumption* as broadly as possible, including different orthographies (in one word, two words, and hyphenated). Time-series observations showed a significant increase in the number of marketing research papers published on the topic of non-consumption from 2014 onwards.

Through the literature review I have successfully positioned non-consumption in the field of consumption and identified two major contexts in which international authors have explored the topic. I have dived deeper in sustainable consumption and voluntary simplicity contexts in which non-consumption has been studied. By examining the literature, I have identified the trend of sustainability, simplicity, and food related patterns. The most common methodology used was in-depth interview.

Non-consumption is a more passive phenomenon compared to voluntary simplifiers, as there is no emotional response. In voluntary simplification, an individual's sense of happiness and fulfilment is also dependent on his or her consumption habits, whereas in non-consumption, self-expression is not involved. Both phenomena aim to reduce overconsumption, and they link with each other in the willingness through sustainable consumption. Non-consumption is not only about sustainable products, while sustainable consumption focuses on sustainable and environmentally friendly products.

Sustainable consumption is more of an individual motivation, which can result in a voluntary choice of simplicity or a drastic decision not to consume. Cherrier et al. (2011) highlight that sustainability is a step-by-step process in the lives of consumers. A limitation of the present study is that a deeper understanding of non-consumption requires a broader perspective, not only in comparison to voluntary simplification and sustainable consumption. Most publications used in-depth interviews to provide a deeper understanding of the non-consumption group.

In terms of future research, the plan is to include conducting in-depth interviews after a systematic literature review.

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Explaining income inequality by the relationship between social network fragmentation and social segregation indicators

Byambasuren Dorjnyambuu

This paper investigates the way social networks and social indicators of segregation interact and their relationship with income disparity for 426 towns and cities in Hungary. Three social indicators of segregation are used to capture different characteristics of social segregation in towns: (i) ethnic fragmentation, (ii) religious fragmentation, and (iii) education inequality. Using open-access data from Tóth et al. (2021), non-spatial and spatial two-stage least square models are estimated for income inequality at the town level. The study finds that these social segregation indicators positively correlate with income inequality through social network fragmentation. Also, the spatial model shows that income inequality has a strong spatial relationship across towns.

Keywords: Inequality; social network; fragmentation; social segregation; spatial two-stage model
JEL classifications: J31, D31, C36

1. Introduction

Rising income inequality remains one of today's significant social and economic difficulties. Widening income inequality is harmful to socioeconomic well-being through many channels. It is the cause of many social issues, such as poverty, crime, unemployment, health problems, lower life expectancy, and lower levels of education (Stiglitz, 2012). A large amount of literature has been written to study the reasons for income inequality, with most studies focusing more on evidence from the United States and the OECD than other nations (Cavanaugh–Breau, 2018). The factors explaining the income disparities can be categorized into six broad explanations: (i) structural macroeconomic sectoral changes, (ii) globalization and technology change, (iii) labor market and other relevant institutions, (iv) demographic and microstructural changes, (v) politics and political processes, and (vi) tax/transfer schemes (Förster–Tóth, 2015). However, many objections still exist over why the expansion in income disparity occurred. The interaction of structural elements such as social networks and geography that influence inequality is less known (Tóth et al., 2021).

Network effects arise when a person's likelihood of adopting a habit rises with the number of other people in their social network who have already done so. Individuals' choices are influenced by their network peers in several domains, such as network externalities, social learning and peer assistance, and normative influence (DiMaggio–Garip, 2012). Studies on social networks highlight how social relationships enable individuals to take advantage of economic opportunities (Granovetter, 1985). However, inequality is aggravated when the impacts of individual differences are magnified via social networks, particularly when

economic status influences the formation of social relationships (DiMaggio–Garip, 2012). Social networks are ingrained in geography, which has profound implications for inequality. For instance, much of an individual's economic potential and access to possibilities through education is determined by where they live (Chetty et al., 2014). Even within relatively small geographical units such as cities and towns, there is a concomitant difference in outcomes between neighborhoods (Glaeser et al., 2009).

There has been very little research into the regional aspects of income disparity. This is due, in part, to a lack of suitably disaggregated data linking geography to income at an individual or household level. Data from wider geographical areas cannot indicate heterogeneity between small geographical units or locations with easy access to a prosperous labor market and more isolated ones. The main motivation of this paper is the open-access data and findings of Tóth et al. (2021) on the joint relationship between social network structure, urban topology, and inequality in Hungarian towns. Tóth et al. (2021) investigated how social networks and urban topology interact and how they affect inequality. They employed three urban topology indicators to capture different characteristics of social segregation in towns: (i) the average distance from the center, (ii) the extent of spatial concentration of amenities in towns, and (iii) the degree to which physical barriers divide residential areas. They found that social network fragmentation is substantially higher in towns where residential communities are divided by physical barriers like rivers and railroads. Towns with relatively remote neighborhoods from the center of town and spatially concentrated amenities are also more socially divided. Finally, they concluded that the spatial characteristics of a location could exacerbate economic inequities through social network fragmentation using a two-stage model. If social network fragmentation is related to income inequality, then the question arises whether other social segregation metrics can explain network relations with inequality. In this regard, this paper aims to examine how social segregation measures connect to inequality via their relationships to social network fragmentation. I use three social measures to capture segregation characteristics: ethnic fragmentation, religious fragmentation, and education disparities. This paper relies on work by Tóth et al. (2021) in data and approach but changes the channels explaining social network fragmentation and extends the estimation method using a spatial two-stage model. The data includes social network, population, and socioeconomic information for 426 towns in Hungary from 2011 to 2016.

This study offers two contributions to the existing literature. First, it stands out for its focus on inequality at the town level, departing from the more common country- or regional-level analyses. Second, exploring inequality through the lenses of spatial and social network fragmentation and conventional indicators adds depth to current research in this area.

The paper is organized as follows. Section 2 examines the relevant literature. The data are introduced in Section 3, which describes spatial characteristics of income inequality across towns, social network fragmentation, and control and instrumental variables. The key findings are then reported in Section 4, and the conclusion is provided in Section 5.

2. Literature review

Income inequality trends and drivers: Medgyesi and Tóth (2021) documented that Hungary had the lowest inequality group during the pre-transition period of 1980-1984, with Gini values below 0.25. However, in the early 1990s, Eastern European (EE) countries underwent a transitional recession, resulting in a significant fall in GDP and increased income inequality (Flemming–Micklewright, 2000). Kattuman and Redmond's (2001) study on income inequality in Hungary from 1987 to 1996 revealed that inequality remained stable until 1991, with factors like falling real incomes and changes in taxes and state transfers playing a role. However, after 1991, income inequality significantly increased due to growing earnings disparity, diverse sources of household income, and emerging disparities in state transfers. Furthermore, throughout the transition period, some sources provide cross-country evidence on trends and determinants of inequality in EE countries (Milanovic, 1999; Flemming–Micklewright, 2000; Aristei–Perugini, 2015).

Authors primarily concluded that the key contributors to rising income inequality in EE countries throughout the transition period were widening differences in labor income distribution, the increasing importance of capital income, and the deterioration of the redistributive impact of welfare state programs. Milanovic (1999) is the first of the studies to give a cross-country perspective on the determinants of income inequality during the transition period in six countries, including Hungary. His findings revealed that the growing wage distribution discrepancy, exacerbated by the reduction in employment, was the fundamental cause of rising overall inequality. Pensions, somewhat unexpectedly, also contributed to increased inequality in EE countries. Meanwhile, both inadequately funded and poorly targeted social transfers had minimal impact on mitigating inequality across countries (Milanovic, 1999). Profits and capital income became more important as the private sector emerged and state-owned firms were privatized, increasing economic disparity in EE countries. This is because capital income is more unequally distributed than labor income (Medgyesi–Tóth, 2022).

Nonetheless, variations in policies and results were evident among EE nations throughout the transition period. Hungary's encounter with inequality during this transition period deviated slightly from that of other countries, marked by a relatively smaller uptick in inequality. This disparity can be attributed to a blend of factors, including Hungary's early initiation of economic liberalization, influential dynamics driving inequality, and diverse social policies that offered some safeguards for individuals in the lower echelons of the labor market (Tóth, 2008). As a result, before becoming a member of the EU, income inequality in Hungary was roughly in line with the EU-15 average (Medgyesi–Tóth, 2021). However, during the global financial crisis, income inequality in Hungary saw a significant and alarming increase of 13.5%. This spike in inequality can largely be attributed to the reduced progressiveness of Hungary's tax system, which had a substantial impact. At the same time, the decline in the full-time employment rate also played a contributing but comparatively smaller role (Brzezinski, 2018).

Aside from the previously identified transitional and structural issues, the next strand of literature has taken a partial approach to exploring the sources of income

inequality by keeping a cross-country perspective in EE countries. These sources include economic development (Tsaurai, 2020), globalization and technological progress (Esposito–Stehrer, 2009; Josifidis et al., 2021; OECD, 2011), labor market institutions (OECD, 2011; Szczepaniak–Szulc-Obłoza, 2020), education and human capital accumulation (Omoeva et al., 2018; OECD, 2011), demographic shifts (Dolls et al. 2019), migration (Docquier et al., 2019), and firm characteristics (Magda et al., 2021).

As of 2020, inequality at the national level is moving closer to the EU average, but inequality within the country is becoming more heterogeneous. Hungary's Gini index of equalized disposable income was slightly lower than the EU average, but it has increased by 3.9 percentage points over the last decade. The top 20% of Hungarian households earn four times more than the bottom 20% of households in the income distribution. These findings are supported by examining changes in quintile distributions from 2010 to 2020. Income transfers in Hungary demonstrated a regressive tendency, with the lower quintiles either losing their share of income or seeing no improvement, while the top quintile had the most significant improvements (Table 1).

Table 1. The main statistics in income inequality in Hungary, 2020

Country	Gini index of equalized disposable[1] income[(a)]		Income quantile share ratio S80/S20 for disposable income[(b)]		Share of national equivalized income by[(c)]									
					First quintile		Second quintile		Third quintile		Fourth quintile		Fifth quintile	
	2020	Change 2010-2020	2020	Change 2010-2019	2020	Change 2010-2020	2020	Change 2010-2020	2020	Change 2010-2020	2020	Change 2010-2020	2020	Change 2010-2020
EU-27	30.2	0	4.9	0.1	8.0	0	13.4	0	17.7	0.2	22.8	0.1	38.1	-0.3
Hungary	28.0	3.9	4.2	0.8	8.8	-1.2	13.8	0	17.8	-0.6	22.9	0.2	36.6	2.4

Sources: Eurostat (2022a); Eurostat (2022b); Eurostat (2022c)
Note: Online codes: (a) ilc_di12, (b) ilc_di11, (c)ilc_di01

Regarding spatial income inequality, Pénzes et al. (2014) investigated the trajectory of spatial income disparities in Hungarian regions (NUTS-2) from 1988 to 2012. The study revealed that the increase in income inequalities was notably more pronounced in underdeveloped areas. Conversely, developed regions experienced a more modest rise in income inequalities, demonstrating their ability to attract new investments and restructure their economies. Vida (2022) examined regional income

[1] Equalized disposable income is determined by taking a household's overall income, which includes earnings, after tax contributions, and other deductions, and then dividing it by an equivalency scale.

disparities in Hungary from 2010 to 2019, focusing on their correlation with geographic trends in "realized competitiveness." The findings reveal significant spatial variations in regional performance and residents' income levels during this period, influenced by economic, spatial, and social factors. While some areas saw reduced spatial disparities, income gaps among different regions widened. Importantly, these changes also manifested in the spatial patterns of regional competitiveness within districts. Zoltán (2022) underscored the importance of geographic proximity in shaping income inequalities and dynamics among local settlements in Hungary, highlighting the formation and evolution of income clubs as a significant aspect of this phenomenon.

Network effects on inequality. Researchers who have examined network effects in various fields often find that these effects tend to exacerbate social inequality. For example, in the context of health, Pampel et al. (2010) suggested that individuals with higher socioeconomic status tend to adopt healthier behaviors and form connections with others of similar status, strengthening their social networks and ultimately contributing to improved health outcomes and widening health disparities. In education, Gamoran (2011) highlighted that school tracking, a form of induced homophily, typically amplifies disparities in academic achievement, thus exacerbating educational inequalities.

According to DiMaggio and Garip (2012), network effects can potentially worsen disparities among different groups in adopting beneficial practices. Their financial or cultural resources should positively influence an individual's likelihood of adopting a useful practice. Financial resources enhance a person's capability to engage in the practice due to improved affordability, while cultural resources, typically assessed through years of formal education, play a role by elevating awareness of new practices, enhancing comprehension of intricate innovations, or facilitating more efficient utilization of these practices. Moreover, individuals' social networks should comprise people who resemble them regarding traits indicative of their likelihood to adopt the new practice. This phenomenon is known as homophily, where individuals tend to establish connections with those who share similar socioeconomic and demographic characteristics. Homophily is observed across various contexts, including adult friendship networks, children's friendship networks, and even marital choices (Bianconi et al., 2014; Rivera et al., 2010). Homophily can arise due to structural factors or individual decisions, but in either case, it can create conditions that lead to increased inequality when network effects are at play (McPherson et al., 2001). This ubiquity of network effects on the micro-level can lead to social segregation on a larger scale: groups with various socioeconomic statuses are segregated in social networks (Stadtfeld, 2018). If access to resources or information passes across the network, this macro-scale network structure might lead to divergent economic potentials between groups (Tóth et al., 2021).

Social network and geography. Social networks are closely intertwined with geography, and this relationship has significant implications for inequality (Tóth et al., 2021). For instance, where an individual lives, often indicated by their home location, can strongly predict a substantial portion of their future economic prospects. Namely, individuals living in certain neighborhoods or areas may have better access to educational opportunities, job markets, and other economic resources that can

positively impact their economic outcomes (Chetty et al., 2014). Interestingly, economic disparities are not solely limited to comparisons between regions or countries. Even within relatively small geographical units like cities and towns, significant divergence in economic outcomes can be observed. Glaeser et al. (2009) reviewed the economic causes of income inequality in metropolitan areas and found that differences in both skill distribution and returns to skill play essential roles in explaining income inequality variations across metropolitan areas. This suggests that disparities in economic well-being can be highly localized and not just a macro-level phenomenon.

Furthermore, people build social relationships with others who are physically close to them. This "local bias" indicates that people are more inclined to form ties with neighbors, coworkers, or community members in the same geographical area. Local relationships can impact many aspects of life, including job opportunities, social support, and resource access (Sampson, 2008). Geography primarily shapes economic outcomes by influencing the composition of social networks. When social interactions are constrained to a particular geographical region, it can limit personal and collective advancement. This is because access to a wide range of resources, information, and opportunities provided by socially distant connections is vital for progress. When social networks are spatially bounded, people may miss out on valuable connections and resources that could enhance their economic well-being (Bailey et al., 2018; Eriksson–Lengyel, 2019).

In essence, geography plays a pivotal role in shaping economic inequality by influencing the structure of social networks. Social ties formed within specific geographic boundaries can either enhance or limit individuals' and communities' access to opportunities, resources, and economic success.

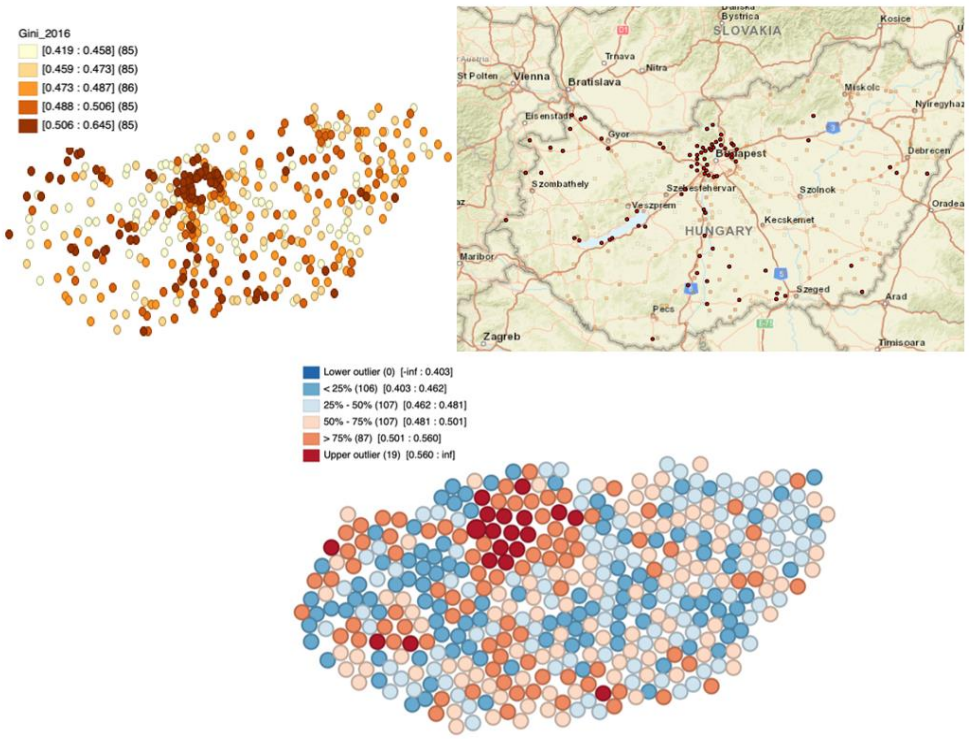
3. Data and variables

This paper uses open-source geographic data (Open Street Map data) and town-level aggregate data applied in the recent paper by Tóth et al. (2021), which includes population and socioeconomic information for 474 towns in Hungary. These towns and cities comprise about 60% of Hungary's population. The capital city of Budapest was excluded from the data due to its considerable disparities with other cities and towns. Because 48 cities were not matched when the data was matched to the map, this paper used 423 cities. Tóth et al. (2021) estimated the Gini index at the town level in 2011 and 2016 to quantify income inequality based on total income distributions across HNSO income categories. This paper uses the town Gini index 2016 (G_(i,2016)) as a dependent variable.

According to Eurostat, Hungary's income disparity has been lower than the EU-27 average for the past decade (the 10-year average is 0.28), but increases in regional disparities within the country have moderated it. Specifically, Hungary has come closer to EU averages while moving further away from other marginalized parts of its territory. The income inequalities in 426 towns and cities range from 0.42 (Füzesgyarmat) to 0.65 (Telki). The towns neighboring Budapest, those along Lake Balaton, certain towns near the western and southern borders, and those along

highway M6 have the highest income inequalities among Hungarian towns (Figure 1.). It is worth noting that inequality is low in towns in the east and north of the country.

Figure 1. Town Gini Index 2016 (Quintile and Cartogram map)



Source: own elaboration based on the dataset of Tóth et al. (2021)

Figure 2a depicts box plots of the towns' Gini index in 2011 and 2016 with descriptive statistics. In terms of inequality developments, there was a strong correlation between inequality in 2011 and 2016 (Figure 2b.). The overall level of inequality in most towns increased somewhat, from an average Gini index of 0.476 in 2011 to an average of 0.485 in 2016. Between 2011 and 2016, inequality increased in around 69% of total towns, remained unchanged in 12%, and declined in 19% of towns; the highest increases and decreases in town Gini were reported in Zalakomár (15%) and Balatonkenese (10%), respectively. High-income disparities have also been observed in high-income and high-density towns, as indicated by the town Gini coefficient's positive correlation with income per capita and population density (Figure 2b.).

Figure 2a. Box plot for the town Gini index for 2011 and 2016

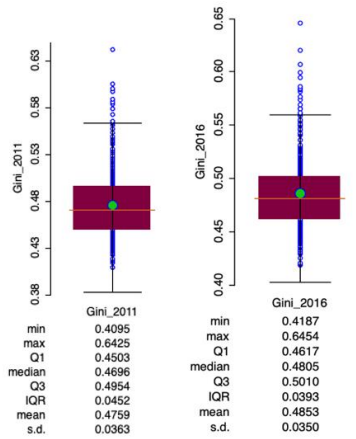
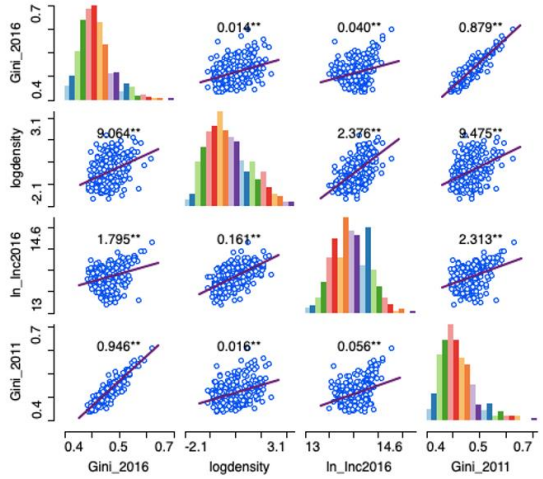


Figure 2b. Correlation and distribution of the variables



Source: own elaboration based on the dataset of Tóth et al. (2021)
Note: (Gini index 2016; ln (population density), ln (income per capita 2016), and Gini index 2011)

Regarding spatial statistics, Moran's I statistic was 0.220 in 2016, indicating that income inequality has a weak spatial autocorrelation. Focusing on the towns where inequality is positively and strongly linked with its spatially lagged counterparts (the first or High-High quadrant of Moran scatter plot), spatial autocorrelation has increased (Moran's I is 0.287) than the overall statistic of 0.220, but unselected observations indicate no spatial autocorrelation (a value of -0.052). This result would imply the presence of spatial heterogeneity in the strength of the spatial autocorrelation, as the subset chosen exhibits a significantly different degree of dependency than its complement or the whole dataset (Figure 3.).

The local indices for spatial analysis (LISA) show that 113 of 426 towns have a significant local spatial association. Based on the position of the value and its spatial lag in the Moran scatter plot, the LISA's cluster map illustrates the significant places with an indicator of the type of spatial relationship. Among the 113 towns, 38 are in high-high clusters, 44 are in low-low clusters, 17 are in low-high clusters, and 14 are in high-low clusters (Figure 4.). Looking at the relationship between the Morgan scatter plot and the cluster map, are 81 towns selected in the High-High quadrant of the Moran scatter plot, of which 38 are significant on the cluster map (see Annex-1).

Figure 3. Moran scatter plot in the town Gini index 2016 (focusing on a subset, including 81 towns)*

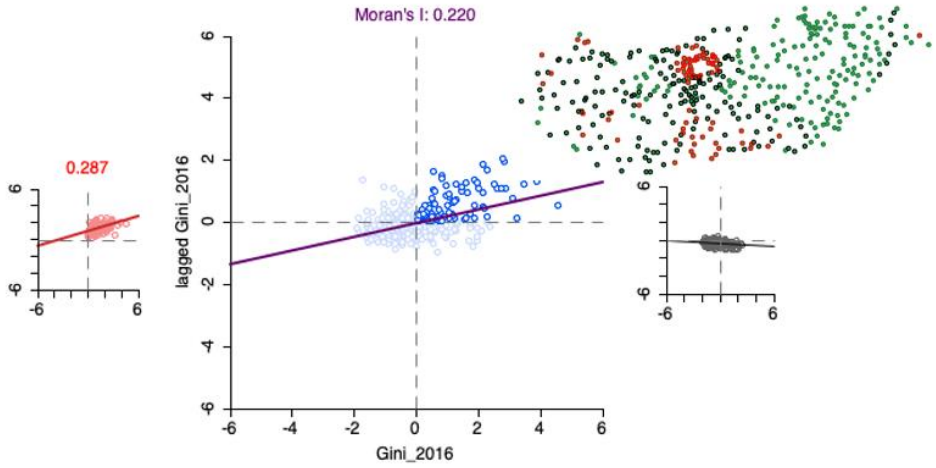
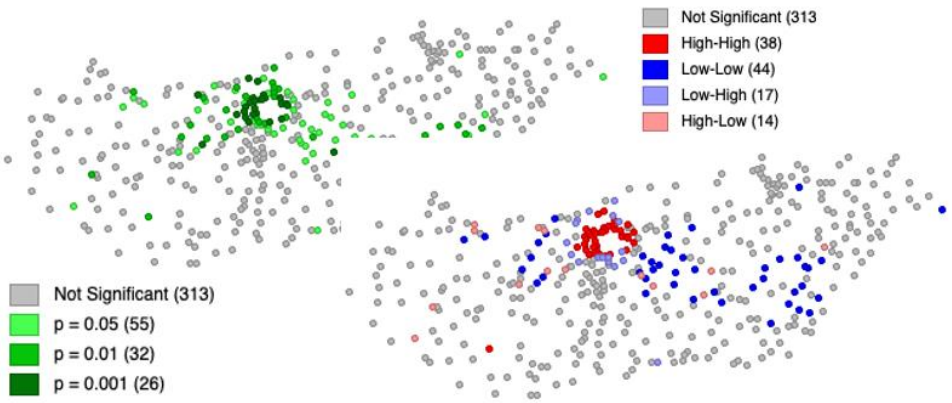


Figure 4. LISA Significance and cluster maps



Source: own elaboration based on the dataset of Tóth et al. (2021)
Note: *The one on the left (in red) is for the selected observations, while the one on the right is for the complement, often known as unselected observations (in black)

Another important variable in this paper is social network fragmentation within a town. Tóth et al. (2021) used data from a Hungarian online social network, iWiW, to describe social network structure within towns. The iWiW (International Who Is Who) network was founded in 2002 and quickly became Hungary's most popular online social network. At its peak in 2010, it was one of the most popular national websites, reaching about 40% of the country's population (Tóth et al., 2021). The site was permanently shut down in 2014 due to heavy competition from Facebook. It is now being utilized as a large-scale dataset, including location (self-reported), birthday, gender, date of registration and last login, the ID of friends,

and ID of inviters, to research the social interactions of the Hungarian people. Regarding population representativity, the iWiW was accessible to those aged 14 and above, potentially reaching 8.2 million people in Hungary. By early 2013, roughly 33% of Hungarians aged 14 and older were members of this network. When compared to nationally representative internet usage surveys conducted in 2013, approximately half of the adult online population was iWiW users. The age distribution of iWiW users closely aligns with the estimated number of internet users in Hungary up to age 60 but decreases significantly after age 70. The network is well-represented among Hungary's economically active population (Supplementary information of Tóth et al. 2021). Tóth et al. (2021) substituted online social ties for in-person social relationships. While this method oversimplifies the complexities of social interactions, they argue that it is still the most accurate data source available. It is important to acknowledge that data is imperfect and comes with limitations, such as not having insights into the specifics of these social connections, including their nature, strength, or how often people communicate. Nevertheless, they believe that there is no systematic bias in the data that would undermine the credibility of the analysis.

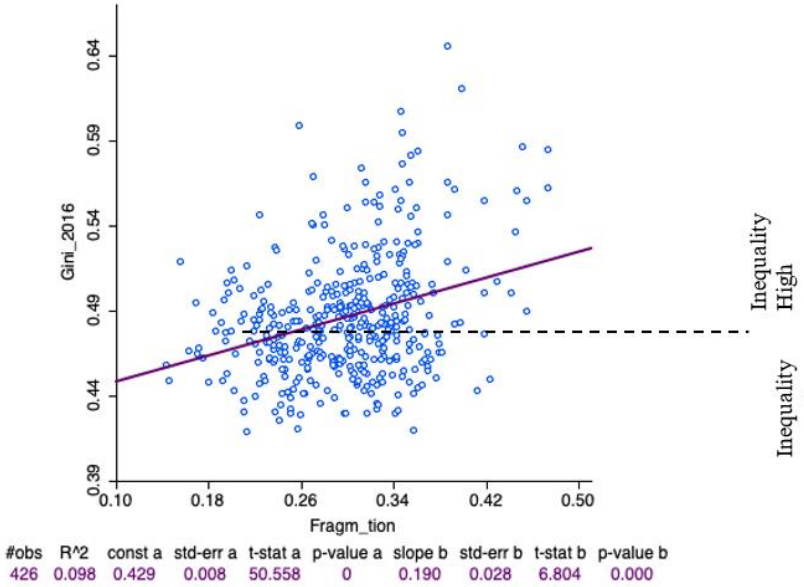
It is important to note potential geographical biases in representativeness, as innovations like iWiW were notably influenced by age, education, and location dynamics. Initially, it gained popularity among young, educated urban demographics, and while later adoption included elderly individuals from rural areas, it never matched the earlier rates. The overall iWiW user rate spans from 23% in small villages to 42% in major cities, with smaller settlements being over-represented by the elderly and those with lower educational levels. Nonetheless, the relatively limited number of outlier settlements in this pattern strengthens the reliability of iWiW data.

When examining social network fragmentation within a town, Tóth et al. (2021) only look at ties between iWiW users that live in the same town through the Louvain algorithm, which detects communities. This approach divides the people in the town *i*'s network into groups by optimizing a modularity metric Q_i, which compares the density of edges within groups to the density across groups. To eliminate the dependence on the size and density of the network, they scaled it by the maximum value of Q_i. Then, the fragmentation is

$$Frag_i = \frac{Q_i}{Q_i^{max}} \quad (1)$$

The fragmentation values in the data were created for the end of 2011. There is a positive correlation (ρ=0.3) between the town Gini 2016 and social network fragmentation (Figure 5.).

Figure 5. The correlation between town Gini 2016 and social network fragmentation



Source: own elaboration based on the dataset of Tóth et al. (2021)
Note: The fitted line indicates a linear regression: $G_{i,2016} = 0.429 + 0.19F_i$; and the dashed horizontal line represents the town Gini 2016 mean (0.485).

Lengyel and Jakobi (2016) found that the economic development of towns influences the adoption of online social networks, including iWiW, with wealthier towns having a higher share of iWiW users. As a result, low-income people may be underrepresented on iWiW, thus skewing the statistical association between social network fragmentation and income disparity. Tóth et al. (2021), on the other hand, noted that those who do not use iWiW may be socially segregated from those who do, implying that social network fragmentation in poorer towns may be even more pronounced than observed in iWiW, underestimating the correlation between fragmentation and income inequality.

The table below describes all the variables used in this study and sample average values. These variables span from 2011 to 2016 based on data availability. However, given the relatively consistent annual changes in most variables, it is believed that having data spanning five years does not have a significant effect.

Table 2. List of variables and sample average

Name of variables	Notation	Type	Definition	Sample average (n=426)
Dependent variable				
Inequality	G_i	Numeric	Gini index calculated at the town level on equivalized household income 2016	0.485
Independent variables				
Distance to border	$Dist_i$	Numeric	The distance in kilometers from the nearest border	60.673
Town size	$Size_i$	Numeric	The town's total area, in km2	7,896.7
Population density	$Dens_i$	Numeric	The population is divided by the size of the residential area.	2.031
Unemployment ratio	$Unemp_i$	Numeric	Unemployed people as a percentage of the total labor force	0.063
Employment in the manufacturing sector	Emp_i	Numeric	Number of persons employed in the manufacturing sector	1,557.69
Business tax	Tax_i	Numeric	Taxes on corporate income. It is used to measure the level of economic efficiency of a town.	560,469.8
Foreign investment	$FInv_i$	Numeric	Revenue capital owned by foreign firms in 2011, measured in 1,000 Hungarian Forint	9,367,646
Fragmentation	$Frag_i$	Numeric	Social network fragmentation (see Equation 1)	0.297
Age	Age_i	Numeric	The ratio of residents older than 60 years	0.245
High school	$Hschool_i$	Numeric	The ratio of residents with high school degrees or above	0.301
Income per capita	Inc_i		The income per capita in 2016 at the town level, measured in Hungarian Forint	999,005.1
Instruments				
Ethnic fragmentation	$Ethnic_i$	Numeric	*The entropy of ethnic distribution* is estimated using ethnic group size distribution. The indicator is high if the town's ethnic groups are of similar size.	0.126
Religious fragmentation	Rel_i	Numeric	*The entropy of religious distribution* is calculated using population distribution across confession groups. The indicator is high if the town's religious groups are of similar sizes.	0.677
Education inequalities	$Educ_i$	Numeric	*Coefficient of variance* in the 6th-grade math exam.[2] The indicator is high if there are significant discrepancies between primary schools in the town's commuter zone.	0.068
User rate	UR_i	Numeric	The fraction of the population of a town on iWiW	0.344

Source: own construction based on the dataset of Tóth et al. (2021) and TEIR database

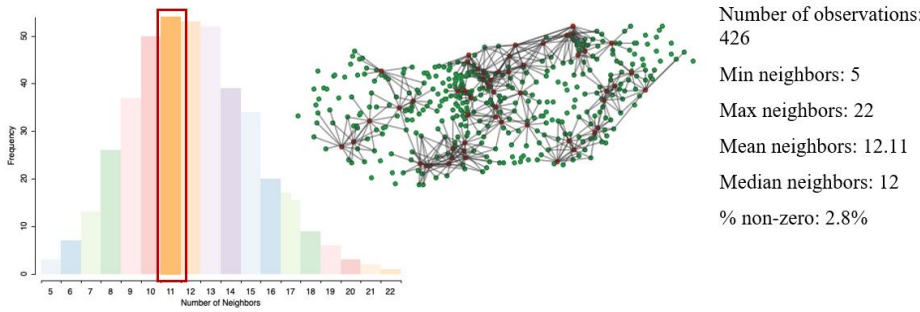
[2] Data were gathered through the national 6th grade mathematical competence test in 2011.

4. Results

The estimation strategy of this paper is twofold. First, I use the non-spatial simple regression models to estimate the relationship between social network fragmentation and income inequality. Second, I apply a spatial two-stage least square (2SLS) regression model to estimate how social segregation measures are associated with income inequality through their relationship to social network fragmentation.

The spatial weights need first be established before analyzing the spatial dependency. Spatial weights are important in constructing spatial autocorrelation statistics because they enable the generation of spatially explicit variables, such as spatially lagged variables and spatially smoothed rates. Technically, the weights are a square matrix that describes the neighbor structure between the observations. This study uses a contiguity weight because the towns with high inequality tend to agglomerate in certain areas (see Figure 1.). Namely, the queen continuity with the second order is applied since it is a little broader, defining neighbors as geographical units with a shared edge or the same vertex.

Figure 6. Queen weights characteristics: Connectivity histogram, towns with 11 neighbors



Source: own elaboration based on the dataset of Tóth et al. (2021)

Non-spatial model:

$$G_i = \beta_0 + \beta_1 Frag_i + \beta_2 \log(Dens_i) + \beta_3 Hschool_i + \beta_4 Age_i + \beta_5 Unemp_i + \beta_6 \log(Emp_i) + \beta_7 \log(FInv_i) + \beta_8 Tax_i + \beta_9 \log(Dist_i) + \beta_{10} \log(Size_i) + \varepsilon \quad (2)$$

The result of OLS regression indicates the ten predictors explained 37.7% of the variance in the town Gini index. Social network fragmentation, population density, foreign investment, business taxes, and town size are positively and statistically significantly related to income inequality in towns. Social network fragmentation, in particular, has the greatest influence on income disparity; one unit increase in fragmentation corresponds to a 0.164 unit increase in income inequality. Employment in the manufacturing sector, on the other hand, has a negative and significant impact

on income disparity in towns (Table 4.). There is no multicollinearity (mean VIF=2.09) between independent variables, and heteroskedasticity-robust standard errors are applied to avoid the presence of heteroskedasticity. However, the normality test confirms that the distribution of the residuals is significantly different from normal (see test results from Annex-2).

Furthermore, Ramsey's regression specification error test (RESET) utilizing powers of the fitted values of the Gini index reveals that the model includes omitted variables, assuming an endogeneity problem in equation (2) (Table 4). To reveal the endogenous variable in the model, I manually performed the Durbin-Wu-Hausman (DWH) test for the potential endogenous regressor, social network fragmentation ($Frag_i$). The test result (F (1,388) =4.37, p=0.037) leads to a rejection of the null hypothesis that social network fragmentation ($Frag_i$) is exogenous (see the test performance from Table A 1 in the Annex-2). Also, diagnostics Moran I of the residuals (I= 7.336, p < 0.001) indicates that the OLS residuals are spatially autocorrelated, meaning that the spatial relationship is identified in the error terms (see Diagnostics for spatial dependence from Table A 2 in the Annex-2). Therefore, I use the spatial two-stage least square regression model with spatial lag.

The spatial 2SLS estimation model:

$$G_i = \beta_0 + \rho WG_i + \beta_1 \widehat{Frag}_i + \beta_2 \log(Dens_i) + \beta_3 Hschool_i + \beta_4 Age_i + \beta_5 Unemp_i + \beta_6 \log(Emp_i) + \beta_7 \log(FInv_i) + \beta_8 Tax_i + \beta_9 \log(Dist_i) + \beta_{10} \log(Size_i) + \varepsilon_i \quad (3)$$

IVs for *Frag*:

$$\widehat{Frag}_i = \alpha_0 + \underbrace{\alpha_1 Etnic_i + \alpha_2 Rel_i + \alpha_3 Educ_i}_{Social\ segregation\ measures} + \alpha_4 UR_i + v_i \quad (4)$$

WG_i in equation (3) is the spatial lagged term of the dependent variable and $Etnic_i, Rel_i, and\ Educ_i$ in equation (4) are the social measures of segregation. The spatial model generally expresses how the dependent variable *G* directly affects its immediate neighbors. In other words, widening income inequality in one town will directly impact towns nearby.

Before proceeding to model estimation, let us first determine whether these variables are suitable instruments for social network fragmentation ($Frag_i$). Key assumptions are that the instrumental variables (IVs) are correlated with social network fragmentation ($Frag_i$) but uncorrelated with residuals of equation (3). An F-test of the first stage regression confirms that social segregation indicators are strong instruments of social network fragmentation (Table 3.). Stock and Yogo (2005) proposed the rule concerning the size of F statistics (with more than one instrument) from the first stage regression to detect weak instruments. The IVs are strong if the first-stage F statistic is more than 10. Thus, the relevant F statistic is 18.97, higher than 10, showing that I do not need to be concerned about weak instruments.

Table 3. Estimation of the first stage

	Fragmentation
Ethnic fragmentation	-0.017
	(0.031)
Religious fragmentation	0.05*
	(0.031)
Education	-0.256**
	(0.112)
User rate	0.229***
	(0.03)
Constant	0.204***
	(0.023)
Observations	426
Adj R-squared	0.145
F statistic (4, 421)	18.97***
Standard errors are in parentheses	
**** p<0.01, ** p<0.05, * p<0.1*	

Source: own computation based on the dataset of Tóth et al. (2021)

The estimation results of non-spatial and spatial 2SLS are presented in Table 3. The social network fragmentation, instrumented by social segregation indicators, is positively and significantly associated with income inequality. Its magnitude has increased dramatically in both 2SLS models compared to the OLS result. This finding provides strong evidence for a link between social network fragmentation and inequality. It also implies that social segregation measures significantly predict social network outcomes associated with inequality.

Regarding control variables, only business tax is turned into a non-significant variable compared to the OLS result. Other relevant controls indicate that highly populated towns, larger towns, and towns with significant foreign investment have higher levels of inequality. In contrast, towns with higher employment in the manufacturing sector have lower levels of inequality. As a result, indicators favoring agglomeration and income tend to increase inequality, whereas ones favoring productivity tend to decrease inequality. This result can be explained as an “inverted-U” Kuznets curve indicating the relationship between a country’s income per capita and interpersonal income inequality. It suggested that inequality would be minor within low-income countries, rise as development progressed, and narrow as growth's advantages spread.

Table 4. Estimation results of non-spatial and spatial models

	OLS	**2SLS**	**Spatial 2SLS**
	Gini 2016	Gini 2016	Gini 2016
WGini 2016			0.233**
			(0.116)
Estimated Fragmentation[(a)]	0.164***	0.594**	0.466***
	(0.029)	(0.241)	(0.162)
Log (Pop. density)	0.048***	0.045***	0.044***
	(0.006)	(0.007)	(0.006)
High school	0.010	0.017	0.014
	(0.012)	(0.016)	(0.014)
Age	0.005	-0.025	-0.019
	(0.031)	(0.037)	(0.033)
Unemployment ratio	-0.017	-0.014	-0.026
	(0.047)	(0.061)	(0.056)
Log (Employment in manufacturing)	-0.055***	-0.063***	-0.058***
	(0.006)	(0.008)	(0.007)
Log (Foreign investment)	0.006**	0.011**	0.009**
	(0.001)	(0.005)	(0.004)
Log (Business tax)	0.007***	0.002	0.003
	(0.002)	(0.004)	(0.003)
Log (Distance to the border)	0.001	0.001	0.002
	(0.002)	(0.002)	(0.002)
Log (Town size)	0.041***	0.048***	0.045***
	0.005	(0.007)	(0.006)
Constant	0.360***	0.299***	0.199***
	(0.024)	(0.045)	(0.077)
Observations	426	426	426
Adj R-squared/Pseudo R-squared/Spatial Pseudo R-squared	0.377	0.274	0.316
F stat/ First stage F-test	26.73***	18.97***	-
RESET	12.31***	-	-
DWH test	-	0.014 (p=0.906)	-
Anselin-Kelejian Test	-	12.288***	2.136 (p=0.144)
*Robust standard errors are in parentheses; *** p<0.01, ** p<0.05, * p<0.1*			

Source: own construction based on the dataset of Tóth et al. (2021)

Note: [(a)]-The level of fragmentation is used in the OLS regression

5. Conclusion

Using Hungarian town-level data from the paper by Tóth et al. (2021), this study examines how social networks and social segregation measures interact and their relationship with income disparity. Hungary's income inequality has approached the

EU average nationally, but the disparity in cities and towns has widened. At the town level, income disparities range from 0.418 to 0.645. The towns surrounding Budapest, those along Lake Balaton, and certain towns along the country's western and southern borders have higher income inequality. In contrast, places in the country's east and north have lower inequality. In this paper, I have found that social network fragmentation, as instrumented by social segregation indicators, significantly impacts income inequality at the town level. When there is ethnic fragmentation, religious fragmentation, and educational inequality in a town, social networks tend to be more fragmented. Therefore, like the urban indicators used by Tóth et al. (2021), these social segregation measures can also be significant predictors of social network outcomes associated with inequality. This study supports the findings of previous studies on the role of ethnicity and identity (e.g. Fundamental Rights Agency, 2014; Omoeva et al., 2018). Furthermore, a positive significant spatial lagged term suggests that inequality in neighboring towns has a strong spillover effect.

Acknowledgments

First, I am grateful to Tóth et al. (2021) for making their aggregated city-level data available. I want to acknowledge Dr. Mónika Galambosné Tiszberger, assistant professor, and Dr. Richard Farkas, assistant professor from the Faculty of Business and Economics at the University of Pécs. Their guidance and advice are valuable for writing this paper. I also express my gratitude to an anonymous reviewer for their insightful feedback. Finally, I am grateful to the Stipendium Hungaricum Scholarship for giving me all these opportunities.

Annex-1: Morgan scatter plots

Figure A-7. High-High Morgan scatter plot locations (81 observations selected)

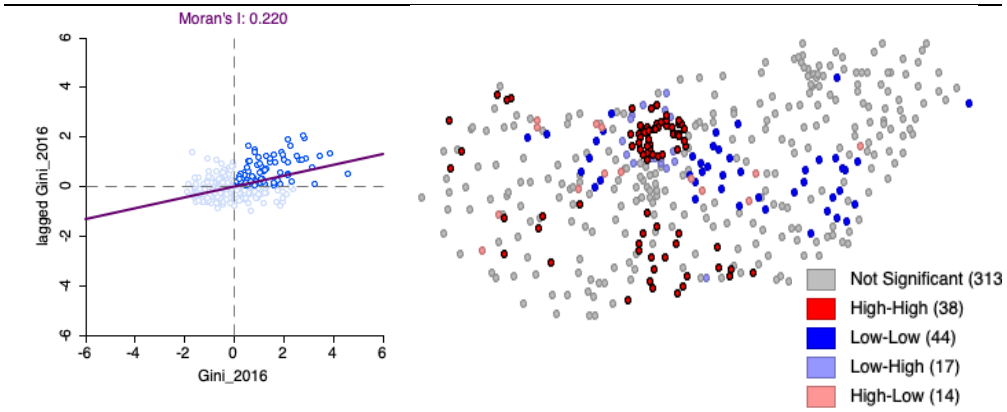


Figure A-8. High-Low Morgan scatter plot locations (99 observations selected)

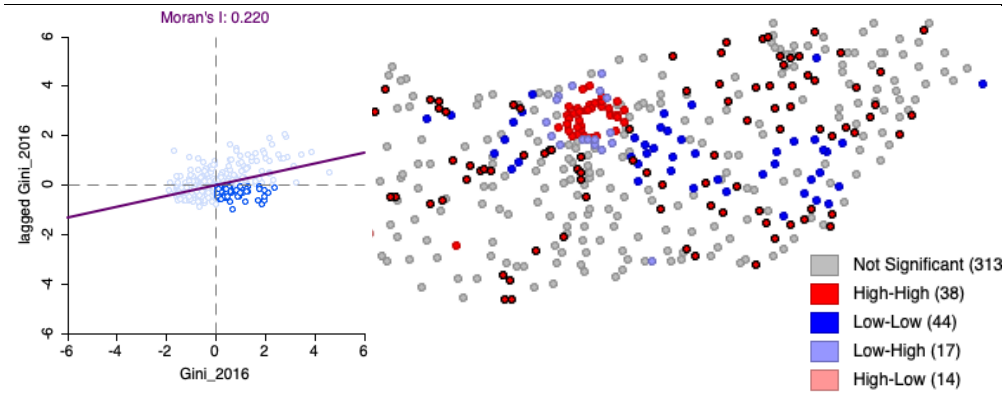


Figure A-9. Low-Low Morgan scatter plot locations (178 observations selected)

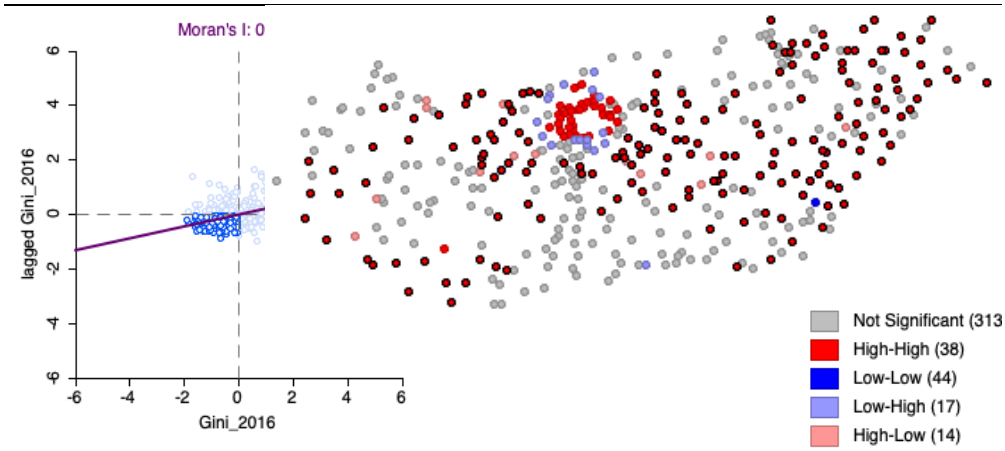
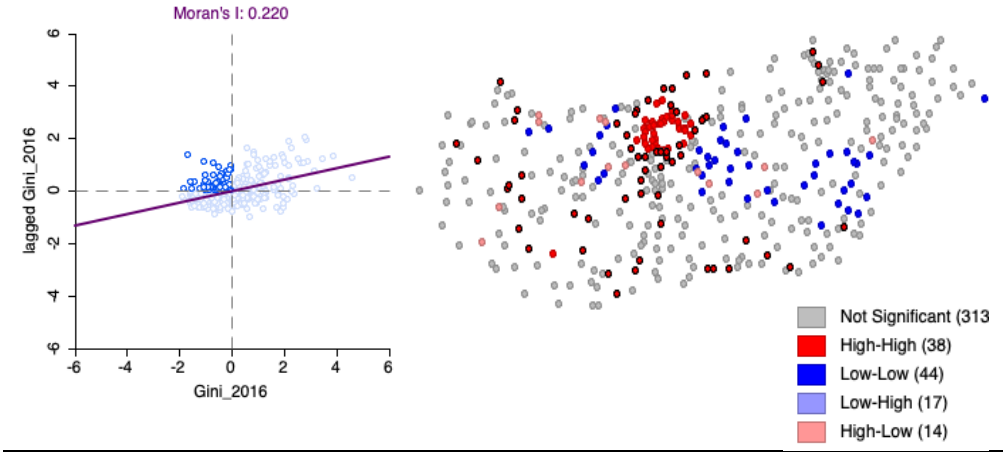


Figure A-10. Low-High Morgan scatter plot locations (68 observations selected)



Source: own elaboration based on the dataset of Tóth et al. (2021)

Annex-2: Test results

Non-spatial model (OLS regression): Test results

1. Heteroskedasticity tests

H0: Constant variance

Test	df	Value	Prob
Breusch-Pagan test	10	97.770	<0.001
Koenker-Bassett test	10	53.699	<0.001

The Breusch-Pegan test result rejects the null hypothesis of homoskedasticity in the OLS regression. Thus, I used a robust heteroskedasticity standard error because significant heteroskedasticity generates biased standard errors and invalidates the resulting hypothesis tests.

2. Test on the normality of errors

H0: Residuals are normally distributed

Test	df	Value	Prob
Jarque-Bera	2	66.159	<0.001

The Jarque-Bera test results show that the distribution of the residuals is significantly different from normal.

3. Durbin–Wu–Hausman (DWH) test of endogeneity (implemented manually):

In the 1st stage, the potential endogenous variable, *Fragmentation*, was estimated on other explanatory variables in equation (2) and instrumental variables. Equation (2) with an additional variable, *Res* (the error from the first stage equation for *Fragmentation*), is estimated in the second stage.

$$G_i = \beta_1 Frag_i + \beta_2 X_i + \gamma Res_i + \varepsilon_i$$

Under the null hypothesis, *Fragmentation* is exogenous. If *Res* could be observed, the exogeneity test would be the test of $H_0: \gamma = 0$. The estimation results in Table A 1 show that the coefficient of fragmentation's residual is different from zero, implying *Fragmentation* is endogenous.

Table A-1. Estimation results of the DWH test

Variables	Stage 1	Stage 2
	Fragmentation	Gini 2016
Fragmentation		.491***
		(.165)
Log (Pop.density)	.016*	.053***
	(.009)	(.005)
High school	-.016	.01
	(.022)	(.012)
Age	.055	-.007
	(.046)	(.03)
Unemployment ratio	-.035	-.036
	(.09)	(.042)
Log (Employment in manufacturing)	.011	-.068***
	(.009)	(.006)
Log (Foreign investment)	-.013**	.01***
	(.005)	(.003)
Log (Business tax)	.011***	.004
	(.004)	(.003)
Log (Distance to the border)	-.002	.004*
	(.004)	(.002)
Log (Town size)	-.008	.051***
	(.009)	(.006)
Ethnic fragmentation	-.043	
	(.032)	
Religious fragmentation	-.031	
	(.033)	
Education	-.238**	
	(.108)	
User rate	-.002	
	(.038)	
Fragmentation residual		-.345**
		(.165)
Constant	.178***	.304***
	(.053)	(.031)
Observations	400	400
R-squared	.331	.478
Robust standard errors are in parentheses		
**** p<0.01, ** p<0.05, * p<0.1*		

H0: Fragmentation Residual =0
F(1,388)=4.37
Prob =0.0371

Source: own elaboration based on the dataset of Tóth et al. (2021)

4. Diagnostics for spatial dependence

Table A-2. Diagnostics for spatial dependence test for the OLS regression model

Test	MI/DF	Value	Prob
Moran's I (error)	0.137	7.336	<0.001
Lagrange Multiplier (lag)	1	35.947	<0.001
Robust LM (lag)	1	1.394	0.2378
Lagrange Multiplier (error)	1	46.49	<0.001
Robust LM (error)	1	11.936	0.0006
Lagrange Multiplier (SARMA)	2	47.883	<0.001

Source: own elaboration based on the dataset of Tóth et al. (2021)

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Gender labor market outcomes during the COVID-19 pandemic: Evidence of she-cession in the Visegrád countries

Wycliffe Obwori Alwago

The effects of the COVID-19 pandemic showed that women's employment declined disproportionately than men's, prompting economists to coin the term "she-cession." This study examines the incidence and persistence of this phenomenon in the Visegrád economies using quarterly data on gender labor market outcomes from 2007Q1-2021Q4. The paper demonstrates that there is significant cross-country heterogeneity in the extent and severity of she-cession, with all the V4 countries demonstrating greater declines in women's employment rates than in men's. The Czech Republic suffered a severe she-cession compared to Hungary, Poland, and Slovakia. The COVID-19 she-cessions were often short-lived, lasting an average of one or two quarters, hence, it can be concluded that the V4 nations do not need to worry about the hysteresis effect of unemployment rates. The panel fixed effect model shows the significance of the gender labor market outcomes on economic progress measured by per capita GDP. Evidence demonstrates that women's labor market outcomes in the V4 countries have a significant impact on per capita GDP, which explains the advantage of eliminating gender disparities in the labor market.

Keywords: She-cession, COVID-19 pandemic, Gender Labor market outcomes

1. Introduction

Recently, gender equality and women's empowerment, both in wealthy and developing nations, have been at risk because of the converging effects of the COVID-19 pandemic, the global financial recession, and geopolitical warfare (Duflo, 2012). To close the gender gaps, a well-diversified economy that generates worthwhile employment opportunities, in particular industries like health and services, is needed (Dang–Nguyen, 2021). However, the COVID-19 shock resulted in enormous worldwide economic disruptions that had uneven economic ramifications on different groups of people in the labor market, with marginalized persons (women) being the most severely affected (Chetty et al., 2020; International Monetary Fund [IMF] 2021). The economic effects of the COVID-19 outbreak contrast those of a regular economic slump. Proponents contend that the COVID-19 pandemic had a significant impact on industries with a significant female workforce, leading to a situation known as "She-Cession," in which women's labor market outcomes and potential significantly decline in comparison to men's (Fabrizio et al., 2021; Alon et al., 2021; Albanesi–Kim, 2021). Contrarily, women in the United States saw lower unemployment rates than males during the global recession and had fewer cyclical employment patterns than men. Hence, the US experienced a "Man-cession" during the global 2008/9 financial crisis, which had a significantly greater negative impact on men's employment than it did on women's (Hoynes et al., 2012; Doepke–Tertilt, 2016). Determining the nature, extent,

and implications of gender labor market outcomes during the COVID-19 epidemic is, thus, a research concern.

The assumption that the pandemic recession would be a "she-cession" at the start of the crisis was made by Alon et al. (2020), based on many reasons. First, it rapidly became clear that the pandemic recession would have its greatest effects on more contact-intensive industries that are dominated by women, even as typical recessions heavily harm sectors with a male predominance, including construction and manufacturing (Mongey et al., 2021; Albanesi–Kim, 2021). Second, when schools are closed, as they were due to lockdowns associated with COVID-19, women typically shoulder a greater childcare responsibility (Adams-Prassl et al., 2020; Fuchs-Schündeln et al., 2020; Russell–Sun, 2020). Third, more women work part-time and in temporary employment, which are more likely to be terminated during a recession (Bahn–Cumming, 2020). Women were disproportionately affected by the associated job losses due to their predominance in service occupations. In addition, childcare responsibilities and school closures caused many women to quit the workforce. As a result, during the pandemic, both the supply and demand of female employment in the labor market suffered, eliminating a significant source of household welfare (Alon et al., 2020).

Even though the COVID-19 shock was associated with a high prevalence of transitory she-cessions, there is a great deal of country-to-country heterogeneity in policy interventions. Colombia experienced a severe she-cession, which was partially caused by the disproportionate number of women employed in the severely affected informal economy (Alvarez–Pizzinelli, 2021; García–Rojas et al., 2020). In the United States, the COVID-19 she-cession resulted in women with young children significantly exiting the job market because there were no other options for childcare due to lockdowns (Fabrizio et al., 2021). The UK, in contrast, did not experience a severe she-cession, probably because of better employee retention policies as well as other pro-women policies (Adams-Prassl et al., 2020). In the UK, mothers initiated furloughs more frequently than fathers did, but among employees without children, no such gender differences were revealed. Moreover, to avoid interruptions to the workforce, the United Kingdom specifically permitted nurseries and early childcare facilities to keep open (Pizzinelli–Shibata, 2023). In Hungary, Acheampong (2021) analyzed gendered COVID-19 impacts on the Hungarian labor market, depicting only the descriptive statistics of the gender gap. The study revealed that females were adversely affected by the COVID-19 pandemic in terms of employment and unemployment rates.

However, there are currently very few studies investigating the impact of the pandemic on gender disparity in a multi-country environment. Using a cross-country approach, Alon et al. (2021) discovered significant variations in the pandemic she-cessions across nations. They observed that the epidemic caused a sizable gender discrepancy in the number of hours worked in Germany and the US. In addition, they detected a significant gender disparity emerging in employment in the United States but not in Germany. These discrepancies suggest that governmental interventions (comprehensive furlough and short-time employment programs in Germany) played a significant role in supporting women's job retention following the downturn. Bluedorn et al. (2023) revealed a significant country-level heterogeneity, with around

two-thirds in a sample of 38 economies showing greater decreases in female employment rates. The average duration of these gender-specific COVID-19 effects was one or two quarters. Additionally, they demonstrated how the effects of COVID-19 on gender disparities in jobs across industries are closely tied to She-cessions.

The present analysis of pandemic-related "She-cessions" focuses on Visegrád countries (the Czech Republic, Poland, Hungary, and Slovakia) classified as emerging economies, contributing to the limited cross-country analyses. Using cross-country gendered labor market indicators at a quarterly frequency, the novelty of the study lies threefold. First, the period of analysis is extended from 2020 to 2021 to investigate the incidence and persistence of COVID-19 related She-cessions. A country is classified as being in a She-cession in a given quarter if the employment rate of women in that quarter has fallen more than that of men relative to their respective base year levels. Second, using the Panel fixed effect OLS model and incorporating global financial recession and the COVID-19 pandemic as dummies, the impact of gender labor market outcomes on the economic performance of V4 countries is investigated. Third, impulse-response functions are constructed to analyze how V4 economic growth reacted to either a reducing or increasing shock on the gender labor market outcomes and vice versa. Following this introduction of the effects of the pandemic on the labor market outcomes, this study aims to answer the following research questions:

1. What was the extent and implication of the COVID-19 she-cessions in the Visegrád countries?
2. How did the decline in the gender labor market outcomes affect the economic performance of the Visegrád countries?
3. Are the labor markets of the Visegrád countries at risk of the hysteresis effect?

The rest of the paper consists of 5 sections. I review the literature in Section 2 before discussing the she-cession concept and methodology in Section 3. I present the estimation results in Section 4 and finally conclude in Section 5.

2. Literature Review

2.1. Theoretical Framework

The idea of equal opportunity and the principle of social justice form the foundation for the requirement for gender parity in the workplace. While social justice addresses issues of the allocation of earnings and wealth, gender equality in employment, and the principle of equality of opportunity about individuals being treated equally (Burchardt, 2006; United Nations, 2006). In connection, many theories of the labor market explain the state of the labor market dynamics, notably for the suppression of unemployment and the achievement of full employment (Snowdon–Vane, 2005). The neoclassical approach contends that full employment is typical and that labor markets are inherently fair and efficient. Contrarily, the opponents – the radical and institutionalists likened to Marxism, Post-Keynesianism, Feminism, and the

segmented labor market theory – contend that the market structure is essentially unjust, with unemployment serving as the norm (Acheampong, 2021; Grimshaw et al., 2017).

Neoclassical proponents hold that the point at which labor supply and demand intersect at a specific wage rate is considered to be the equilibrium of labor markets. The amount of labor demanded by employers at the equilibrium wage rate is equal to the number of hours that people are willing to put in for that pay. Thus, the internal mechanisms in the economy will naturally adjust labor demand and supply to full employment and its natural rate of unemployment if the market deviates from the equilibrium condition (McConnel–Brue, 2008). Importantly, Say's Law forms the basis for the market-clearing premise of the neoclassical perspective, which holds that supply generates demand for itself (Sayre–Morris, 2006). In a similar vein, Muth's (1961) rational expectations theory holds that employers and employees have complete knowledge of the labor market, allowing them to foresee and adapt to future economic outcomes, notably, adjustments to the demand and supply of labor.

Neoclassical labor market assessments are disregarded by critical segmented labor market theory. The primary contention of the labor market segmentation hypothesis is that, as a result of prejudice and preconceptions in society, some groups of people are overrepresented in particular occupations and industries based on personal traits like sex and race (Blackburn, 2009), hence, the idea that labor markets are inherently fair is at odds with this viewpoint. The segmented labor market divides the labor market into two segments, the "good" and "bad" jobs, being distinguished on a qualitative level (Tilly, 2004). The secondary segment, which composes the bad jobs, is characterized by occupations with low pay, substantial turnover, random monitoring, and frequently horrific working environment as opposed to the primary segment, the good jobs, which are well-paying with favorable working conditions. Marginalized groups in the labor market including women more often occupy the secondary segment (Elder–Smith, 2010).

In connection with these theoretical underpinnings, economic downturns appear to have a variety of effects on the gender labor market's dynamics. More specifically, during the first year of the COVID-19 pandemic, many people experienced involuntary unemployment and shift cutbacks that significantly impacted their quality of life (ILO, 2020). The COVID-19 pandemic had an unequal effect on men and women globally and in different nations when it came to the labor market. Based on ILO (2020), there was a historic global employment loss of 114 million jobs in 2020 compared to 2019, however, in terms of relative employment losses, women, as well as young individuals, severely suffered more than men and older workers. Contrary to what was predicted by neoclassical theory, demand-side factors might be linked to the negative effects of the financial crisis on the labor markets, while both demand and supply factors in the labor market were linked to the negative effects of the COVID-19 pandemic on gender labor market outcomes.

2.2. COVID-19 and the Labor Market

Many nations implemented restrictions on individuals and enterprises in March 2020 to halt the spread of COVID-19, going as far as closing all business operations (Liu

et al., 2021; Feitelson et al., 2022). Constraints on economic activity caused a slump, which by historical standards resulted in a sharp rise in unemployment rates (Jena et al., 2021). The COVID-19 economic downturn hit its worst point after two months, with severe ramifications for the loss of lives and individuals' livelihoods (Groshen, 2020). Earlier recessions piled up over time, with rising unemployment lasting for at least five months (Rožman et al., 2021). In terms of the global greatest economies, the US GDP shrank by 5 percent and 32 percent in the first and second quarters of 2020, respectively, hiking the rate of unemployment from 3.5 percent to 14.7 percent, and experiencing the loss of 22 million jobs (Groshen, 2020). Similarly, in China, the first quarter of 2020 saw a sharp decline in GDP by 6.8 percent, the highest-ever contraction since 1992 (Kazunobu–Hiroshi, 2020). Moreover, the COVID-19 pandemic led to a drop in world trade, which aggravated the downturn in economies dependent on the network of international trade (Vidya–Prabheesh, 2020).

The COVID-19 pandemic had different effects on different industries, which were correlated with the severity of the restrictions put in place (Montenovo et al., 2020). In the first few months of lockdown, there were significant interruptions in the industries connected to the service sector, which is traditionally female-dominated, such as in transportation, hospitality, and tourism. The only exemptions were for critical essential service providers and nursing care, where the rate of employment remained stable or just slightly decreased (Bartik et al., 2020). Home confinement was one of the effects of the temporary shutdowns on households. This resulted in a sharp plunge in consumption expenditures (Jena et al., 2021) as well as income and wealth creation. This led to a rise in savings, which weakened aggregate demand. Because of this, expenditure on durable goods decreased, which in turn caused entrepreneurs to spend less on business investments (Meyer et al., 2022; Stiglitz, 2021), lowering the demand for labor. Regarding labor supply, people's capacity, and desire to work decreased as well because of the pandemic's danger to childcare services and school closures (Montenovo et al., 2022).

The main issue about labor market equilibria was the protracted permanence of increased unemployment rates brought on by the lockdown, which could result in a hysteresis effect (Stiglitz, 2021). Because of the rapid and severe economic shock brought on by the COVID-19 pandemic, conventional macroeconomic instruments were only partially effective in sustaining aggregate demand or supplying enterprises with liquidity (Chetty et al., 2020). Individuals did not believe in the success of the implemented government stimulus initiatives because of the economy's instability, and as a result, they did not react as anticipated (Coibion et al., 2020). Budgets for state and municipal governments were put under strain during the recession because of falling income and rising spending demands, hence, a considerable reduction in public service provisions, capital expenditures, and labor costs. Public expenditures acted procyclically due to the inability to finance expenses by taking on more debt coupled with a reduction in employment levels (Green–Loualiche, 2021).

Segmentation mechanisms on both the supply and demand sides of the labor market occur because it does not operate perfectly (Pissarides, 2000). Due to this, there are discriminatory access possibilities and working conditions (Holzer, 2005). The literature supports the notion that some workforce groups are discriminated against, as seen by increased unemployment and lower salaries. Women, those with

limited education, and skill levels (Belan et al., 2010), young people and the elderly (Golsch, 2004), immigrants, and members of racial and ethnic minorities (Pereira, 2012) are among those who experience discrimination. The rising rate of unemployment predominantly impacted the listed demographics in the early months of the COVID-19 pandemic (Montenovo et al., 2022). The forced switch to part-time work, implemented to lessen the number of layoffs during the crisis, had a greater significant negative impact on them (Cowan, 2020). A larger fall in employment among women attributes this phenomenon to the feminization of labor in sectors most affected by economic barricades. Also, parenting school-age children during the pandemic contributed to women's withdrawal from the job market and a drop in hours worked (Groshen, 2020).

In the European Union, the youth, particularly those with elementary or secondary education, suffered from financial hardship (Gavriluță et al., 2022), while in the US, low-income people were disproportionately impacted by the loss of employment (Chetty et al., 2020). More than 35% of workers in the lowest quintile of the income spectrum had experienced temporary joblessness, while just 9% of individuals in the highest quintile experienced the same (Cajner et al., 2020). In contrast, high-income employees endured temporary unemployment that lasted for a few weeks, whereas low-pay workers suffered far worse losses that prolonged for several months (Chetty et al., 2020). Employers started recruiting their former workers again as early as 2020 once the infection rate was put under control. Since nearly the whole economy was constrained, laid-off employees struggled to rapidly find new employment, and from the employer's standpoint, the re-hired employee did not need to be re-trained (Cajner et al., 2020).

In fact, following the initial lockdown restrictions, there was a lot of discussion about the economic impacts on the job market of social-distancing initiatives and a total lockdown. While some studies have concentrated on the rise in unemployment (Coibion et al., 2020), others have assessed what proportion of ordinary jobs can be performed without putting employees in danger of contracting COVID-19 or working from home. Lockdown tactics decrease contagion and mortality (with significant social and economic gains), but at the danger of a total shutdown of the economy – with significant consequences on the economic expansion. (Policy proposals that enable a return to normal economic functioning while protecting the most vulnerable were adopted to reduce this threat.) Other studies examined the distribution effects and asserted that COVID-19 had probably increased the income gap because it had greater detrimental effects on more vulnerable groups and people who work in the gig economy (Alon et al., 2020; Adams-Prassl et al., 2020).

2.3. Labor Market of Visegrád Countries Before the COVID-19 She-cession

The Visegrád Group was founded in 1991 in Visegrád, a town in Hungary (Zieliński, 2022). Integration was centered on the territories' proximity, a considerable degree of both cultural and historic cohesiveness, and shared customs. The survival of the V4 group – Poland, Czechia, Slovakia, and Hungary – was greatly aided by the similar economic development levels, institutional commonalities, and economic

systems of the member countries (Miljkovic, 2021; Dmytrów–Bieszk-Stolorz, 2019; Bieszk-Stolorz–Dmytrów, 2020). Due to the adoption of institutional reforms, huge technological advancements, enhancements in the quality of human capital, and fiscal consolidation policies, the Visegrád countries are now regarded as an example of the successful transition that increased their economic viability in the international market (Balcerzak–Pietrzak, 2016). The V4 economies' employment structures are dominated by the service sector, however, industry jobs still account for a sizable portion of total employment with agriculture accounting for a negligible portion. By 2019, the employment structure in the Czech Republic was 37.25% for industry, 60.09% for services, and 2.66% for agriculture. In Hungary, it was 32.09% for industry, 63.19% for services, and 4.727% for agriculture. In Poland, it was 32.13% for industry, 58.71% for services, and 9.15% for agriculture. In Slovakia, it was 36.09% for industry, 62.12% for services, and 2.79% for agriculture (Distribution of Employment by economic sector 2019).

The V4 group embarked on a phase of multi-year economic expansion after a time of hiked unemployment rates in the early 1990s brought on by the revolutionary recession (Tvrdon, 2011). Once the V4 nations joined the EU in 2004, favorable developments in the job markets accelerated. Foreign direct investment (FDI), which improved earnings and generated jobs, boosted the labor markets in V4. Czechia had a portion of employment in foreign-controlled firms 28.3%, Hungary had a portion of 26%, Poland had 19.9%, and Slovakia had 28.4% in 2018 (Distribution of Employment by economic sector 2019). Economic emigration to nations in Western Europe also hurt the labor supply in the V4 countries and, consequently, the unemployment rate (Lemos–Portes, 2008). The Visegrád nations have lower employment levels in comparison to Western Europe, which is counterbalanced by relatively high average working hours and better human capital (Sulich, 2016). However, with the declining trend in unemployment, the labor input in the V4 nations is no longer lower than in Western Europe when the total number of hours is taken into consideration (Kónya, 2008).

Due to their open economies and membership in the EU, the V4 nations are subject to labor market changes (employment and unemployment rates). The extent of openness is demonstrated by the GDP shares of exports and imports, which in 2020 were respectively 71% and 64.2% in the Czech Republic, 79.5% and 77.8% in Hungary, 56.2% and 49.4% in Poland, and 85.4% and 84.5% in Slovakia (World Bank, 2023). Poland participates significantly in global (EU) supply chains despite having the relatively lowest GDP share of the trade balance (Zieliński, 2022). The usage of flexible job options was one strategy for reducing unemployment (Mura et al., 2020). Employers benefit from non-standard employment arrangements since they lower personnel costs and make it simpler to end a contract in a recession (Mikołajczak, 2021). Employees' desire to work in non-standard forms (fixed-term employment, part-time employment, and self-employment) depends on the state of the market and the laws that are in effect; these laws affect the extent to which these forms are used in various economies. When flexible work is their only source of income, whether it began because of their initiative or the absence of traditional job offers, employees approach it uniquely (Blundell et al., 2014). In response to the financial crisis of 2008, temporary employment and part-time employment

increased significantly in the Czech Republic and Slovakia, self-employment decreased in Hungary, while part-time employment and self-employment increased in Poland (Zieliński, 2022).

To provide liquidity to businesses and safeguard workers during the epidemic, the V4 nations actively pursued fiscal and monetary strategies (reducing interest rates). Jobs were subsidized, social security premiums were eliminated or lowered, temporary changes were made to the income tax laws, and subsidies for rent, loans, and guarantees were given to businesses in all V4 nations (Zieliński, 2022). The Czech Republic provided the most assistance to enterprises in terms of GDP, followed by Hungary, Poland, and Slovakia. When direct non-returnable subsidies were used, Poland saw the highest proportion of entrepreneurs' gain (Czech et al., 2020). Hungary, in particular, devised a five-point economic protection strategy to lessen the possible negative effects of the lockdown restrictions on labor market outcomes: the first stage in the state's interventions was to take over a share of the wages paid by businesses that had to resort to reducing hours of work owing to the pandemic. The government also invested HUF 450 billion (EUR 1.23 billion) to create jobs. Giving economic stimulus to pandemic-hit sectors like tourism and hospitality was the third intervention. The fourth step was to make HUF 2,000 billion worth of discounted, treasury direct loans to Hungarian firms, while the fifth plan, named the "Family and Pensioner Protection Program," was to progressively reinstate 13th-month pensions (The Hungarian Government, 2020). The goal of all these government initiatives in Hungary was to lessen the negative effects that the COVID-19 pandemic had on the country's job market (Acheampong, 2021).

3. Methodology

From 2007 to 2021, quarterly OECD data were used to address the research questions. The data used is related to individuals aged between 15 and 64 years, defined as the working population by OECD. The comparison of quarterly data spanning the period 2019Q1 – 2021Q4 served as the starting point for the examination of labor market responses to the effects of the pandemic in the Visegrád nations. The choice of the study period was to determine the trends in the labor markets two years before the pandemic, and whether the COVID-19 pandemic disturbed those patterns. The table below includes information on the unemployment rate, employment levels, labor force participation, inflation, and GDP since 2007Q1.

Table 1. Variables and Measurement

Variable	Measurement	Source
Employment, men	Men, % of the working population aged 15-64	OECD database
Employment, women	Women, % of the working population aged 15-64	OECD database
Unemployment, men	Men, a percentage of the labor force	OECD database
Unemployment, women	Women, a percentage of the labor force	OECD database
Gross Domestic Product	Gross domestic product - US $, current prices, current PPPs, seasonally adjusted	OECD database
Labor force participation, men	Men, a percentage of individuals aged 15-64 (OECD estimate)	OECD database
Labor force participation, women	Women, a percentage of individuals aged 15-64 (OECD estimate)	OECD database

Source: own construction based on OECD database

I apply the idea of she-cession to enable an evaluation of the implications of the COVID-19 pandemic on the extent and growth in asymmetries in the labor market outcomes and evaluate changes in the pattern of employment and unemployment using 2019 as the base year. Equation 1 defines the percent changes in the employment rates of men and women.

$$\Delta\, e_{t,2019\ Average}^{Diff\ Ratio,W-M} = \frac{e_t^w}{e_{2019\ average}^w} - \frac{e_t^m}{e_{2019\ average}^m} \qquad (1)$$

Where $e_{2019\ average}^w$ and $e_{2019\ average}^m$ represent the average rates of employment between women and men respectively in 2019 (a year before pandemic). while e_t^w and e_t^m define the women and men employment rates in a certain quarter between 2020Q1 – 2021Q4. Equation 1 denotes the change in She-cession gender inequality, which shows the relative variations in employment rates between women and men. A country is said to be in she-cession if the change in employment gender disparity $\Delta\, e_{t,2019\ Average}^{Diff\ Ratio,W-M}$ is negative, implying that the proportionate change in women employment is higher than that of men.

I construct the impulse-response functions from an estimated Panel Vector autoregression to evaluate the dynamic relationship between labor market outcomes and macroeconomic indicators arising from the COVID-19 pandemic effect. The PVAR model order m is therefore described as follows:

$$Y_{it} = \beta_1 Y_{it-1} + \beta_2 Y_{it-2} + \cdots\cdots\cdots + \beta_{m-1} Y_{it-m+1} + \beta_m Y_{it-m} + \mu_{it} \qquad (2)$$

Where

$i = 1 \ldots \ldots \ldots \ldots \ldots \ldots n$ captures country-specific,
$t = 1 \ldots \ldots \ldots \ldots T$ represents the time (year)
$Y_{it} =$ represents the vector of endogenous variables $(1\ x\ k)$
$\beta_1, \beta_2, \ldots \ldots \ldots \ldots \beta_{m-1}, \ldots \beta_m =$ captures the coefficients to be estimated denoted as (k x k) matrix, $\mu_{it} =$ vector of the idiosyncratic errors

The following process entails the PVAR model estimation procedure. Using the Im, Pesaran, and Shin (2003) (IPS) or Levin, Lin, and Chu (LLC) approaches, series stationarity is tested first. These tests examine the degree to which the series' value in the current t period is influenced by its value in the preceding t period expressed as AR (1) process.

$$Y_t = \gamma_i Y_{t-1} + \mu_t \quad (3)$$

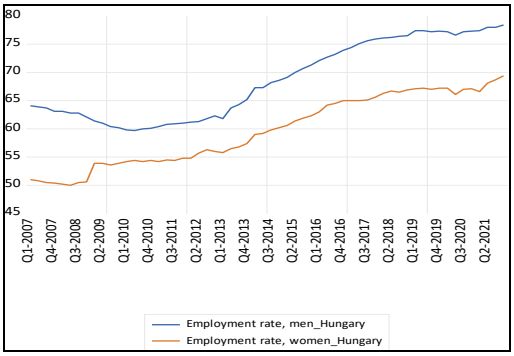
LLC operates under the premise that unit root coefficients are homogeneous ($\gamma_i = \gamma$), while IPS operates under the assumption that unit root coefficients are heterogeneous. Second, using the F test, LM/Honda test, and Hausman test, it is determined whether the pooled, random, or fixed effect model is appropriate for estimation before PVAR estimation. Last, the impulse response functions (IRFs) are estimated to ascertain how a shock to the GDP affects labor outcomes for men and women over time and vice versa. IRFs have the benefit of separating the dynamic behavior of one variable brought on by shock to another parameter in the system while keeping the shock constant (Love–Zicchino, 2006).

4. Results and Discussion

A trend analysis of the employment and unemployment patterns in Visegrád countries from 2007Q1 to 2019Q4 identified a gender gap in the labor market outcomes, with on average more males employed than women in relation to unemployment rates, before the COVID-19 epidemic. The discrepancy grew from 2020Q1 to 2021Q4 due to the pandemic, which has been continuously widening over time. Since 2007Q1, all of the V4 countries have seen men with higher employment levels than women, as shown in Figures 1, 2, and 3. With 64.1% of men's employment levels and 51% of women's employment levels as a percentage of all employment levels in Hungary, there is a significant gender pay difference. However, the disparities between men's and women's work levels began to reduce in the second quarter of 2009, when men's employment levels fell by 4.1% and women's employment rates rose by 3%. At the same time period, Slovakia likewise had a sharp decline in male employment rates, whereas Poland and the Czech Republic saw very modest differences in employment between men and women. The global recession induced by the global financial crisis of 2008/2009 and the European debt crisis resulted in a fall in men's employment levels relative to women's between 2009Q1 and 2013Q3. This demonstrates that the V4 nations also went through a "He-cession" during the global recession, just like the US. However, the labor market prospects bounced back from the shock starting in

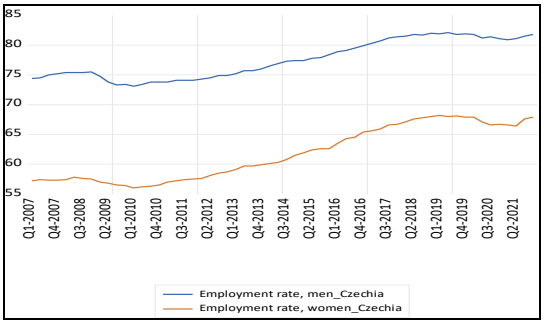
2014, with employment levels rising for both men and women but maintaining a gender disparity in employment throughout the V4 countries.

Figure 1. Trends in employment levels in Hungary by gender (2007Q1-2021Q4)



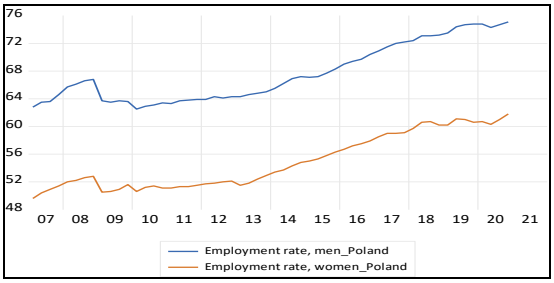
Source: own computation based on OECD database

Figure 2. Trends in employment levels in the Czech Republic by gender (2007Q1-2021Q4)



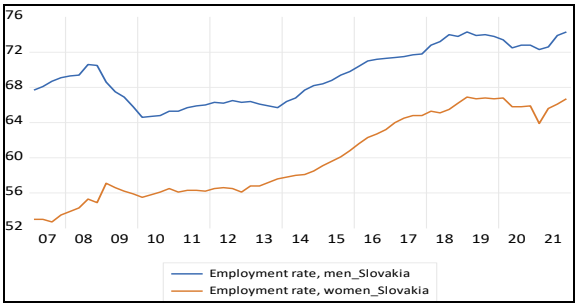
Source: own computation based on OECD database

Figure 3. Trends in employment levels in Poland by gender (2007Q1-2021Q4)



Source: own computation based on OECD database

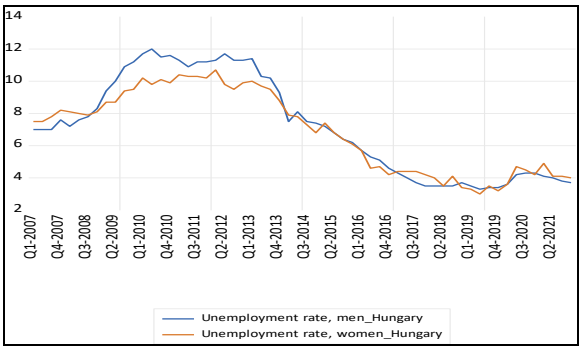
Figure 4. Trends in employment levels in Slovakia by gender (2007Q1-2021Q4)



Source: own computation based on OECD database

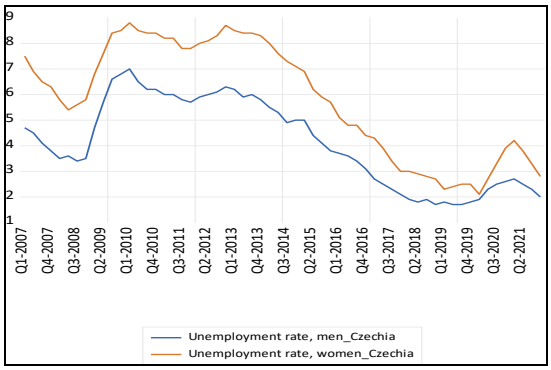
In the Czech Republic, there was a significant gender disparity in unemployment, with a dramatic increase from 2009Q1 to 2010Q1. In Poland, Slovakia, and the Czech Republic, women experienced greater unemployment rates than males did, but the difference had closed up by 2019Q1, shortly before the COVID-19 pandemic (Poland closed the gap in 2015Q4). Interestingly, the gender gap in unemployment rates in Hungary closed down in 2008Q3 (7.8%), and intriguingly, the unemployment rate for males increased relative to that for women from 2008Q4 to 2014Q1, after which the pattern became cyclical for both sexes. Notably, even during the COVID-19 pandemic period, the gap between the jobless rates for men and women had significantly closed. Figures 6, 7, and 8 below demonstrate the trends in the unemployment rates in the V4 nations. The findings offer the conclusion that during the period of the European debt crisis and the global recession, when men's labor market outcomes were most negatively impacted by the shocks, there was evidence of "he-cession" in all of the Visegrád nations, though the effects were short-lived.

Figure 5. Trends in Unemployment levels in Hungary by gender (2007Q1-2021Q4)



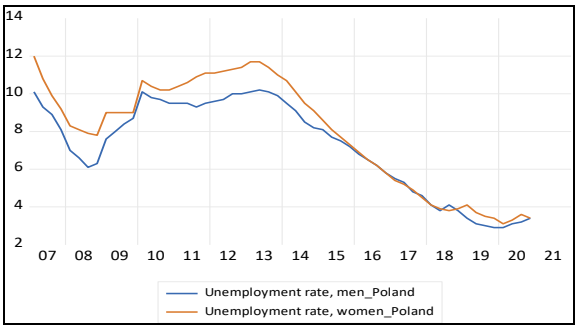
Source: own computation based on OECD database

Figure 6. Trends in Unemployment levels in the Czech Republic by gender (2007Q1-2021Q4)



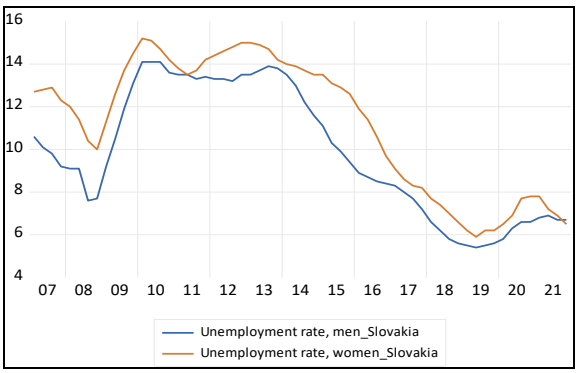
Source: own computation based on OECD database

Figure 7. Trends in Unemployment levels in Poland by gender (2007Q1-2021Q4)



Source: own computation based on OECD database

Figure 8. Trends in Unemployment levels in Slovakia by gender (2007Q1-2021Q4)



Source: own computation based on OECD database

The severity of the labor market inequities in the V4 economies has been significantly impacted by the pandemic, as shown by Table 2's quarterly trends in employment and unemployment rates. The findings indicate that the pandemic had a variety of effects on gender disparities in labor market outcomes, but it also temporarily reverted the declining trend in unemployment rates that had been observed in all V4 countries before the COVID-19 outbreak. Slovakia (1.3%), Hungary (0.9%), Czechia (0.9%), and Poland (0.8%) saw the largest increases in the unemployment rate for men compared to the fourth quarter of 2019 (Q4). Slovakia (1.6%), Czechia (1.7%), Hungary (1.7%), and Poland (0.3%) all had considerable increases in the unemployment rates for women compared to the fourth quarter of 2019. We see that Slovakia had the highest rates of unemployment for both sexes during the pandemic, whereas Poland saw a return to pre-pandemic unemployment levels in 2021Q4. Employment in Czechia had been rising before the pandemic, but the COVID-19 outbreak reversed the trend (a decrease in employment) for both men and women until 2021Q4 when the pre-pandemic levels were restored. Comparable trends were observed in Slovakia, however there was a slower decline there than in Czechia. Women's employment levels were restored in 2021Q4, while men's employment levels were restored in 2021Q3. Men and women's employment levels in Hungary and Poland reached their pre-pandemic levels in 2020Q4 and 2020Q3, respectively, and started to rise again.

Table 2. Trends in employment and unemployment levels across gender in V4 countries

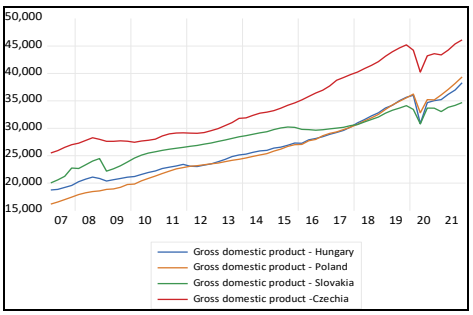
		Czechia				**Hungary**		
Year	Emp_ men	Emp_ women	Unemp_ men	Unemp_ women	Emp_ men	Emp_ women	Unemp_ men	Unemp_ women
2019Q4	81.9	67.9	1.8	2.5	77.3	67.2	3.4	3.2
2020Q1	81.8	67.9	1.9	2.1	77.2	67.2	3.6	3.6
2020Q2	81.2	67.1	2.3	2.7	76.6	66.1	4.2	4.7
2020Q3	81.4	66.6	2.5	3.3	77.2	67	4.3	4.5
2020Q4	81.1	66.7	2.6	3.9	77.3	67.1	4.3	4.2
2021Q1	80.9	66.6	2.7	4.2	77.4	66.6	4.1	4.9
2021Q2	81.1	66.4	2.5	3.8	78	68.1	4	4.1
2021Q3	81.5	67.6	2.3	3.3	78	68.7	3.8	4.1
2021Q4	81.8	67.9	2	2.8	78.4	69.4	3.7	4
		Poland				**Slovakia**		
	Emp_ men	Emp_ women	Unemp_ men	Unemp_ women	Emp_ men	Emp_ women	Unemp_ men	Unemp_ women
2019Q4	74.8	60.6	2.9	3.4	73.8	66.7	5.6	6.2
2020Q1	74.8	60.7	2.9	3.1	73.4	66.8	5.8	6.5
2020Q2	74.3	60.3	3.1	3.3	72.5	65.8	6.3	6.9
2020Q3	74.7	61	3.2	3.6	72.8	65.8	6.6	7.7
2020Q4	75.1	61.8	3.4	3.4	72.8	65.9	6.6	7.8
2021Q1	76.5	62.4	3.7	3.7	72.3	63.9	6.8	7.8
2021Q2	76.5	63.7	3.7	3.5	72.6	65.6	6.9	7.2
2021Q3	77	64.5	3.2	3.3	73.9	66.1	6.7	6.9
2021Q4	77.2	64.6	3.1	3.2	74.3	66.7	6.7	6.5

Source: own computation based on OECD database
Note: Emp_men – employment rate, men; Emp_women – employment rate, women; Unemp_men – unemployment rate, men; Unemp_women -unemployment rate, women (expressed in percentage, Quarterly)

Variations in the rate of economic productivity were the reason behind the different changes in the unemployment rate and employment rate in V4 economies. The

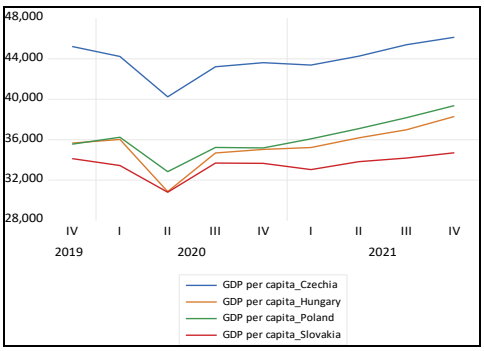
increase in employment in Poland during the pandemic period was matched by a minor recession in 2020 (GDP declined by 2.5%), which was more than offset in the following year (GDP expanded by 5.7%). The rest of the V4 countries performed slightly worse in terms of growth, posting the following annual growth rates: Slovakia at 3.0% in 2021, following a growth rate of 4.4% in 2020; Czechia at 3.3% in 2021, following a growth rate of 5.8%; and Hungary at 7.1% in 2021, following a growth rate of 4.7% in 2020, which supported their recovery of pre-pandemic employment rates (Zieliński, 2022). Figure 9 shows the patterns in per capita GDP in the V4 countries from the first quarter of 2007 to the fourth quarter of 2021, with a severe decline shown during the COVID-19 era before the economies recovered from the recession. Since 2007, the Czech Republic has had the greatest economy among the V4 nations, followed by Slovakia, Hungary, and then Poland. Nonetheless, Slovakia was surpassed by Hungary and Poland in terms of a rise in GDP per capita in 2018. Since a minor recession in 2008, brought on by the global financial crisis of 2008–2009, which Slovakia experienced more severely than the other V4 nations, the trajectory in economic growth in those nations has been growing.

Figure 9. Trends in GDP per capita of Visegrad countries (2007Q1-2021Q4)



Source: own computation

Figure 10. Trends in GDP per capita of Visegrád countries (2019Q4-2021Q4)



Source: own computation

Figure 10 shows indications of a COVID-19 recession with a trough in 2020Q2 when considering developments in the per capita GDP of the V4 nations over the COVID-19 pandemic era. By 2020Q2, Poland had seen a 7.65% decline in GDP per capita, the Czech Republic had experienced a 10.99% decline, Slovakia had experienced a 9.75% decline, and Hungary had experienced a 13.48% decline in GDP per capita compared to 2019Q4 projections. The economies began to improve in 2020Q3, but 2021Q1 saw a minor decline in the economies of the Czech Republic, Hungary, and Poland. It is noteworthy that, resuming an upward trend in growth, all of the V4 countries recovered from the COVID-19 recession and reached their pre-pandemic per capita GDP by 2021Q2.

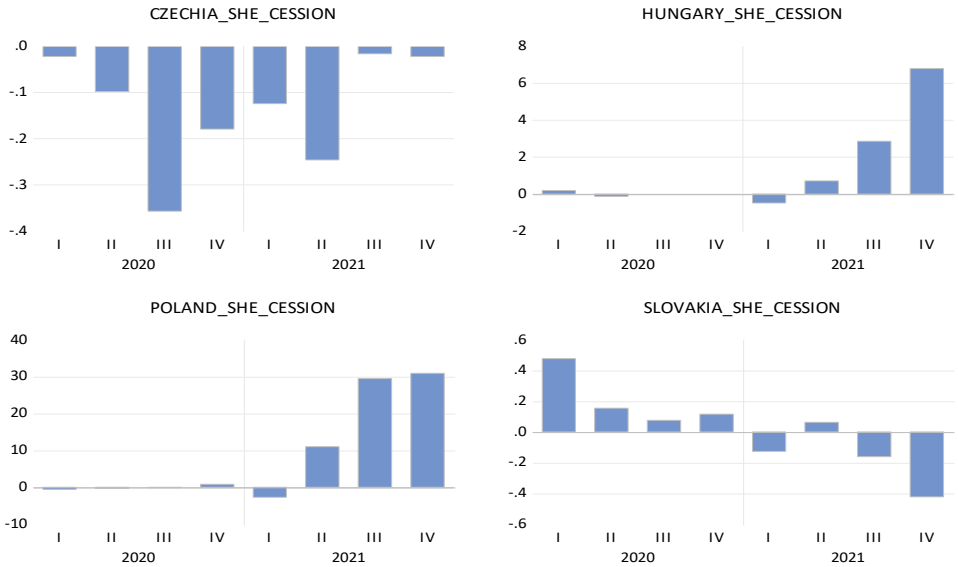
The results of the She-cession gender gap shift are shown in Table 3 and Figure 11, which is represented by Equation 1 and reflects the significant variations in employment levels between men and women compared to its average in 2019. She-cession, as has been noted, happens when the decline in women's employment rates is disproportionately bigger than that of men's. In the Czech Republic, the progression of the employment rate by gender fell below the 2019 average during the whole COVID-19 period, from 2020Q1 to 2021Q4. This is evidence of severe she-cession in Czechia relative to Hungary, Poland, and Slovakia. Predictably, there is a precipitous drop (trough) in the employment rate by gender in Czechia in 2020Q3 and 2021Q2 (see Figures 10 and 11). This decline was caused by the country's severe lockdowns that were implemented to stop the spread of COVID-19. In Hungary, Poland, and Slovakia, the she-cession trough was noted in the first quarter of 2021. The entire COVID-19 period (2020Q1-2021Q4) saw a severe she-cession in Czechia, whereas Hungary and Poland only had a modest decline in 2020. It is interesting to note that Slovakia did not undergo she-cession in 2020, unlike the other V4 nations, however, it experienced a she-cession trough in 2021Q1 and 2021Q4. This demonstrates the surprising degree of variation in She-cession experiences among the Visegrád countries. The heterogeneity might be attributed to the variety of policies that were enacted and put into place at different times in order to stop the spread of COVID-19, flex the labor market, and ease containment measures. The results are in line with those of Zieliński (2022), whose she-cession analysis found cross-country heterogeneity.

Table 3. Visegrád She-cession

	CZECH_ She-cession	HUN_ She-cession	POL_ She-cession	SLVK_ She-cession
2020Q1	-0.0218	0.1945	-0.5930	0.4765
2020Q2	-0.0976	-0.1255	-0.2974	0.1541
2020Q3	-0.3570	0.0000	-0.1026	0.0760
2020Q4	-0.1790	0.0000	0.8129	0.1157
2021Q1	-0.1242	-0.4863	-2.6847	-0.1263
2021Q2	-0.2461	0.7111	11.0047	0.0622
2021Q3	-0.0162	2.8667	29.4435	-0.1611
2021Q4	-0.0218	6.7980	30.8948	-0.4222

Source: own construction based on OECD database

Figure 11. Trends in GDP per capita of Visegrád countries (2020Q1-2021Q4)



Source: own construction based on OECD database

In the Czech Republic, the economy hit a she-cession low in 2020Q3, meaning that the employment rates of women fell more sharply than those of men. In 2020Q4 and 2021Q1, the economy returned to pre-pandemic levels. But, in 2021Q2 and 2021Q4, the economy saw a second decline into a she-cession trough. After the she-cession trough in Slovakia's economy in 2021Q2, there was a trend reversal in 2021Q2, but in 2021Q3 and 2021Q4, the economy experienced another she-cession trough. Discussions about the hysteresis effect on labor market results in V4 countries may be sparked by the differences in she-cession experiences in those countries. Slovakia did not have a she-cession trough in 2020, but from the start of the COVID-19 pandemic until 2020Q4, women's employment levels began to decline. It is claimed here that the V4 countries did not experience the hysteresis effect since women's employment rates began to rise after the recovery and the she-cessions impacts were transient because the rise in unemployment rates during the pandemic period was rather moderate in all countries.

The gradual recovery in some of the originally hardest-hit economic sectors, like the hotel and service industries, which are dominated by women, may help to explain the she-cession recovery paths in different regions of V4 countries. In addition, the containment measures put in place to stop the pandemic's spread had been eased, and by 2020Q4 schools and childcare facilities had reopened, allowing women to return to the workforce. It should be noted that by 2020Q4 the economies had also recovered from the GDP recession, implying a rise in production capacity and, consequently, a rise in employment for both men and women. Gender disparities in employment rates that already existed did not change, even when the initial COVID-19 exacerbation of the gender gap subsided.

Notwithstanding the she-cession recovery in V4 countries, COVID-19 increased the gender employment gap. These results contrast with those from the global financial crisis, which showed that the U.S. labor market experienced a "He-cession" during the global financial recession (Hoynes et al., 2012; Wall, 2009).

I also investigated how the gender labor market outcomes affected economic performance, as assessed by per capita GDP, in light of the evidence that COVID-19 significantly affected gender labor market outcomes, i.e. She-cession in V4 countries. In order to accomplish this goal, we used the Panel Fixed effect OLS model for quarterly data between 2007Q1 and 2021Q4, with GDP per capita as the predicted variable, and the gender labor market outcomes of employment, unemployment, and labor force participation as the predictors. To better understand the structural flaws in the economy, I also incorporated dummy variables for the COVID-19 pandemic and the 2008 global financial crisis.

An economic or political shock to one of the panel's countries can be tested for cross-sectional dependence to see if it has an impact on the other countries. When conducting the analysis, it is important to account for any such interactions. Results could be skewed when a cross-sectional dependence exists but is neglected. I tested cross-sectional dependence using LM, scaled LM, and CD tests (Breusch–Pagan, 1980; Pesaran, 2007). The results in Table 4 depict that the prob < 0.05 at a 5% level of significance, hence, I reject the null hypothesis of no cross-sectional dependency and conclude that there is cross-sectional dependency among the V4 countries. This implies that the financial crisis or the COVID-19 shock to one of the Visegrád member countries resulted in spillover effects to other member countries.

Table 4. Cross-sectional Dependence test

Residual Cross-Section Dependence Test			
Null hypothesis: No cross-section dependence (correlation) in residuals			
Equation: Untitled			
Periods included: 60			
Cross-sections included: 4			
Total panel observations: 240			
Cross-section effects were removed during estimation			
Test	Statistic	d.f.	Prob.
Breusch-Pagan LM	23.91189	6	0.0005
Pesaran scaled LM	5.170717		0.0000
Bias-corrected scaled LM	5.136819		0.0000
Pesaran CD	2.022204		0.0432

Source: own computation

Consequently, I also applied the F test to ascertain the choice of the Panel fixed effect model instead of Panel Pooled OLS. The null hypothesis is of no fixed effects on the panel and if it is rejected then it is decided that the individual effects are fixed in the panel over time. From Table 5, the null hypothesis is rejected for cross-section and period since prob = 0.000 < 0.05 implying that cross-section (individual) effects and time effects are fixed. Evaluating the two effects together (cross-section/period F) also leads to the rejection of the null hypothesis since prob = 0.000 < 0.05, hence, the effects are fixed, ascertaining the choice of Panel fixed effect OLS in the analysis.

Table 5. F-test for fixed effect model

Redundant Fixed Effects Tests			
Equation: Untitled			
Test cross-section and period fixed effects			
Effects Test	Statistic	d.f.	Prob.
Cross-section F	72.795633	(3,171)	0.0000
Cross-section Chi-square	197.498374	3	0.0000
Period F	8.760191	(59,171)	0.0000
Period Chi-square	334.058171	59	0.0000
Cross-Section/Period F	9.178357	(62,171)	0.0000
Cross-Section/Period Chi-square	351.615641	62	0.0000

Source: own computation

Table 6. Panel Fixed Effect Model

Dependent Variable: LNGDP				
Method: Panel Least Squares				
Date: 04/10/23 Time: 22:49				
Sample: 2007Q1 2021Q4				
Periods included: 60				
Cross-sections included: 4				
Total panel (balanced) observations: 240				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNEMPLOYMENT_MEN	-0.006343	0.010015	-0.633299	0.5272
LNEMPLOYMENT_WOMEN	0.009655	0.004071	2.371315	0.0186
LNLABORFORCE_MEN	0.030354	0.009410	3.225905	0.0014
LNLABORFORCE_WOMEN	0.013546	0.004051	3.343915	0.0010
LNUNEMPLOYMENT_MEN	0.044685	0.010444	4.278480	0.0000
LNUNEMPLOYMENT_WOMEN	-0.051037	0.007816	-6.530127	0.0000
COVID_19	0.033505	0.017227	1.944968	0.0530
FINANCIAL_CRISIS_2008	-0.017878	0.017036	-1.049396	0.2951
C	7.035788	0.210795	33.37747	0.0000
R-squared	0.927860	Mean dependent var		10.24474
Adjusted R-squared	0.924379	S.D. dependent var		0.223662
S.E. of regression	0.061505	Akaike info criterion		-2.690681
Sum squared resid	0.862500	Schwarz criterion		-2.516649
Log-likelihood	334.8818	Hannan-Quinn criteria.		-2.620559
F-statistic	266.5924	Durbin-Watson stat		0.256651
Prob(F-statistic)	0.000000			

Source: own computation

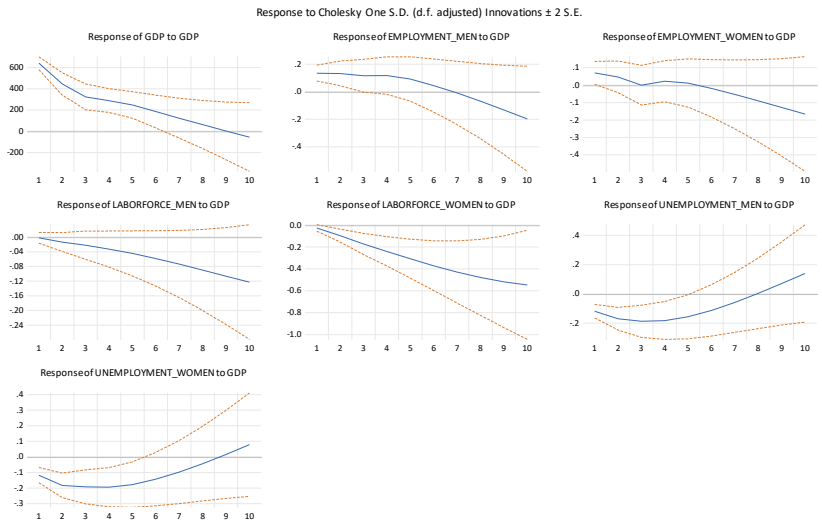
The findings in Table 6 demonstrate the model's overall significance at a 5% level of significance (F-statistics 266.5924, prob = 0.0000 < 0.05). Additionally, the model's explanatory power, as indicated by Adjusted R^2 and R^2, demonstrates that between 2007Q1 and 2021Q4, the gender labor market outcomes accounted for 92.4% of the differences in per capita GDP. Apart from men's employment levels (prob = 0.5272 > 0.05), labor market outcomes were found to significantly affect per capita GDP (p-value < 0.1). Men's employment levels have a negative impact on GDP per capita ($\beta = 0.6343\%$), however, it is insignificant, whilst women's employment levels have a positive significant impact ($\beta = 0.009655$). This implies that women's employment levels raise per capita GDP in V4 countries by 0.9655%, ceteris paribus. The labor force participation rates of males ($\beta = 0.030354$) and females ($\beta = 0.013546$) both increase per capita GDP by 3.0% and 1.3%, respectively. Women's unemployment rate has a negative significant impact on per capita GDP while men's unemployment positively influences economic growth. As was the case during the COVID-19 period, there was evidence of she-cession in the V4 countries where women employment levels declined disproportionately than men's. This resulted in the withdrawal of women from the labor force hence increasing involuntary unemployment and reducing domestic

demand and consumption in the economy. Based on these results, women's labor market outcomes in V4 countries have a significant impact on per capita GDP, which helps explain the advantages of eliminating gender disparities in the workforce. The results are in line with feminist perspectives that gender equality, in the labor market, is a macroeconomic variable and when women's full potential is realized in the economy then it results in macroeconomic efficiency.

The global financial crisis had an insignificant effect (prob = 0.2951 > 0.05), however, the COVID-19 pandemic had a significant impact (prob = 0.000 < 0.05) on per capita GDP, all treated as dummies to account for structural breaks in the model. Interestingly, the COVID-19 outbreak contributed to a rise in economic growth in V4 nations ($\beta = 0.033505$). This implied that during the COVID-19 period, the shock had a cross-sectional fixed effect on all V4 countries, and their economies grew by 3.35% on average. This result confirms the findings in Figure 10, which showed an increase in per capita GDP in the V4 countries during the COVID-19 pandemic period despite a slight decline. Manufacturing and other non-contact-intensive industries were less affected by the COVID-19 outbreak and continued to operate, necessitating production in the economy, and boosting economic growth.

Figure 12 shows the impulse-response functions that illustrate how per capita GDP and gender labor market outcomes respond to either a diminishing or an increasing shock. I initially identified the response of the series to its own shock to ascertain whether the shock on the series is lessening or increasing. When we look (top left) at how per capita GDP reacted to its own shock (by initially declining), we may infer that it was a decreasing shock. So, in response to a decreasing shock to per capita GDP, women's employment rate and both men's and women's labor force participation responded in the direction of the drop, whereas men's and women's unemployment rates responded by rising. The COVID-19 pandemic resulted in a slight recession (decline in per capita GDP) which also negatively impacted the gender labor market outcomes (see Figures 1-8).

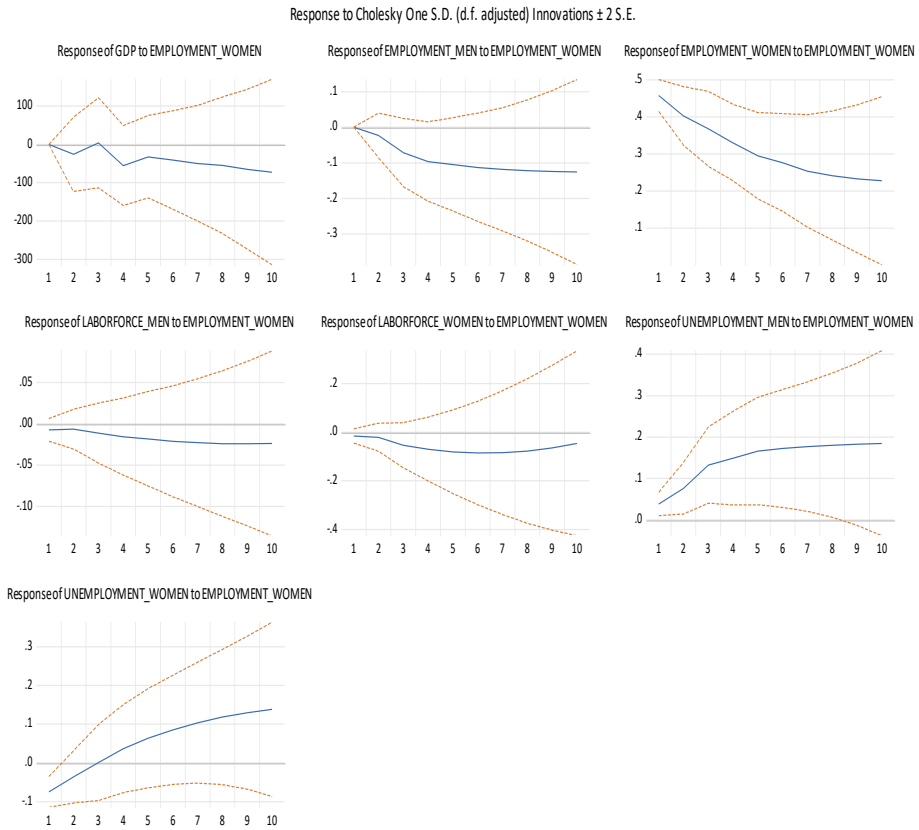
Figure 12. Impulse-Response functions computed from Panel VAR estimation



Source: own computation

In a similar vein, we can see how changes in the per capita GDP and other gender labor market outcomes were influenced by a shock to the employment rate of women (the She-cession scenario). Figure 13 shows that following a decreasing shock (top right) to women's employment levels, per capita GDP, and men's employment rates, both men's and women's unemployment rates reacted by initially increasing. The panel fixed effect model showed the significance of women's employment rates on economic progress hence a reducing shock on the former reciprocate similar effects to the latter. The fact that both men's and women's employment levels declined as a result of the COVID-19 epidemic, but that women's employment levels declined proportionately more than men's did, and that both men's and women's unemployment rates rose, supports the behavior of the impulse-response functions.

Figure 13. Impulse-Response functions computed from Panel VAR estimation



Source: own computation

5. Conclusion

Unique characteristics of the COVID-19 pandemic recession, such as extensive economic lockdowns, school closings, and significant losses in contact-intensive industries, raised worries about the disproportionately negative effects on women's

employment prospects. This paper has examined a panel of Visegrád economies through 2021 and found significant heterogeneity in the extent and severity of the she-cessions, where women's employment rate declines proportionately higher than men's. In the Czech Republic, the progression of the employment rate by gender falls below the 2019 average during the whole COVID-19 period, from 2020Q1 to 2021Q4. This shows that Czechia suffered major she-cession compared to Hungary, Poland, and Slovakia. Predictably, there was a significant decline (trough) in Czechia's employment rate by gender in 2020Q3 and 2021Q2, which was spurred by the country's rigorous lockdowns and containment procedures designed to stop the spread of COVID-19. In Hungary, Poland, and Slovakia, the she-cession trough was noted in the first quarter of 2021. The entire COVID-19 period (2020Q1-2021Q4) saw a severe she-cession in Czechia, whereas Hungary and Poland only had a modest decline. It is interesting to note that Slovakia did not undergo she-cession in 2020, unlike the other V4 nations. There was a she-cession trough in 2021Q1 and 2021Q4 in Slovakia. Moreover, she-cessions also tended to be short-lived, with the Hungary and Poland recovering from she-cession by 2021Q1.

The significant inter-country heterogeneity raises the question of what structural features or differences in policy responses might account for inter-country heterogeneity in the incidence of COVID-19-related she-cessions. One institutional aspect that may have caused women's worse labor market outcomes in the acute period of the COVID-19 epidemic was the gender discrepancy in the fraction of workers on temporary employment and variations in the stringency of job protection. For pandemic policy responses, stricter lockdowns were linked to less significant alterations in the gender imbalance in the labor market, but harsher school closures were linked to larger gender differences. Before the pandemic, the labor markets of three of the four V4 nations (Poland 2.9% men and 3.4% women; Czechia 1.8% men, 2.1% women; Hungary 3.4% and 3.2% for men and women, respectively) were described by unemployment rates similar to frictional unemployment, remaining in a state of close equilibrium. In these countries, the pandemic led to a slight uptick in the unemployment rate for all genders. In Slovakia, where the jobless rate was already the worst among the V4 countries (2019Q4), with 5.6% for males and 6.2% for females, the effects of the pandemic on the unemployment rate were slightly more pronounced. Furthermore, the lack of an impact on Czechia and Slovakia and the return to pre-pandemic employment levels in Poland and Hungary by 2021Q2 may be attributed to differences in economic systems. Both the percentage of employment in industry and the percentage of employment in businesses under foreign ownership are lower in Poland and Hungary. This could mean that the disruption of supply chains has a greater negative impact on employment in the industry than it does on services.

The low unemployment rate at the end of 2019Q4 may have led to weak employer responses in the form of layoff decisions, i.e. employers may have been concerned about the difficulty of recovering laid-off workers who may have found another job. The modest severity of the recession in 2020 and the recovery in 2021, as well as financial help from public funding for businesses affected by the lockdown, granted that employment was preserved, were two further factors preventing an increase in unemployment in the V4 countries. It is safe to conclude that V4 nations do not need to worry about the hysteresis effect as a result of a slight increase in

unemployment caused by the COVID-19 pandemic. Moreover, labor market outcomes have a significant impact on economic growth measured by per capita GDP in Visegrád economies. The impulse-response functions revealed two-way nexus between gender labor market outcomes and economic growth in case of a shock like the COVID-19 pandemic.

To conclusively determine what generated cross-country disparities in COVID-19 she-cessions, future research utilizing cross-country microdata analysis on gender labor market outcomes across the pandemic would be needed. Significant structural factors that contribute to women's poor employment trends during the COVID-19 she-cessions include women's higher employment ratios in the service and hospitality sectors. Policymakers could work to ensure that there are affordable and dependable childcare alternatives (public or private) open throughout, that family leave is accessible for equitable use by men and women (acknowledging evolving gender responsibilities), and flexibility in working hours.

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Investigation of sense of community among cyclists

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Cycling has become determinate in many areas of life. It is a cheap, environmentally friendly and flexible mode of transport, and due to the emergence and development of cycle sport and the growing willingness to follow a healthy lifestyle, cycling provides sports opportunities and the daily exercise for many. The aim of this study1 is to investigate the sense of community among cyclists by conducting an online survey using validated questions from the Sense of Community Index 2 (SCI-2) model, with 362 responses gathered. According to the results, the interpreted scales were applicable and most of the respondents agreed with the 4 dimensions of the SCI-2 (Membership, Influence, Integration and fulfilment of needs, Shared emotional connection) which assumes that cyclist do feel a kind of community with each other. From a marketing point of view, cycling can be perceived not only as an activity but also as a group of consumers linked to this activity.

Keywords: sense of community, cycling, Sense of Community Index 2

1. Introduction

Cycling is playing an increasingly important role in everyday life, and there may be a number of motivations behind an individual opting for the bike. The popularity of following a healthy lifestyle, regular exercise (Légrádi, 2001) and the commitment to environmental protection and sustainability contribute to its spread (Kisgyörgy et al., 2008). However, it can be observed that cycling tourism has also boomed in recent years, with cycling becoming an important component of the industry. In addition to its many positive features, the popularity of cycling lies in its role in building individuals' identity and attachment, as well as being an excellent tool for symbolizing social status (Volgger–Demetz, 2021). As a result, the role of cycling and also the role of communities formed around this activity have increased, so their examination and deeper understanding is important. In the present study, we aim to explore whether cycling – as an activity – is able to create a community among cyclists. If so, what factors contribute to its development and how they affect its extent.

People prefer activities that can relax them physically, mentally, and spiritually, and are enjoyable, fun, and easy to spend time in their leisure time. One such activity is cycling, which plays an important part in people's lives and has long been a popular tool, whether for transportation or sports purposes (Duran et al., 2018), and even sports can strengthen belonging to the community (Csóka et al., 2021). Cycling is cheap, flexible, and the one most sustainable modes of transport – which can even be used as a sharing economy (Buda et al., 2019) – and its emissions do not

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result in any pollutant emissions, thus reducing carbon dioxide content, which in turn contributes to the adequate health of people (Hidvégi et al., 2015).

2. The role of the consumer community and tribe in marketing

Community participation is vital to people's well-being, so that a lack of social connection affects both mental and physical health (Ipsen–Hall, 2021). The stratification of society and the formation of groups have been observed for a long time. The widespread and popular hippie era in the 1960s drew attention to the fact that a lifestyle can be chosen by anyone, which also marked the beginning of the division of society into smaller groups (Törőcsik et al., 2019). Communities are no longer required to be geographically close to each other. It is sufficient to mutually recognize a common identity, and if this is achieved, individuals may be symbolically close to each other, even if they are separated by a significant distance (Prónay–Hetesi, 2016).

Consumer communities can also form, which are an integral part of the marketing field. In this case, individuals explore groups in which they feel comfortable, have an experience, and can identify with common values (Prónay–Hetesi, 2016). The formed groups play a significant role in the (purchasing) decision-making and behavioral processes due to the individual's desire to resemble or imitate the group (Hofmeister-Tóth, 2006). Some consumer communities are not tied to a specific brand, which is why we can distinguish between brand communities and consumer tribes. In the former case, members nurture emotions about the brand of a product or service. They can be described as a special and geographically unrelated community based on social relationships between fans of a given brand (Muniz–O'Guinn, 2001). According to Cova and Cova (2002), tribal consumption was created through the search for social relationships with people, the shared use of products and services, through a "connecting value". Consumer tribes are made up of individuals with similar consumption, mindsets, or value judgments, but in contrast to the brand community, they are not centered on the brand, much more importance can be attributed to the community and community thinking. What is also important to emphasize is that joining one type of tribe does not preclude membership of other tribes or communities (Robin, 2011).

We also interpret the cycling community as a consumer tribe. Their role is being enhanced by the growing popularity of cycling, which is compounded by the growing importance of this activity in building individuals' identities, their attachment to each other and in symbolizing their social status. Today, it can be seen much more as a symbolic activity of the affluent, so the connection between cycling and striking consumption has become apparent. It is also true of the cycling tribe, which is also integrated into the definition of a sense of community through the membership dimension, that in relation to cycling, the tribe defines the norms, competencies, and symbolic knowledge that cyclists must acquire to become a full member. Cycling is therefore a good tool to reflect that we are a member of a community (Volgger–Demetz, 2021).

3. Sense of Community

A sense of community is one of the most defining parts of community psychology, in which belonging is expressed as a feeling in the individual and his or her needs are satisfied as a result of togetherness. The first prominent theoretical definition of a sense of psychological community is due to Sarason's (1974) work that characterizes an environment or community that allows individuals to experience group-like similarity, belonging, and social support that they are willing to maintain in the long run. A sense of community is important in modern social life because it has many benefits that improve quality of life in both mental and physical terms (Warner et al., 2013).

The sense of community can be conceptually related to the idea of a consumer community already expressed earlier. A sense of community among individuals is mostly able to develop as a result of a similar range of interests, regardless of how far apart they are geographically located. Several studies have previously raised research questions for brand communities or groups based on the same interests or leisure activities. Based on these, it can be concluded that the sense of community does not always have to be linked to the brand of a product or service, this phenomenon cannot be observed only in relation to brand communities. The combined consumption of activities of the same interest by members of a group can both evoke a sense of belonging. A sense of community in this sense expresses the extent to which an individual is able to attach to another person as a result of performing the same activity (Drengner et al., 2012).

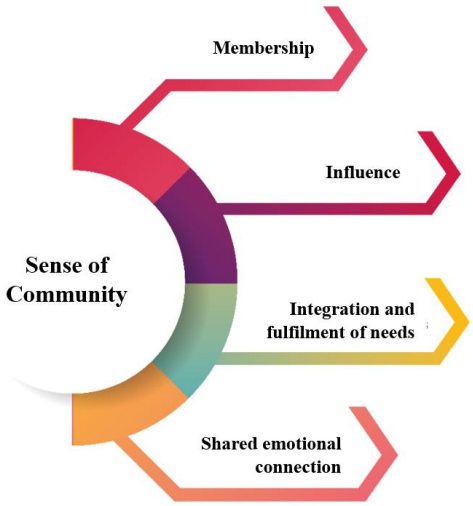
3.1. Sense of Community Index 2 (SCI-2)

The sense of community can be interpreted along four dimensions. A sense of membership develops in a person when he or she is accepted by a community and is able to fully integrate into it. Predefined criteria and boundaries to protect intimacy ensure group structure and security (Mcmillan–Chavis, 1986). From the marketing perspective, membership can be interpreted as meaning that an individual must purchase an object or service that makes the membership valuable to him or her and secures his or her position within the group (Rosenbaum et al., 2005). Influence can be interpreted as a two-way definition; on the one hand, the member matters to the other members, so his or her actions affect the group as a whole and even be able to influence community activities and on the other hand, the group also influences the actions of individual actors. These two seemingly opposite factors can work simultaneously (*I wonder what other cyclists think of me*).

Reinforcement and meeting needs is the primary function of a strong community, so by interpreting integration and fulfilment of needs, the community is able to meet the individual needs that have made members join (*I can meet important needs by being a cyclist*). The personal values that can be considered as common values within a group are confirmed for the members. Shared emotional connections are based in part on time spent together and sharing experiences together (*Cyclists often experience significant events together, such as holidays, outings, or tragedy*). Communication assumes that the more people interact with each other, the more likely

they are to have a closer relationship also plays an important role. Furthermore, the quality of the interactions is of paramount importance, as the more positive the participants experience through the community and the relationships they build, the stronger the attachment. (Mcmillan–Chavis, 1986).

Figure 1. Dimensions of the Sense of Community



Source: own construction based on McMillan–Chavis (1986)

3. Research method

The study investigates the Sense of Community among cyclists. As far as we can tell, this is the first study which applies this theoretical model in case of cycling. Thus, the study should provide evidence about that the SCI-2 model and its scales can be applied in this field. Since the scales originally were used for measuring sense of community in other cases, had to interpret the scales in Hungarian language, thus slight justifications were made in order to better fit to cycling. In sum, our hypothesis is the following:

H1: Cyclists have sense of community towards other cyclists

The data collection was carried out via an online questionnaire between March 14 and April 4, 2020. The questionnaire was shared through Facebook posts, friends and groups. These groups contain cyclists who have any kind of interest in cycling. The latter could have impact on the results since cycling could play greater importance in the member's life. The responses were gathered by the Survio online survey system which is optimized for mobile devices, thus filling out the questionnaire was easy for the respondents.

This method allowed us to reach more cyclists through social media and collect data in a structured way. The scales of the SCI-2 model were applied in our

investigation, however, slight changes were made during the interpretation to better fit to measuring sense of community among cyclists. The scales were measured on 5-point Likert scales, which is the most accepted range in Hungary, where "1" represented "Totally disagree", while "5" represented "Totally agree". This method allowed us to measure the strength and the direction of the attitude (Sakip et al., 2018).

The data collection provided 364 responses which were reduced to 362 after data cleaning (non-cyclists were excluded). 61% of the respondents were male cyclists, while 39% of were female. Most respondents were between 36-55 years of age (57% of the respondents). 12% of the sample was between 15-25, 18% were between 26-35, while 11% were between 56-65 years of age. 2% of the sample was older than 65, the average age of the whole sample was 42 years.

44% of the respondents graduated from university (possessing Bachelor's, Master's or other university degrees), while 43% graduated from high school. The rest finished only elementary school or vocational training.

4. Research results

The data were analyzed with the help of IBM SPSS Statistics. According to our research purpose we wanted to measure whether a sense of community exist among cyclists or not. This assumption was linked to two expectations:

1. The internal consistency of the SCI-2 scales is acceptable in case of cycling.
2. If the internal consistency is acceptable, then the means of the SCI-2 dimensions are above the average (more than 3.0 where the range is between 1-5).

The dimensions were created based on the SCI-2 model. In order to test the applicability of the model, a Cronbach alpha test was carried out (Table 1.). According to the results *Membership*, *Influence* and *Shared emotional connection* comply the requirements relating to Cronbach alpha, since the values are over 0.7. However, in case of *Integration and fulfilment of needs* and Cronbach alpha value is below 0.7. In recent years, there are competing opinions regarding the range of acceptance in the scientific community and there are scientists who argues for lowering the threshold to 0.6 (Taber, 2018). Thus, we decided to accept the *Integration and fulfilment of needs* dimension as well.

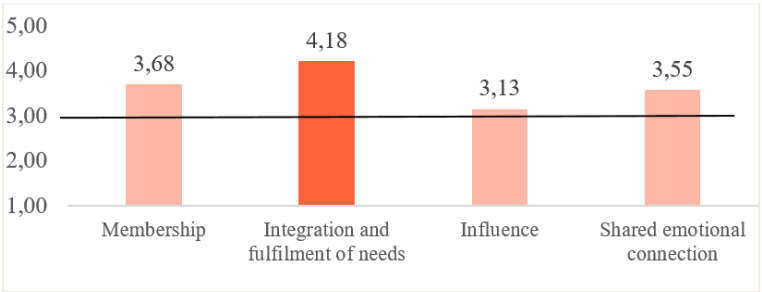
Table 1. Cronbach alpha test for SCI-2 dimensions

Dimensions of SCI-2	Number of scales	Cronbach-alpha
Membership	5 scales	0.761
Integration and fulfilment of needs	3 scales	0.622
Influence	5 scales	0.777
Shared emotional connection	4 scales	0.746

Source: own construction

Figure 2. demonstrates the results of the SCI-2 where the means were calculated from the scales of the given dimensions. In the figure, the black line demonstrates the middle point of the range (3.0 where the range was between 1-5).

Figure 2. Mean of the SCI-2 dimensions



Source: own construction

According to the results, we can conclude that cyclists have a sense of community since the means of all dimensions are above 3.0. *Integration and fulfilment of needs* was ranked the highest (m=4.18), which means that most cyclist agree with that cycling can fulfil important needs and if a problem arises, then he/she can discuss it with other cyclists as well. Most respondents also agreed with the scales related to *Membership* (m=3.68). In this case cyclist feel that cycling is an important part of their life and recognize other cyclists as well in their neighborhood. Furthermore, these respondents also agree with that there are certain words and objects that help them to be associated with cycling. *Shared emotional connection* was also important among the respondents (m=3.55), which assumes that cycling is important for them personally and spend time with other cyclists. *Influence* was ranked lower (m=3.13) compared to the other dimensions, however, it is still above 3.0. Based on our investigation it turned out, most cyclist do not care about other cyclists' opinions about themselves, however, taking part in the cyclist community is important for them.

In sum, we can conclude that the internal consistencies of the dimensions are acceptable and most of the respondents agreed with the SCI-2 dimensions. Thus, the study provides evidence that the theory of Sense of Community can be interpreted among cyclists, and the community has the characteristics of community.

5. Conclusion

The aim of the study has been to measure the sense of community among cyclists using the SCI-2 model. As can be seen from the results, a sense of community appears among the respondents we examined, and the assumptions related to the application of the model have also been met. However, the relationship between a sense of community could not be clearly identified in relation to attendance at cycling events. Overall, however, a significant proportion of the cyclists in our survey say that cycling plays an important role in their own lives and makes them feel good about cycling. Furthermore, they believe they are able to influence other communities, and most of

them feel that if they have a problem, they can discuss it with other cyclists. Based on these results, we have seen that many cyclists view the bicycle not only as a simple means of transportation but as a kind of activity that connects the individual with other cyclists. This activity is part of their everyday life that they take pride in.

This study has an important message not only for the cycling community but also for researchers and marketers. On one hand, it provides evidence that the SCI-2 model can be applied, however, it is important to note that this general model was not primarily developed to measure the sense of community experienced during cycling. Accordingly, it may be worthwhile to further develop a measurement specifically designed to examine cycling community feelings in more detail based on the model. Furthermore, the results of the research can be well-suited to lifestyle studies that are becoming increasingly important in marketing, as for some consumer groups cycling can even be a means of self-expression or a well-defined segment. It provides opportunities for brands to raise brand awareness in such communities and associate those lifestyle values with the brand perception – such as environmental issues, sports, sustainability and health.

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The past, present, and future of the accounting profession and its digitalization: Where is accounting going next?

Ervin Denich – Attila Veress – Krisztina A. Sisa – Ágnes Siklósi

The technological development of the past decade has brought about revolutionary changes in our everyday life. We communicate and find information differently than ten years ago. In comparison to this, the changes brought about by networked devices are understated, even in the short term this technological step can be the one which fundamentally changes the lives of individual users and organizations, the production structure, and also business models. It can be said that Industry 4.0 has transformed the global industrial environment, not sparing accountancy either. The accounting profession can be considered to be traditional, in which the rules and principles have not radically changed in the last decade(s). Globalization, increasing regulations, new technological solutions, and innovations have also made an impact on the profession. Therefore, accountants have a significant opportunity to expand their digitized skills and knowledge, but at the same time, the changes also pose a threat to them if they do not understand how they affect the organization. The challenges facing the individual accountant are manifested in the rapid adaptation and necessity of business practices and business processes without sacrificing the basic accounting rules and principles. In our research, on the one hand, the opportunities and risks related to the digitization of the accounting profession are examined, on the other hand, the challenges faced against digitalization are overviewed, and, thirdly, the results of a questionnaire study administered amongst people working in the field and students are reported. Our results highlight that digitization represents both significant opportunities and risks for the future. The most important challenges to digitization can be outlined as follows: the use of big data in accounting and reporting, cloud-based and continuous accounting, artificial intelligence and blockchain technology. In conclusion, it can be said that technological advances and digitization will have a significant impact on the industry in the future as well, which will introduce changes in the education system, and the needs of the users of accounting information will change. These changes will affect the work of accountants, the acquisition and adaptation of new knowledge, and ultimately the quality of accounting reports.

Keywords: digitalization, accounting profession, education

1. Introduction

In recent decades, rapid technological change and development have taken place. Given the exponential growth of technological advances, it is not surprising that many areas of human life are affected by technology. Industry 4.0 has transformed the global industrial landscape, relying heavily on digital software and automation of robotic functions to replace human tasks (Sima et al., 2020). Therefore, digital technology has an impact on a company's strategy, which is nothing more than a commitment to several coherent, mutually reinforcing actions and behaviors to achieve goal-oriented competition (Pisano, 2015). A good strategy promotes

alignment of teams within the organization, clarifies goals and priorities, and helps focus resources (Sadun et al., 2017). A good strategy has clear, explicit and specific objectives that will help the company to achieve sustainable competitiveness and achieve its competitive goals. Competitiveness is defined as the efficient use of resources relative to other firms producing similar products or services (Vörös, 2010). Competitiveness can be effectively measured by indicators expressing competitive priorities such as cost, quality, flexibility, age, and speed of realization of productivity knowledge gains (Krajewski et al., 2013; Vörös, 2009; Vörös, 2021; Mishina–Takeda, n.d.) and the creation of an integrated supply chain (Simchi-Levi–Timmermans, 2021). Competitive advantage in competitive priorities is difficult to replicate, enables firms to achieve sustainable growth, and has an impact on the firm's market perception.

In addition, digital technology has a significant impact on accounting information systems (Mancini et al., 2017). Thus, the accounting profession is no exception to this, as its evolution can be broken down into five "technological stages": traditional manual, mechanized, automated, robotized, and artificial intelligence-assisted accounting (Bakulina et al., 2020). Technological advances and digitalization allow the accounting profession to be updated and changed. The development of modern computer systems leads to a reduction in the workload of accountants. Accounting professionals seem to be receptive to the idea of automating relatively minor and repetitive tasks because IT infrastructure allows them to take on more important tasks (Andreea et al., 2021).

Technological developments, globalization and increasing competition are forcing the industry to change constantly. The accounting profession is at the forefront of the professions that are and will continue to be most affected by technological developments and globalization. It is evident that with technological advances, many digital systems are being used that did not exist in the accounting profession ten years ago (Tekbas, 2018). According to the results of research conducted by Frey and Osborne (2017), 702 jobs are threatened by automation, and the accounting profession is at the top of the list, with a high probability of being automated and digitized in the near future already.

The aim of this study is to examine the opportunities and risks associated with the digitization of the accounting profession, the challenges facing the accounting profession, and the results of our questionnaire survey of accounting professionals and students studying accountancy.

The second section presents a literature review of the development of accounting. Subsequent sections describe the research methodology, results, and, finally, present the conclusions.

2. Literature review

From the humble bean counter to the most advanced supercomputer, the history of accounting has been in tandem with the development of humankind, and has to willingly embrace the changes required.

2.1. The evolution of accounting

2.1.1. Ancient times: the beginnings

Accounting has been part of human life almost since the beginning of time. To understand the modern face of accountancy, we need to look to the past and follow the evolutionary journey.

The emergence of accounting dates back to ancient times and can be traced back to Mesopotamian agriculture. According to researchers, accounting records were used in agriculture as early as 3500 BC to record the annual quantities of grain, bread, and beer. These records were carved on clay tablets in the cuneiform script used in Mesopotamia. The tablets were stamped with a seal that corresponds to the current signature. It can, therefore, be said that accounting is as old as writing. It is probable that the tablets with numbers and writing found during the excavations contain the accounting records of the time (Sztanó, 2019).

According to the findings of excavations, the next main stage in the world of accounting can be traced back to the Babylonian period in Egypt in 3000 BC. The Egyptian accountants of the time kept a record of the treasures of the pharaohs, the property of the church, and the treasury on papyrus scrolls. Their work was particularly significant, as any error detected in royal auditing could have serious consequences, such as mutilation, or in more serious cases, the death penalty (Harford, 2017).

There is also evidence from the 5th century BC that suggests that there were people responsible for the logistical tasks of the Attic confederation, who had to settle the accounts of the treasury of the Attic confederation and pay the tithes to the goddess Athena Pallas (Sztanó, 2019).

In ancient Greece, coinage became widespread in the 7th century BC. Bartering caused various difficulties, as the needs of bartering merchants were not necessarily met on the market, and to overcome this difficulty, commodity money was introduced.

The emergence of commodity money coincided with the emergence of banks and banking services. Bankers kept books of accounts, changed money, lent money, and organized cash transfers for citizens. In this way, citizens from one city could transfer money to each other through the bank of another city (Sztanó, 2019).

2.1.2. From middle age to the threshold of automation

The next milestone in the world of accounting came in 795, during the reign of Charlemagne, King of France. The first balance sheet is attributed to him, since in 795 he laid down a legal framework for the royal chancellery to draw up a year-end balance sheet, for which a sample balance sheet was drawn up within a given framework. This was effectively the equivalent of a property register (Sinka, 2014).
The first evidence of the emergence of double-entry accounting is the Genoa ledger from 1340. In these ledgers, the revenues and debts of the state were recorded, and already in this ledger, tax debts, fines and loans were separated, which clearly resembles the current appearance of double-entry bookkeeping (Sztanó, 2019).

At the beginning of the 13th century, Venetian merchants were already keeping records of their economic activities. These records are practically the equivalent of today's single-entry bookkeeping. As trade developed, so did the need for detailed records. It was then that double-entry bookkeeping in the records that were kept developed (Sztanó, 2019).

Double-entry bookkeeping is still associated with the Venetian monk Luca Pacioli, the father of accounting, who in 1494 was the first to write down a unified summary of the information known about double-entry bookkeeping in his *Summa de Arithmetica Geometria, Proportioni et Proportionalita.* The last chapter of the book deals with accounting and is entitled 'Double-entry bookkeeping and written documents'. In it, the monk described the rules of double-entry bookkeeping and the basics of drawing up balance sheets (Barancsuk, 2016).

Although we call Luca Pacioli the father of double-entry bookkeeping, it is significant that Benedetto Cotrugli was the first to write about bookkeeping in 1458, but his book was not published until 1573.

Both the fifteenth and sixteenth centuries saw an exponential increase in trade, leading to new demands being imposed on the methodology of bookkeeping. A business economics approach became important, including the calculation and monitoring of costs, which could be tracked mainly through statistical calculations (Sztanó, 2019).

With the development of legislation, accounting rules have also evolved. First, in 1794, Prussia's General Law of 1794 introduced compulsory balance sheets, with strict consequences for failure to keep them (Sinka, 2014).

As the General Law reads, "A trader who either fails to keep proper accounts or fails to prepare a balance sheet, which is required to be drawn up at least once a year, and thus fails to know his own position, will be punished as a negligent banker in the event of insolvency" (Sinka, 2014:1).

In Hungary, Act 37 of 1875 on Commerce required the preparation of balance sheets and inventories. Subsequently, in 1925, a decree of the Minister of Finance (Decree 7000 of 1925) was issued, which included the issues of the authenticity of the merchant's balance sheet.

In today's digitized world, it seems almost inconceivable that relatively not so long ago our accounting predecessors used transcription techniques to copy invoice entries into diaries. These were then known as ledger files. In practice, the transcription technique was to place the journal on a metal plate (*evolutra*) and then transcribe the ledger book using carbon paper, which was placed over the sheet with a paper clip. This technique made it possible to carry out both the accounting process in sequence and the time-series accounting process.

On January 1, 1947, the first compulsory chart of accounts was introduced in Hungary. Until then, there was no single compulsory account numbering system in Hungary.

In 1954, a decree of the Minister of Finance was issued, which defined the content of the balance sheet of companies. It stated that the main purpose of accounting was to measure and report detailed information on the fulfilment of plans (Sztanó, 2019).

2.1.3. The transformation of accounting in the wake of digitalization

Later, this process was automated, mainly by using typewriters, and, with the advent of computers, automatic bookkeeping machines. At that time, they were still very rudimentary manual-mechanical devices, but soon afterwards, devices with electromechanical transmission appeared (Sinka, 2014).

We can see how many centuries it took to develop the accounting service as we know it today. Paper-based bookkeeping has now been almost completely replaced by the computer, as the recording process, returns and reporting are all completely electronic, and today, contacts with the various authorities are almost exclusively online or by telephone.

2.2. Digitalization

The work of accountants has evolved in line with the development of information technology (Granlund–Mouritsen, 2003), with accounting information and technology hav[ing] been linked from the beginning. The literature describes two phases of technological development that have an impact on organizations.

The first stage of technological development that significantly changed the work of organizations and accountants was the emergence of computerized information systems (Porter–Heppelmann, 2015). These systems, which were introduced in the 1960s and 1970s, enabled accountants to record data in greater detail and produce more accurate analyses. The second phase was mainly characterized by the emergence of the Word Wide Web and integrated information systems (IIS) (Porter–Heppelmann, 2015). In this context, integrated information systems support management accounting (Rom–Rohde, 2007). In the late 1990s and early 2000s, integrated information systems, including ERP systems in particular, were a fashionable topic in IT. These ERP systems enabled accountants to provide and obtain information from within the organization in a much more efficient way than before.

A third phase of technological development is now emerging. The combined emergence of many technologies has had a major impact on the way organizations work, including the work of accountants. This third phase is typically referred to as 'digitalization' (Karimi–Walter, 2015; Parviainen et al., 2017).

Digitalization should not be confused with digitization. The latter refers to the technical process of encoding analogue information into a digital format, making digitized content programmable, addressable, traceable, and communicable (Hylving–Schultze, 2013; Yoo et al., 2010). As such, digitization is a less comprehensive change than digitalization. On the other hand, digital transformation entails significant organizational changes driven by digital technologies and, therefore, profound changes in both strategy and business management (Fitzgerald–Kruschwitz, 2013). Digitalization involves more than a mere technical process but does not necessarily entail a reconfiguration of strategy or a fundamental change in business management. However, digitalization is associated with important changes to sociotechnical structures (Yoo et al., 2010). These structures are being transformed by challenging underlying assumptions about the design and use of digital technologies (Thorseng–Grisot, 2017).

The concept of digitalization is also found in paragraph 2 of Government Decree 451/2016 (XII. 19.) of the Hungarian government, which states that digitalization is "a process that transforms analogue information into digital information that can be processed by computer equipment".

Digitalization in the field of accounting can, therefore, be defined as the replacement of the paper-based submission of tax returns by data submission via a client or company gateway. This has not replaced the human factor but facilitated the workflow by allowing the computer to encode and transmit information in electronic form rather than by mail. Automation is when technology replaces human resources, thus replacing the human involvement in the work process. In a way, automation creates value, because while in digitalization the computer adds little or no value, in automation the value added is high.

Digitalization is the use of digital technologies to change a business model and create new revenue and value opportunities, a shift to digital business (Gartner Glossary n.d.). It means transferring more responsibility to Internet-related software applications. With the drive to digitize the accounting profession, the accounting industry is undergoing a transformation (Duong–Fledsberg, 2019). A number of digital technology developments is available to meet the requirements of different business models.

2.3. Digitalization of the accounting profession

The accounting profession is both growing and evolving. Thanks to technological advances and changing consumer expectations, the workforce of accountants is expanding. As a result, the accounting profession needs to adapt more to technological advances and digitalization, as the accounting profession now uses automated systems that did not exist ten years ago (Tekbas, 2018). With the implementation of digitalization in the accounting profession, the work of accountants has changed radically and is increasingly dependent on modern equipment and advances in technology.

Digitalization has also changed the way people think and practice accounting (Fettry et al., 2018). As the accounting profession adopts technology, the number of jobs for accountants with programming and analytical skills is expected to decrease. Therefore, it is necessary and desirable for firms to provide adequate retraining for current employees (Zhang et al., 2020). Proper training not only boosts employees' confidence but also improves their understanding of their tasks, as well as of the information and skills needed to perform their duties.

2.4. Main digital solutions for accountants

2.4.1. Artificial intelligence

"Industry 4.0 describes the organization of production processes in which devices communicate autonomously with each other along the value chain: creating a 'smart' factory of the future in which computer-controlled systems monitor physical processes, create a virtual replica of physical reality and make decentralized decisions based on self-organizing mechanisms" (Smit et al., 2016:23).

The rise of smart technologies such as artificial intelligence and machine learning are bringing near real-time information to businesses. Artificial intelligence and automation can significantly reduce the need for human labor and can be integrated into accounting and auditing processes. Artificial intelligence can be successfully applied to more structured, programmable, and repetitive tasks, where human knowledge and expertise are not too difficult or demanding to gather (Moudud–Ul-Huq, 2014). Smart technologies are not being developed to replace human intelligence but to help accountants become better strategic advisors. Artificial intelligence and machine learning enable accountants to better access a wide range of real-time information while considering multiple sources.

2.4.2. Blockchain

Blockchain is another trend in the financial and accounting field. A blockchain is a digitalized ledger that records transactions without the involvement of a financial intermediary (Dai–Vasarhelyi, 2017). A blockchain contains the repositories called "blocks" in which data is recorded. Each block acts as a real-time ledger. Each block stores all the information about the previous transaction, and when the block "completes", it joins the next block and passes on the available information. Therefore, blocks are closely related to each other and have security specific information about the previous block. Blocks are connected in a linked chain, and therefore this technology is called blockchain (Fanning–Centers, 2016). This system is decentralized, so that all parties involved in a transaction have access to the blockchain, where they have the possibility to read, check, update and publish new transactions in the blocks.

One of the advantages of blockchain is that it can be a good way to prevent fraud, as changes within blocks are extremely complex. Another advantage is that the two parties involved in the transaction can send and receive the invoice through the blockchain, as well as have the option to repay the invoice through the blockchain system, which makes the transaction process faster and paperless, preventing missed invoices (Fanning–Centers, 2016).

According to Alarcon and Ng (2018), there are insufficient tools to control the system and ensure that it works as promised, leading to low system reliability. Yeoh (2017) observed that there is still a lack of standards in this area of technology. According to Partida (2018), a barrier to blockchain is the lack of expertise and of professionals who can manage the system.

2.4.3. Continuous accounting

Technological progress offers new opportunities for the daily provision of information. Accounting continues to be based on periodic review and analysis of financial information, but stakeholders, auditors and other partners with close links to the business expect comprehensive and real-time reporting. A transition period and implementation steps will be needed to introduce and move from a periodic accounting and reporting system focused strictly on financial information to a more comprehensive review of accounting reporting. The implementation and transition to

a more comprehensive accounting function will result in some shift in current roles (Smith, 2018).

2.4.4. Big data

According to Rezaee and Wang (2017), big data has been increasingly used in finance and accounting over the past decade. Big data is an enormous data set of great size that cannot be analyzed manually or with old traditional accounting software. In addition, big data is composed of structured and unstructured data, which makes it difficult to use traditional accounting software to analyze it (Warren et al., 2015). Big data can be divided into four dimensions, which can be called the four Vs: volume, variety, velocity, and veracity. Each dimension represents a different claim. Size refers to the large volume of data, variety to the diversity of data types, velocity to the speed of data generation, and veracity to the reliability of data (Syed et al., 2013).

Richnis et al. (2017) argue that as big data is developed through the accounting function, accounting processes would be automated, but despite this, the role of the accountant would remain significant, the accountant position would not disappear, instead a more labor-intensive accountant role would take over, managing the interpretation and analysis of financial data. Accountants already know and understand the business processes and have worked with data in the past, so the accountant role remains important.

In addition to the benefits of big data, it is important to talk about its drawbacks and risks. According to Payne (2014), the main disadvantages of big data for companies are data privacy issues on the one hand and cybersecurity issues on the other, which can lead to unethical use of data. In addition, as big data becomes more widespread in the use of accounting, the accounting profession will need more knowledge and skills to adapt to technological changes. Griffin and Wright (2015) argue that the adoption of big data in the accounting profession should be most prevalent among academics and educators, where no specific curriculum has been developed to prepare students for the new technological changes. Accountants should, therefore, know how to analyze and use databases, and, more specifically, how to use big data analysis tools.

Overall, for accountants to continue to add value to the business, they need to learn new skills in artificial intelligence and other digital solutions in the modern business environment. Accountants need to develop critical thinking and problem-solving skills, and focus on high levels of adaptability, flexibility and interpersonal interaction. Prospective accountants need a range of skills for a successful career, including motivation, good written and oral communication, decision-making, financial analysis, and professional judgement. Education also needs to change, with the education system changing to focus on critical and systems thinking to develop students' creativity. Accountants will have a major pro-active role in running the business of the firm and will need to work with other staff in other functions.

3. Method and results

Both induction and deduction methods were used in our study. As external observers, we tried to capture the subject of the study – the opportunities and risks associated with the digitalization of the accounting profession and the challenges facing the accounting profession in the face of digitalization. At the same time, human beings, as cognitive subjects, cannot completely separate themselves from the object and exclude themselves from the picture of the object. Our cognitive tools, both material and intellectual, are always human tools, and a human is always a person of a certain age and society.

In our work, we have chosen the research methods to be applied in order to answer the research questions. To identify the opportunities and risks related to the digitalization of the accounting profession and the challenges facing the accounting profession in the face of digitalization, it became necessary to review and analyze the literature. The picture that emerged from the secondary information helped to delimit the scope of primary and secondary information needed for the research.

Furthermore, due to the practical nature of our research topic, the methodological background of the study is mainly provided by the application of primary research methods. In order to answer the research questions, the questionnaire survey method was used, using an online questionnaire. When selecting the target group, we considered it important that the current situation, challenges and experiences of the profession are expressed by professionals who are personally involved and have relevant experience, therefore the online questionnaire was shared on the websites of professional communities, platforms, and groups, and we also directly involved relevant participants in the practical research using our own professional network. At the same time, we also examined the impact factors related to digitalization from the perspective of students who are studying accounting.

The online format ensured that as many people as possible could be reached quickly and efficiently. Our study summarizes the results of measurements carried out in 2020 and 2022 and includes the results of 1,167 questionnaire surveys completed by accountants in 2020 and 1,070 in 2022.

The sample based on the available valid and assessable responses is approximately 1.5 to 2% of the Hungarian accountancy community (according to the records of the Ministry of Finance, the number of registered accountants exceeded 52,000 in 2023), so the sample can be considered representative, as the proportion is around 2% in public opinion surveys. Furthermore, there was a significant number of accountants from all accountancy sections (small accountancy firms, larger accountancy firms, multi-accountancy firms, and non-accountancy firms) among the respondents.

In our ever-changing world, many people have written and continue to write about the future of certain professions in many different ways. For some professions, such as accountancy, a particularly bleak future has been predicted. In their study, Frey and Osborne (2017) found that, on average, 47% of all occupations in the US and 94% of accountants and auditors' work could be computerized. In 2015, the Wall Street Journal wrote: "The new bookkeeper is a robot" (Monga, 2015:1).

Technological advances, globalization and increasing competition mean that careers are constantly changing (Frey et al., 1999). According to the report, 702 jobs are at risk of automation, and accounting is the most likely to be automated and digitized in the near future. Digitalization can be seen as both an opportunity within the accounting profession and an exposure to risk. If accountants do not understand how technological change and digital transformation will affect their workplace activities, they are putting themselves at risk (ACCA, 2020). Table 1 summarizes the most common digital opportunities and risks.

Table 1. Opportunities and risks related to the digitalization of the accounting profession

Opportunities	**Risks**
Creating new jobs	Job losses
Reduced working hours and greater autonomy	Extending working hours, increasing "anytime, anywhere" working
New forms of cooperation between workers and machines	Weakening worker representation and "bargaining"
Better ergonomics thanks to support during difficult and complex work	Increased competition between workers to reduce costs
Smart jobs: jobs outsourced to low-wage countries are making a comeback	Increasing work, dependence on "data masters" and supervision
More gender equality	Increasing inequality between workers
Sharing economy	Financing the erosion of the tax base and social security

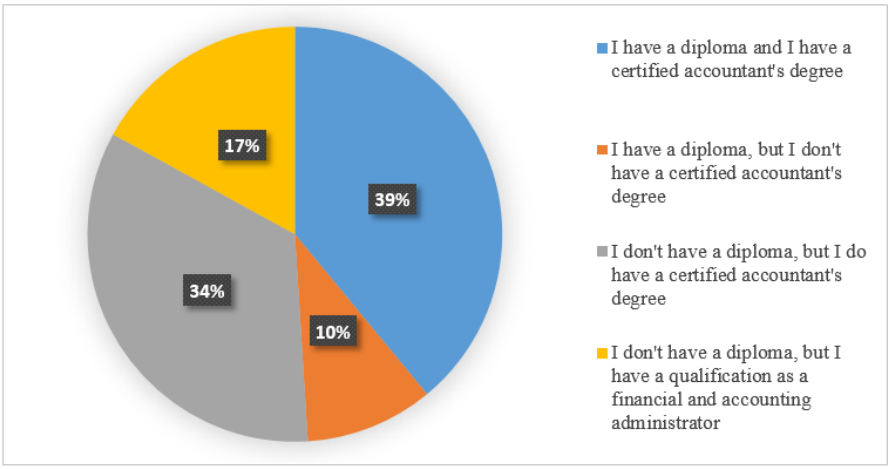
Source: Voss–Riede (2018)

Firms in developing countries are less likely to invest in skills development and innovation activities than firms in developed countries. At the same time, it should not be forgotten that digital capabilities increasingly determine which businesses create or lose value (Hirt–Willmott, 2014). Soon, technological developments and digitalization will have a major impact on the accounting profession (Gulin et al., 2019), and the shift towards digitalization will be a key factor in the success of businesses and the new accounting system. It is therefore necessary to examine the opportunities and risks associated with the digitalization of the accounting profession from the perspective of current and future accountants.

Among the opportunities and risks listed in Table 1, we looked at the location and education of accountants, which has an impact on salaries in addition to the length of time in the profession.

The following tables and figures show the distribution of the 464 Budapest based accountants and 703 accountants from the rest of the country surveyed by qualification, years in the profession, and place of work.

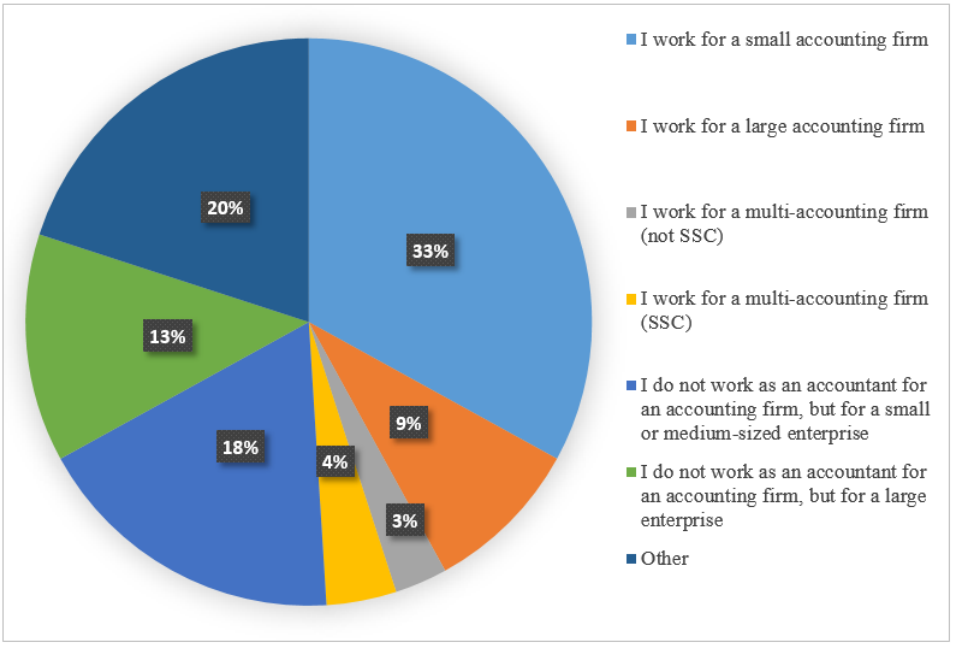
Figure 1. Distribution of survey respondents by education



Source: own construcion

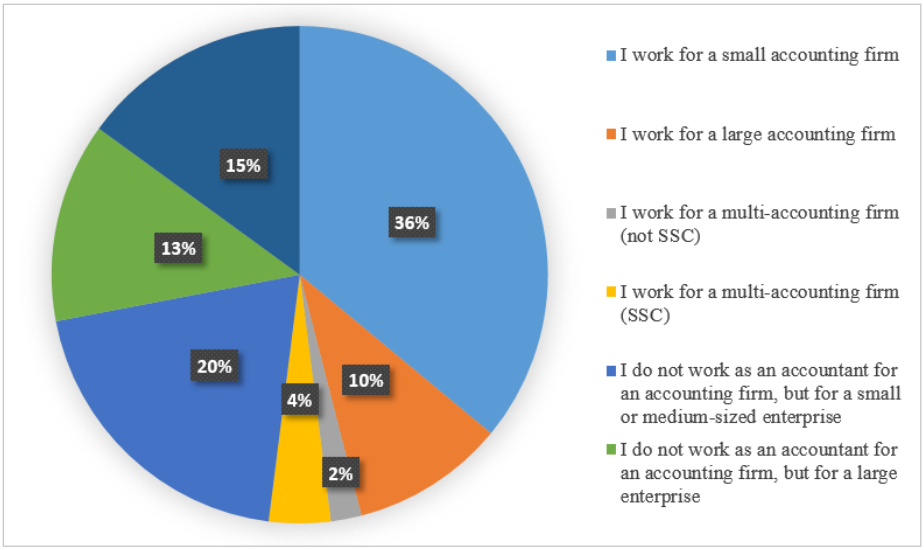
We also looked at the number of years accountants have been in the profession. 37.75% of the respondents have been working in the profession for more than 8 years, 25.38% have 3 to 5 years of professional experience, and only 8.05% are new accountants.

Figure 2. Distribution by place of work in 2020



Source: own construcion

Figure 3. Breakdown by place of work in 2022



Source: own construcion

The results of Figures 2 and 3 show that about half of the respondents work in accounting services firms (small accounting firms, large accounting firms, and multinational accounting firms). About one third of the accountants work in smaller accounting firms, and only 6-7% of the accountants work in multinational companies.

Both the place of work and the length of time spent in the profession affect the evolution of average earnings, which can be either an opportunity or a risk thanks to digitalization, so it is important to examine their evolution.

Income was examined only for full-time accountants and self-employed, other questions were examined for all respondents.

Table 2. Evolution of average gross earnings

Categories	**2020**			**2022**		
	Budapest	Other	Total amount	Budapest	Other	Total amount
early career	312,417	267,656	288,200	410,417	332,237	362,500
1-2 years	361,111	284,091	317,975	454,545	367,647	412,736
3-5 years	420,066	314,762	358,516	495,070	418,116	457,143
6-8 years	496,728	368,487	435,567	621,667	501,923	553,986
more than 8 years ago	566,822	391,460	452,177	677,568	524,740	584,388

Source: own construcion

An interesting comparison can be made by comparing average wages with national average wages. Data from the Hungarian Statistical Office (gross average wage, for full-time employees) shows the following:

- 2020 I-IV quarter cumulative data: 403,606 HUF
- 2021 I-IV quarter cumulative data: 438,814 Ft
- First half year of 2022 cumulative data: 505,272 HUF (www.ksh.hu).

Table 2. shows that salaries in Budapest exceeded the average salaries of rural accountants in both years and in all categories. Compared to the national average, the average salary of accountants with more than 5 years of experience is higher than the national average, but not for those with less experience.

Table 3. Evolution of average earnings by type of employer enterprise

Title (workplace of the accountant)	**2020** Cumulative average*	**2022** Cumulative average	**Change 2022/2020**
In a small accounting firm	329,025	464,831	141.28%
In a larger accounting firm	414,865	485,000	116.91%
In a multi accountancy firm (not SSC)	477,174	787,500	165.03%
In a multi accountancy firm (SSC)	586,290	582,031	99.27%
I do not work for an accountancy firm, but for a small or medium-sized enterprise	432,721	556,753	128.67%
I do not work for an accounting firm, but for a large company	494,575	576,600	116.58%

Source: own construcion
Note: * The cumulative average is the cumulative average of the individual income category for the years spent in the profession

One of the great advantages of an accountancy qualification is that it opens up a number of career paths for those starting out. Qualifications, language skills, and ambitions and plans also play a major role in guiding the choice of career. Table 3 shows that multi-accountancy firms offer the highest salaries in both years, 2020 and 2022. The average salary in SSCs (Shared Service Centers) is almost 600,000 HUF (interesting data on the decrease in average salary), while in other multi firms it reaches almost 800,000 HUF, with a significant increase of 65% from 2020 to 2022. It is important to note, however, that service centers and other multi-companies only expect new entrants with language skills and SSCs only expect accountants to perform sub-tasks related to a specific field in the first years. In multi-accountancy firms, for example, a salary of up to around 750,000 HUF is available after 6-8 years as a team leader. A relatively good starting salary can also be expected if you are not in an accountancy firm but in an SME or a large company in the accounting field. An accountant in a non-accounting small and medium-sized enterprise earned 556,753

HUF and an accountant in a large enterprise 576,600 HUF in 2022, with average wage growth above the rate of inflation for both types of employers, which may also suggest that there is a supply market in this field, so employers are constantly looking for skilled and dedicated accounting workforce, typically focused on early-career employees. Professional development in the first few years is best in non-multi-accounting firms, although starting salaries are conspicuously the lowest in these firms. Still, we believe that if one wants to own one's own accounting firm, the best "schools" are in these firms.

Whether one wants to own one's own accountancy practice or work as an accountant for a firm, there will be plenty of opportunities to expand digital skills and knowledge, but there is also a risk if one does not understand the impact on one's organization. The challenges facing the accountancy profession are reflected in the need and rapid adaptation of business practices and processes without "abandoning" basic accounting rules and principles.

Therefore, it was also important to investigate how much accountants fear digitalization and how much they fear their jobs because of increased digitalization. From 2020 to 2022, there is a change from 58% to 70% of those who "do not fear digitalization at all". Overall, therefore, the majority of respondents are optimistic, and this optimism has increased over the period. Between 4% and 6% of respondents are not at all afraid of change. Interestingly, the proportion of respondents who are "a little" afraid of digitalization is relatively high (down from 36% to 26%), but this cautious attitude has decreased, which is positive, as the use of various IT applications by future professionals will be inevitable.

Based on research by Budai and Denich (2021), prospective accountants and accounting students ranked a thorough knowledge of Excel as the most important digital competency, while programming skills were the least important, in addition to their current knowledge of the digital competencies expected by employers. Their results show that each of the digital skills they surveyed will become more valued and important in five years' time. Both data mining and programming skills are expected to be significantly higher in the expectations.

Due to the rapid development of software and various programs supporting accountancy work, and the constant changes in the legal environment, accountancy tasks are constantly changing. At the same time, if we look at the tasks that accountants perform, we can see that at present they still spend most of their time on routine tasks, as shown in Table 4.

As accountants progress in their careers, they tend to take on increasingly complex and higher professional tasks. After 1-2 years, an accountant may be responsible for the full accounting of a company, and after 3-5 years in larger accounting firms, they may coordinate and supervise the work of several accounting colleagues as a team leader, supervisor, or manager.

Table 4. Accountancy tasks by years of experience in the accounting profession

Title	Data recording, preparation	I keep accounts for one area (e.g., customers, suppliers, bank, etc.)	I do all the accounting for a company	Supervise and coordinate the work of my accountant colleagues at lower levels	I do full accounting for several companies.
I am a newcomer	32.97%	32.97%	15.38%	1.10%	17.58%
1-2 years	12.57%	34.29%	12.00%	1.14%	40.00%
3-5 years	4.88%	24.74%	14.98%	8.36%	47.04%
6-8 years	1.99%	25.83%	12.58%	17.88%	41.72%
more than 8 years	3.04%	13.11%	12.65%	22.48%	48.71%

Source: own construcion

With accounting processes becoming more automated and less time-consuming, accountants are increasingly in touch with clients and expanding their advisory services in their day-to-day activities. In their study, Herbert et al. (2016) examined how digitalization and automation are used to eliminate or minimize routine and repetitive tasks, allowing accountants to focus on more creative, non-routine and unstructured tasks that require more thought and additional skills. This change in approach will have an impact on the future activities of experienced accountants. It can therefore be said that accountancy qualifications will continue to be in great demand in the long term and that accountancy qualifications will still be indispensable in the profession in a few years' time. It is therefore important to examine which are the main digital solutions that have or will have an impact on the accounting profession.

4. Conclusion

Digitalization and the development of information technologies represent a major opportunity for companies. Moreover, digitalization brings many changes to the accounting profession, representing both a great opportunity and a significant risk for the accountants of the future. It will change the way accountants work and think. According to the responses to the questionnaire survey, the vast majority of accountants do not fear digitalization. Nor should the accounting profession fear that digitalization will take their jobs away and replace them with robots. Digitalization and automation can be used to perform routine tasks. There are and will be accounting tasks and activities that require critical thinking and creativity, and these cannot all be easily and simply automated. Accountants must be ready for automation, which requires specific and new knowledge and skills from accountants. The information network, knowledge-based systems and data mining are powerful tools for running a successful business. All these new digital solutions will have an impact on reducing manual data entry and improving the speed, quality and accuracy of data. Professional

accountants will become consultants. Therefore, for this potential evolution to occur, accountants must seize the opportunity to develop technology that will facilitate and enhance their profession.

The digitization of processes and the introduction of new software(s) enabling knowledge-based management is very expensive and only available to large companies. The day-to-day digitization of accounting and financial reporting linked to financial markets can have a significant impact on investor decisions. Improvements to IT, analytical and tax knowledge are vital components in the development of the skills required pertaining to modern accounting practices.

These changes require universities to modify their curricula to prepare accounting students to work in a modern environment, alongside automation and digitalization. The education system could include more information on the opportunities and risks of digitalization in the curriculum to provide accounting graduates with better career planning guidelines. In addition, professional bodies can provide future accountants with greater exposure to the opportunities and risks of a digitized environment. In this way, prospective accountants will have a clearer perspective and be better prepared for the real digital workplace. In agreement with other researchers (Frey–Osborne, 2017; Rajeevan, 2020), we also find that the accounting profession will not disappear but will move in the direction of counselling.

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